HEIDENHAIN

QUADRA-CHEK 3000

Operating Instructions

Evaluation Unit

English (en)
02/2020

Contents

1

Fundamentals

1.1 Overview

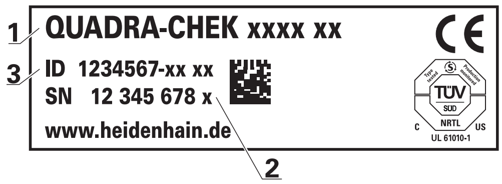
This chapter contains information about the product and this manual.

1.2 Information on the product

Product designation	ID	Firmware version	Index
QUADRA-CHEK 3000	1089174-xx	826880.1.4.x	-/A

The ID label is provided on the back of the product.

Example:



1 Product designation
2 Index
3 Part number (ID)

1.3 Demo software for the product

QUADRA-CHEK 3000 Demo is software you can install on a computer regardless of the device. QUADRA-CHEK 3000 Demo helps you to become familiar with, try out or present the functions of the device.

You can download the current version of the software here: **www.heidenhain.de**

> To download the installation file from the HEIDENHAIN Portal, you need access rights to the **Software** portal folder in the directory of the appropriate product.
>
> If you do not have access rights to the Portal's **Software** folder, you can request the access rights from your HEIDENHAIN contact person.

1.4 Documentation on the product

1.4.1 Validity of the documentation

Before using the documentation and the product, you need to verify that the documentation matches the product.

- Compare the ID number and the index indicated in the documentation with the corresponding data given on the ID label of the product
- Compare the firmware version given in the documentation with the firmware version of the product

Further information: "Device information", Page 462

> If the ID numbers and indexes as well as the firmware versions match, the documentation is valid

If the ID numbers and indexes do not match, so that the documentation is not valid, you will find the current documentation for the product at **www.heidenhain.de**.

1.4.2 Notes on reading the documentation

⚠ WARNING

Fatal accidents, personal injury or property damage caused by non-compliance with the documentation!

Failure to comply with the documentation may result in fatal accidents, personal injury or property damage.

- Read the documentation carefully from beginning to end
- Keep the documentation for future reference

The table below lists the components of the documentation in the order of priority for reading.

Documentation	Description
Addendum	An addendum supplements or supersedes the corresponding contents of the Operating Instructions and, if applicable, of the Installation Instructions. If an addendum is included in the shipment, it has the highest priority for reading. All other contents of the documentation retain their validity.
Installation Instructions	The Installation Instructions contain all of the information and safety precautions needed for the proper mounting and installation of the product. The Installation Instructions are contained as an excerpt from the Operating Instructions in every delivery. The Installation Instructions have the second highest level of priority for reading.
Operating Instructions	The Operating Instructions contain all the information and safety precautions needed for the proper operation of the product according to its intended use. The Operating Instructions are included on the supplied storage medium and can also be downloaded in the download area from **www.heidenhain.de**. The Operating Instructions must be read before the unit is put into service. The Operating Instructions have the third highest level of priority for reading.
User's Manual	The User's Manual provides all information required for installing the demo software on a computer and for using it as intended. The User's Manual is located in the installation folder of the demo software and can be downloaded from the download area at **www.heidenhain.de**.

Have you found any errors or would you like to suggest changes?

We continuously strive to improve our documentation for you. Please help us by sending your suggestions to the following e-mail address:

userdoc@heidenhain.de

1.4.3 Storage and distribution of the documentation

The instructions must be kept in the immediate vicinity of the workplace and must be available to all personnel at all times. The operating company must inform the personnel where these instructions are kept. If the instructions have become illegible, the operating company must obtain a new copy from the manufacturer.

If the product is given or resold to any other party, the following documents must be passed on to the new owner:

- Addendum (if supplied)
- Installation Instructions
- Operating Instructions

1.5 About these instructions

These instructions provide all the information and safety precautions needed for the safe operation of the device.

1.5.1 Document category

Operating Instructions

These instructions are the **Operating Instructions** for the product.

The Operating Instructions

- Are oriented to the product life cycle
- Contain all information and safety precautions needed for the proper operation of the product according to its intended use

1.5.2 Target groups for the instructions

These instructions must be read and observed by every person who performs any of the following tasks:

- Mounting
- Installation
- Commissioning and configuration
- Operation
- Programming
- Service, cleaning and maintenance
- Troubleshooting
- Removal and disposal

1.5.3 Target groups according to user types

The target groups of these instructions refer to the various user types of the product and their authorizations.
The product features the following user types:

OEM user

The **OEM** (Original Equipment Manufacturer) user has the highest level of permissions. This user is allowed to configure the product's hardware (e.g. connection of encoders and sensors). He can create **Setup** and **Operator**-type users, and configure the **Setup** and **Operator** users. The **OEM** user cannot be duplicated or deleted. This user cannot be logged in automatically.

Setup user

The **Setup** user configures the product for use at the place of operation. This user can create **Operator**-type users. The **Setup** user cannot be duplicated or deleted. This user cannot be logged in automatically.

Operator user

The **Operator** user is permitted to use the basic functions of the product.
An **Operator**-type user cannot create additional users, but is allowed to edit various operator-specific settings, such as his name or the language. A user of the **Operator** group can be logged in automatically as soon as the product is switched on.

1.5.4 Contents of the chapters

The table below shows:

- from which chapters these instructions are derived from
- which information the chapters of the instructions contain
- to which target groups the chapters of the instructions mainly apply

Section	Contents	Target group		
	This chapter contains information about...	**OEM**	**Setup**	**Operator**
1 "Fundamentals"	... this product ... these instructions	✓	✓	✓
2 "Safety"	... Safety regulations and safety measures ■ for mounting the product ■ for installing the product ■ for operating the product	✓	✓	✓
3 "Transport and storage"	... transporting the product ... storing the product ... items supplied with the product ... accessories for the product	✓	✓	
4 "Mounting"	... correct mounting of the product	✓	✓	
5 "Installation"	... correct installation of the product	✓	✓	

Section	Contents	Target group		
	This chapter contains information about...	**OEM**	**Setup**	**Operator**
6 "Basic operation"	... the operating elements of the product user interface ... the user interface of the product ... basic functions of the product	✓	✓	✓
7 "Commissioning"	... commissioning the product	✓		
8 "Setup"	... correct setup of the product		✓	
9 "Quick Start"	... an example of a typical measuring sequence: ■ Aligning the measured object ■ Measuring features ■ Creating a measuring report			✓
10 "Measuring"	... geometry types ... the acquisition of measuring points ... the performance of a measurement ... the definition and construction of features			✓
11 "Measurement evaluation"	... the evaluation of measurements ... the determination of tolerances			✓
12 "Programming"	... the creation, processing and use of measuring programs		✓	✓
13 "Measurement reports"	... the creation, modification and management of templates for measuring reports ... the creation of measuring reports		✓	✓
9 "Quick Start"	... a typical manufacturing process based on a sample workpiece			✓
14 "File management"	... the functions of the "File management" menu	✓	✓	✓
15 "Settings"	... setting options and associated setting parameters for the product	✓	✓	✓
16 "Servicing and maintenance"	... general maintenance work on the product	✓	✓	✓
17 "What to do if ..."	... causes of faults or malfunctions of the product ... corrective actions for faults or malfunctions of the product	✓	✓	✓
18 "Removal and disposal"	... disassembly and disposal of the product ... environment protection specifications	✓	✓	✓
19 "Specifications"	... the technical data of the product ... product dimensions and mating dimensions (drawings)	✓	✓	✓
20 "Index"	This chapter enables accessing the content of these instructions according to specific topics.	✓	✓	✓

1.5.5 Notes in this documentation

Safety precautions

Precautionary statements warn of hazards in handling the product and provide information on their prevention. Precautionary statements are classified by hazard severity and divided into the following groups:

⚠ DANGER
Danger indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **will result in death or severe injury.**

⚠ WARNING
Warning indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **could result in death or serious injury**.

⚠ CAUTION
Caution indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **could result in minor or moderate injury.**

NOTICE
Notice indicates danger to material or data. If you do not follow the avoidance instructions, the hazard **could result in property damage**.

Informational notes

Informational notes ensure reliable and efficient operation of the product. Informational notes are divided into the following groups:

ℹ	The information symbol indicates a **tip**. A tip provides additional or supplementary information.
⚙	The gear symbol indicates that the function described **depends on the machine**, e.g. ■ Your machine must feature a certain software or hardware option ■ The behavior of the functions depends on the configurable machine settings
📖	The book symbol represents a **cross reference** to external documentation, e.g. the documentation of your machine tool builder or other supplier.

1.5.6 Symbols and fonts used for marking text

In these instructions the following symbols and fonts are used for marking text:

Depiction	Meaning
▶ ... > ...	Identifies an action and the result of this action Example: ▶ Tap **OK** > The message is closed
■ ... ■ ...	Identifies an item of a list Example: ■ TTL interface ■ EnDat interface ■ ...
Bold	Identifies menus, displays and buttons Example: ▶ Tap **Shut down** > The operating system shuts down ▶ Turn the power switch off

2

Safety

2.1 Overview

This chapter provides important safety information needed for the proper operation of the unit.

2.2 General safety precautions

General accepted safety precautions, in particular the applicable precautions relating to the handling of live electrical equipment, must be followed when operating the system. Failure to observe these safety precautions may result in personal injury or damage to the product.

It is understood that safety rules within individual companies vary. If a conflict exists between the material contained in these instructions and the rules of a company using this system, the more stringent rules take precedence.

2.3 Intended use

The products of the QUADRA-CHEK 3000 series are advanced digital evaluation electronics for the measurement of 2-D and 3-D features in metrology applications. The products are used primarily on measuring machines, video measuring machines, coordinate measuring machine as well as profile projectors.

The products of this series

- must only be used in commercial applications and in an industrial environment
- must be mounted on a suitable stand or holder to ensure the correct and intended operation of the product
- are intended for indoor use in an environment in which the contamination caused by humidity, dirt, oil and lubricants complies with the requirements of the specifications

	The products support the use of peripheral devices from different manufacturers. HEIDENHAIN cannot make any statements on the intended use of these devices. The information on their intended use, which is provided in the respective documentation, must be observed.

2.4 Improper use

In particular, the products of the QUADRA-CHEK 3000 series must not be used in the following applications:

- Use and storage outside the operating conditions specified in "Specifications"
- Outdoor use
- Use in potentially explosive atmospheres
- Use of the products of the QUADRA-CHEK 3000 series as part of a safety function

2.5 Personnel qualification

The personnel for mounting, installation, operation, service, maintenance and removal must be appropriately qualified for this work and must have obtained sufficient information from the documentation supplied with the product and with the connected peripherals.

The personnel required for the individual activities to be performed on the product are indicated in the respective sections of these instructions.

The personnel groups are specified in detail as follows with regard to their qualifications and tasks.

Operator

The operator uses and operates the product within the framework specified for the intended use. He is informed by the operating company about the special tasks and the potential hazards resulting from incorrect behavior.

Qualified personnel

The qualified personnel are trained by the operating company to perform advanced operation and parameterization. The qualified personnel have the required technical training, knowledge and experience and know the applicable regulations, and are thus capable of performing the assigned work regarding the application concerned and of proactively identifying and avoiding potential risks.

Electrical specialist

The electrical specialist has the required technical training, knowledge and experience and knows the applicable standards and regulations, and is thus capable of performing work on electrical systems and of proactively identifying and avoiding potential risks. Electrical specialists have been specially trained for the environment they work in.

Electrical specialists must comply with the provisions of the applicable legal regulations on accident prevention.

2.6 Obligations of the operating company

The operating company owns or leases the device and the peripherals. At all times, the operating company is responsible for ensuring that the intended use is complied with.

The operating company must:

- Assign the different tasks to be performed on the device to suitable, qualified and authorized personnel
- Verifiably train the personnel in the authorizations and tasks
- Provide all materials and means necessary in order for the personnel to complete the assigned tasks
- Ensure that the device is operated only when in perfect technical condition
- Ensure that the device is protected from unauthorized use

2.7 General safety precautions

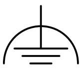
> The safety of any system incorporating the use of this product is the responsibility of the assembler or installer of the system.

> The product supports the use of a wide variety of peripheral devices from different manufacturers. HEIDENHAIN cannot make any statements on the specific safety precautions to be taken for these devices. The safety precautions provided in the respective documentation must be observed. If there is no documentation at hand, it must be obtained from the manufacturers concerned.

The specific safety precautions required for the individual activities to be performed on the product are indicated in the respective sections of these instructions.

2.7.1 Symbols on the product

The following symbols are used to identify the product:

Symbol	Meaning
	Observe the safety precautions regarding electricity and the power connection before you connect the product.
	Functional ground connection as per IEC/EN 60204-1. Observe the information on installation.
	Product seal. Breaking or removing the product seal will result in forfeiture of warranty and guarantee.

2.7.2 Electrical safety precautions

⚠ WARNING

Hazard of contact with live parts when opening the unit.

This may result in electric shock, burns or death.

- Never open the housing
- Only the manufacturer is permitted to access the inside of the product

⚠ WARNING

Hazard of dangerous amount of electricity passing through the human body upon direct or indirect contact with live electrical parts.

This may result in electric shock, burns or death.

- Work on the electrical system and live electrical components is to be performed only by trained specialists
- For power connection and all interface connections, use only cables and connectors that comply with applicable standards
- Have the manufacturer exchange defective electrical components immediately
- Regularly inspect all connected cables and all connections on the product. Defects, such as loose connections or scorched cables, must be removed immediately

NOTICE

Damage to internal parts of the product!

If you open the product, the warranty and the guarantee will become void.

- Never open the housing
- Only the product manufacturer is permitted to access the inside of the product

3

Transport and storage

3.1 Overview

This chapter contains information on the transportation and storage of the product and provides an overview of the items supplied and the available accessories for the product.

> The following steps must be performed only by qualified personnel.
> **Further information:** "Personnel qualification", Page 31

3.2 Unpacking

- Open the top lid of the box
- Remove the packaging materials
- Unpack the contents
- Check the delivery for completeness
- Check the delivery for damage

3.3 Items supplied and accessories

3.3.1 Items supplied

The following items are included in delivery:

Name	Description
2-D demo part	Demonstration part for 2-D application examples
Addendum (optional)	Supplements or supersedes the contents of the Operating Instructions and, if applicable, of the Installation Instructions.
Operating Instructions	PDF issue of the Operating Instructions on a memory medium in the currently available languages
Product	Evaluation Unit QUADRA-CHEK 3000
Installation Instructions	Printed issue of the Installation Instructions in the currently available languages

3.3.2 Accessories

> Software options need to be enabled on the product via a license key. Before you can use the associated hardware components, you need to enable the respective software option.
>
> **Further information:** "Activating the Software options", Page 139

The following accessories are optionally available and can be ordered from HEIDENHAIN:

Accessories	Name	Description	ID
For operation			
	2-D demo part	Demonstration part for 2-D application examples	681047-02
	Calibration standard	Calibration standard for calibrating video measuring machines, measuring microscopes, and profile projectors; can be traced back to national or international standards	681047-01
	QUADRA-CHEK 3000 3D software option	Point measurement via touch probe for 3-D measuring applications	1089229-09
	QUADRA-CHEK 3000 3-D Trial software option	Measured-value acquisition via touch probe for 3-D measuring applications; trial version for a limited period (60 days)	1089229-59
	QUADRA-CHEK 3000 AEI1 software option	Enabling of an additional encoder input	1089229-01
	QUADRA-CHEK 3000 AEI1 Trial software option	Enabling of an additional encoder input, test version for a limited time (60 days)	1089229-51
	QUADRA-CHEK 3000 OED software option	Automatic point measurement via optical edge detection **Product requirement:** Index A or higher	1089229-08
	QUADRA-CHEK 3000 OED Trial software option	Automatic point measurement via optical edge detection, time-limited test version (60 days) **Product requirement:** Index A or higher	1089229-58
	QUADRA-CHEK 3000 VED software option	Automatic point measurement via video edge detection; display and archiving of live images; light control	1089229-02

Accessories	Name	Description	ID
	QUADRA-CHEK 3000 VED Trial software option	Automatic point measurement via video edge detection, display and archiving of live images; light control; test version for a limited time (60 days)	1089229-52
For installation			
	Adapter cable for touch-probe connection, DIN 5-pin female	Conversion of the pin layout from HEIDENHAIN touch probe interface to Renishaw touch probe interface	1095709-xx
	Adapter connector for 11 µApp	Conversion of the 11 μA_{PP} interface from installation in D-sub connector, 2-row, female, 9-pin to D-sub connector, 2-row, with locking screws, male, 15-pin	1089213-01
	Adapter connector for 1 Vpp	Conversion of the 1 V_{PP} interface from installation in D-sub connector, 2-row, male, 15-pin to D-sub connector, 2-row, with locking screws, male, 15-pin	1089214-01
	Adapter connector for 2 Vpp	Pin layout conversion from HEIDENHAIN 1 V_{PP} to Mitutoyo-2 V_{PP}	1089216-01
	Adapter connector for light control	Conversion of the pin layout for light control (without zoom) from QUADRA-CHEK 3000 (X103) to assignment for ND 1300 QUADRA-CHEK (light)	1089212-01
	Adapter connector for TTL	Conversion of the pin layout from HEIDENHAIN TTL to RSF TTL and Renishaw TTL	1089210-01
	Cables	For information on connecting cables, see "Cables and Connectors for HEIDENHAIN Products" brochure.	—
	Power cable	Power cable with European plug (type F), length: 3 m	223775-01
	USB connecting cable	USB connecting cable for connector type A to type B	354770-xx
For mounting			
	Duo-Pos stand	Stand for rigid mounting, inclination angle 20° or 45°, fixing hole pattern 100 mm x 100 mm	1089230-02

Accessories	Name	Description	ID
	Multi-Pos holder	Holder for fastening the device on an arm, continuously tiltable within an angle of 90°, fixing hole pattern 100 mm x 100 mm	1089230-04
	Multi-Pos stand	Stand for continuously variable tilting within an angle of 90°, fixing hole pattern 100 mm x 100 mm	1089230-03
For OED software option			
	Connection for optical fiber	Fiber-optic cable with two SMA connectors (subminiature A)	681049-xx
	Holder	Transparent holder for accepting a fiber-optic cable with right-angle end	681050-xx
	Optical fiber	Fiber-optic cable with one right-angle end and an SMA connector (subminiature A)	681049-xx
For TP software option			
	3-D demo part	Demonstration part for 3-D application examples	681048-01
	KT 130 edge finder	Touch probe for probing a workpiece (for setting presets)	283273-xx
	TS 248 touch probe	Touch probe for probing a workpiece (for setting presets), axial cable outlet	683110-xx
	TS 248 touch probe	Touch probe for probing a workpiece (for setting presets), radial cable outlet	683112-xx
For VED software option			
	QUADRA-CHEK 3000 AF software option	Automatic focusing of the camera onto the measured object; prerequisite: the camera is used in combination with a numerically controlled axis	1089229-03
	QUADRA-CHEK 3000 AF Trial software option	Assisted focusing of the camera onto the measured object. Prerequisite: the camera is used in combination with the Z axis; trial version for a limited period (60 days)	1089229-53

Recommended cameras

> The product supports only cameras from camera manufacturer IDS Imaging Development Systems GmbH.
> The product supports only cameras with a maximum resolution of 2.0 megapixels.
> For connection, HEIDENHAIN recommends the use of USB connecting cables from the manufacturer IDS Imaging Development Systems GmbH.

HEIDENHAIN recommends the following cameras from IDS Imaging Development Systems GmbH:

Part no.	Model designation	Interface	Resolution
AB00795	UI-1240LE-C-HQ QUADRA-CHEK APPROVED	USB 2.0	1.31 megapixels
AB00796	UI-1240LE-M-GL QUADRA-CHEK APPROVED	USB 2.0	1.31 megapixels
AB00799	UI-1250LE-C-HQ QUADRA-CHEK APPROVED	USB 2.0	1.92 megapixels
AB00800	UI-1250LE-M-GL QUADRA-CHEK APPROVED	USB 2.0	1.92 megapixels
AB00797	UI-1240SE-C-HQ QUADRA-CHEK APPROVED	USB 2.0	1.31 megapixels
AB00798	UI-1240SE-M-GL QUADRA-CHEK APPROVED	USB 2.0	1.31 megapixels
AB00801	UI-1250SE-C-HQ QUADRA-CHEK APPROVED	USB 2.0	1.92 megapixels
AB00802	UI-1250SE-M-GL QUADRA-CHEK APPROVED	USB 2.0	1.92 megapixels
AB00870	UI-5240SE-C-HQ Rev.2 QUADRA-CHEK APPROVED	GigE	1.31 megapixels
AB00871	UI-5240SE-M-HQ Rev.2 QUADRA-CHEK APPROVED	GigE	1.31 megapixels
AB00877	UI-5240CP-M-GL QUADRA-CHEK APPROVED	GigE	1.31 megapixels

3.4 In case of damage in transit

- Have the shipping agent confirm the damage
- Keep the packaging materials for inspection
- Notify the sender of the damage
- Contact the distributor or machine manufacturer for replacement parts

> If damage occurred during transit:
> - Keep the packaging materials for inspection
> - Contact HEIDENHAIN or the machine manufacturer
>
> This applies also if damage occurred to requested replacement parts during transit.

3.5 Repackaging and storage

Repackage and store the product carefully in accordance with the conditions stated below.

3.5.1 Repackaging the product

Repackaging should correspond to the original packaging as closely as possible.

- Re-attach all mounting parts and dust protection caps to the product as received from the factory, or repackage them in the original packaging as received from the factory
- Repackage the product in such a way that
  - it is protected from impact and vibration during transit
  - it is protected from the ingress of dust or humidity
- Place all accessories that were included in the shipment in the original packaging
  Further information: "Items supplied and accessories", Page 36
- Enclose all the documentation that was included in the original packaging
  Further information: "Storage and distribution of the documentation", Page 23

> If the device is returned for repair to the Service Department:
> - Ship the device without accessories, without encoders and without peripherals

3.5.2 Storage of the product

- Package the product as described above
- Observe the specified ambient conditions
  Further information: "Specifications", Page 539
- Inspect the product for damage after any transport or longer storage times

4

Mounting

4.1 Overview

This chapter describes the mounting of the product. It contains instructions about how to correctly mount the product on stands or holders.

> The following steps must be performed only by qualified personnel.
> **Further information:** "Personnel qualification", Page 31

4.2 Assembly of the product

General mounting information

The mount for the mounting variants is provided on the rear panel. The connection is compatible with the VESA standard 100 mm x 100 mm.

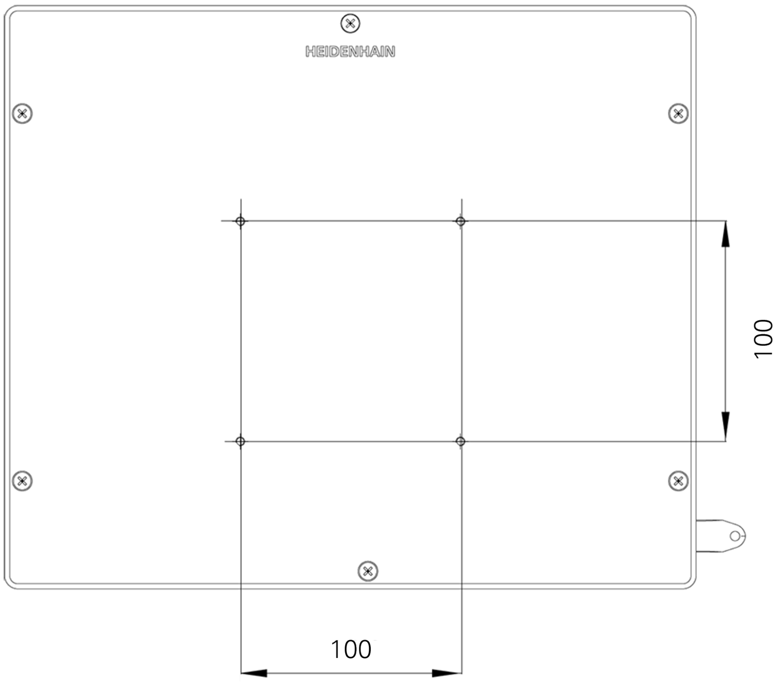


Figure 1: Dimensions of the rear panel

The materials for attachment of the mounting variants on the device are included in delivery.

You will also need the following:

- Torx T20 screwdriver
- Torx T25 screwdriver
- Allen key, size 2.5 (Duo-Pos stand)
- Materials for mounting on a supporting surface

> The unit must be mounted to a stand or a holder to ensure the correct and intended use of the product.

4.2.1 Mounting on Duo-Pos stand

You can fasten the Duo-Pos stand to the product at a 20° or 45° angle.

- Use the provided M4 x 8 ISO 7380 hexagon socket screws to fasten the stand to the lower VESA 100 threaded holes on the rear panel

> Comply with the permissible tightening torque of 2.6 Nm

- Using the mounting slots (width = 4.5 mm), screw the stand to a supporting surface

or

- Set up the device freely at the desired location
- Route the cable from behind through the two supports of the stand and then through the lateral openings to the connections

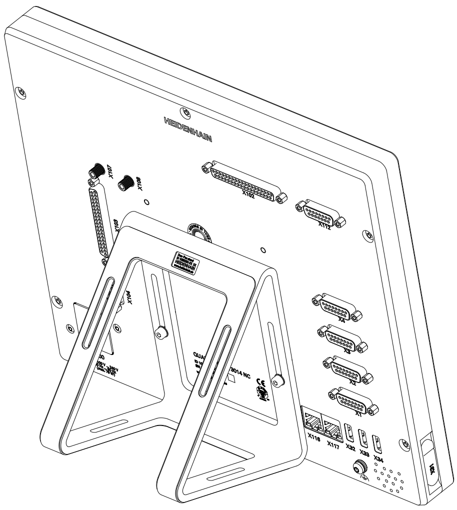


Figure 2: Product mounted on Duo-Pos stand

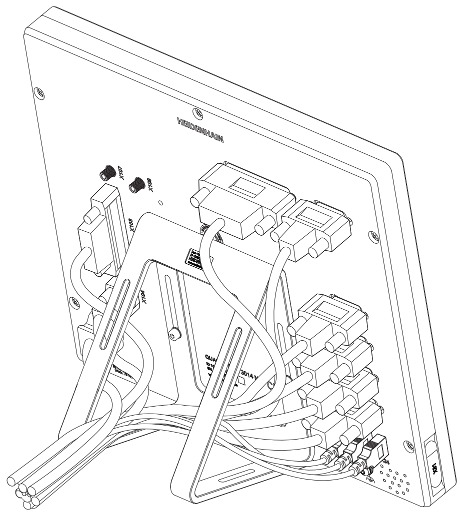


Figure 3: Cable routing on Duo-Pos stand

Further information: "Product dimensions with Duo-Pos stand", Page 543

4.2.2 Mounting on Multi-Pos stand

- Use the provided M4 x 8 ISO 14581 countersunk head screws (black) to fasten the stand to the VESA 100 threaded holes on the rear panel

> Comply with the permissible tightening torque of 2.6 Nm

- Using two M5 screws, you can also optionally screw the stand to a supporting surface from the bottom
- Adjust the desired angle of inclination within the tilting range of 90°
- To fix the stand: Tighten the T25 screw

> Comply with the tightening torque for screw T25
> - Recommended tightening torque: 5.0 Nm
> - Maximum permissible tightening torque: 15.0 Nm

- Route the cable from behind through the two supports of the stand and then through the lateral openings to the connections

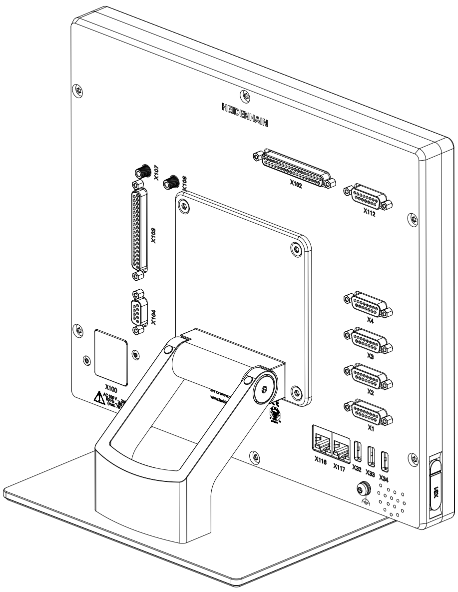


Figure 4: Product mounted on Multi-Pos stand

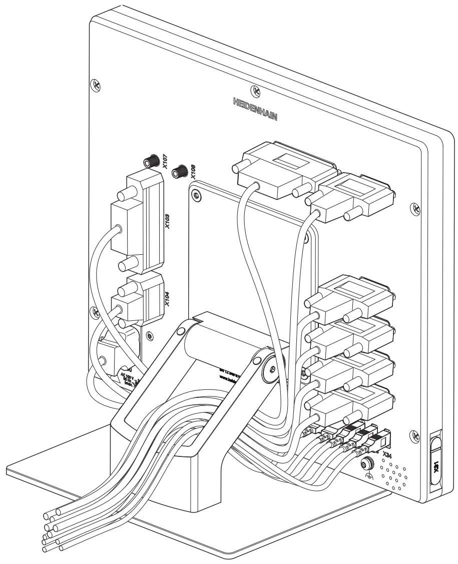


Figure 5: Cable routing on Multi-Pos stand

Further information: "Product dimensions with Multi-Pos stand", Page 543

4.2.3 Mounting on Multi-Pos holder

- Use the provided M4 x 8 ISO 14581 countersunk head screws (black) to fasten the holder to the VESA 100 threaded holes on the rear panel

> Comply with the permissible tightening torque of 2.6 Nm

- Mount the holder with the supplied M8 screw, the washers, the handle and the M8 hexagon nut to an arm
- Adjust the desired angle of inclination within the tilting range of 90°
- To fix the holder in place: Tighten the T25 screw

> Comply with the tightening torque for screw T25
> - Recommended tightening torque: 5.0 Nm
> - Maximum permissible tightening torque: 15.0 Nm

- Route the cable from behind through the two supports of the holder and then through the lateral openings to the connections

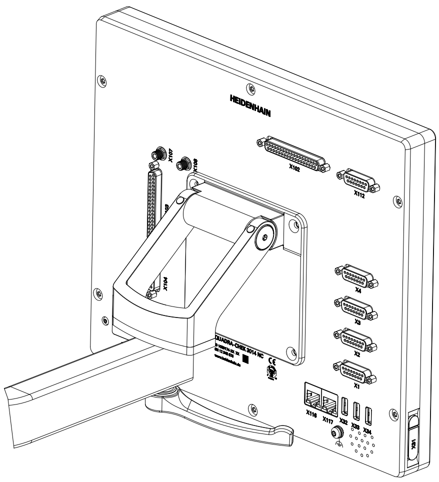


Figure 6: Product mounted on Multi-Pos holder

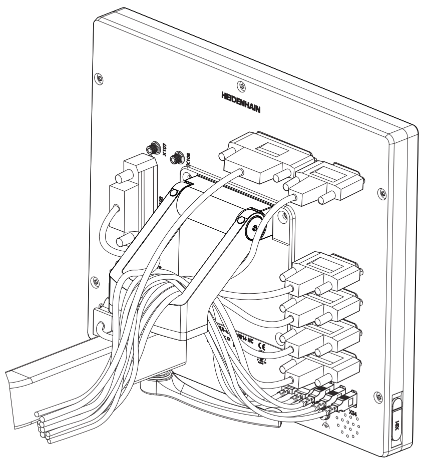


Figure 7: Cable routing on Multi-Pos holder

Further information: "Product dimensions with Multi-Pos holder", Page 544

5

Installation

5.1 Overview

This chapter describes the Installation of the product. It contains information about the product's connections and instructions about how to correctly connect the peripheral devices.

> The following steps must be performed only by qualified personnel.
> **Further information:** "Personnel qualification", Page 31

5.2 General information

NOTICE

Interference from sources of high electromagnetic emission!

Peripheral devices, such as frequency inverters or servo drives, may cause interference.

To increase the noise immunity to electromagnetic influences:

- Use the optional functional ground connection as per IEC/EN 60204-1
- Use only USB peripherals with continuous shielding, e.g. by metalized film and metal braiding or a metal housing. The degree of coverage provided by the braiding must be 85 % or higher. The shield must be connected around the entire circumference of the connectors (360° connection).

NOTICE

Damage to the device from the engaging and disengaging of connecting elements during operation!

Damage to internal components may result.

- Do not engage or disengage any connecting elements while the unit is under power

NOTICE

Electrostatic discharge (ESD)!

This device contains electrostatic sensitive components that can be destroyed by electrostatic discharge (ESD).

- It is essential to observe the safety precautions for handling ESD-sensitive components
- Never touch connector pins without ensuring proper grounding
- Wear a grounded ESD wristband when handling device connections

NOTICE

Damage to the product due to incorrect wiring!

The incorrect wiring of inputs or outputs can cause damage to the unit or to peripheral devices.

- Comply with the pin layouts and specifications of the product
- Assign only pins or wires that will be used

Further information: "Specifications", Page 539

5.3 Device overview

The connections on the rear panel of the device are protected by dust protection caps from contamination and damage.

NOTICE

Contamination or damage may result if the dust protection caps are missing!

If no dust protection caps are fitted to unused connections, this may impair the proper functioning of the contacts or destroy them.

- Remove dust protection caps only when connecting measuring devices or peripherals
- If you remove a measuring device or peripheral, re-attach the dust protection cap to the connection

The type of connections for encoders may vary depending on the product version.

Rear panel without dust protection caps

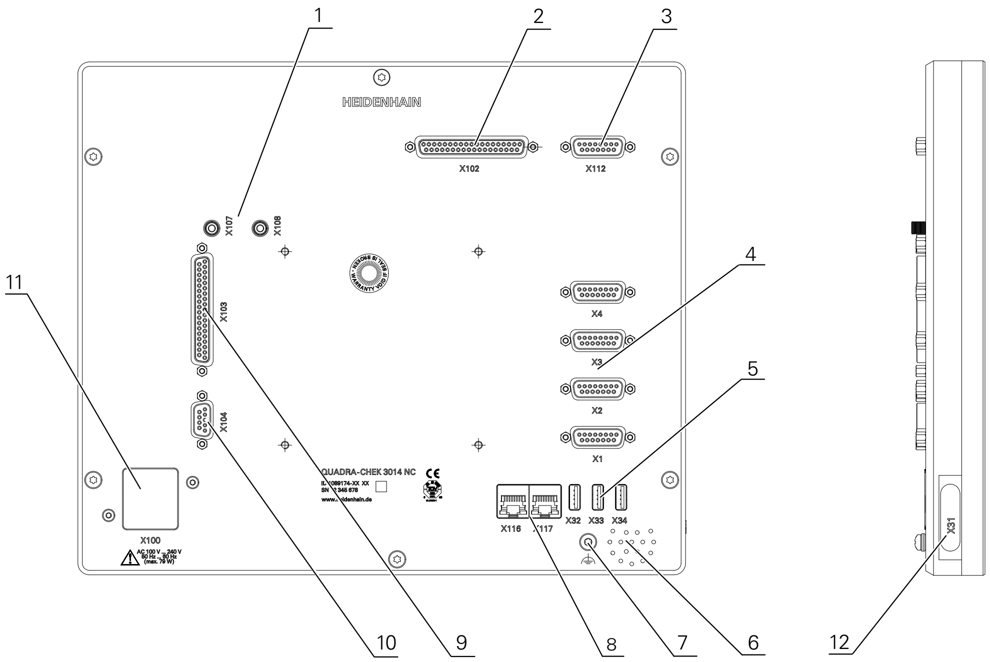


Figure 8: Rear panel

Connections that are independent of software options:

4 D-sub connections for encoders, 2 inputs enabled by default, another 2 inputs can be enabled optionally

X1 to X3: Product variant with 15-pin D-sub connections for encoders with 1 V_{PP}, 11 μA_{PP}, or EnDat 2.2 interface

X21 to X24: Product variant with 9-pin D-sub connections for encoders with a TTL interface

5 USB connections

X32: USB 2.0 Hi-Speed connection (type A) for digital cameras, printers, input devices or USB mass storage devices

X33 to X34: USB 2.0 Hi-Speed connection (type A) for printers, input devices or USB mass storage devices

6 Speaker

7 Functional ground connection as per IEC/EN 60204-1

8 RJ45 Ethernet connections

X116: connection for communication and data exchange with subsequent systems or PC

11 **X100**: power switch and power connection

Connections that depend on software options:

1 Connections for optical edge detector for point measurement
X107: reference input for optical waveguide from the light source
X108: input for optical waveguide from the projection screen

2 **X102**: 37-pin D-sub connection for digital TTL interface (8 inputs, 16 outputs)

3 **X112**: 15-pin D-sub connection for touch probes (e.g. HEIDENHAIN touch probe)

8 RJ45 Ethernet connections
X117: connection for digital camera

9 **X103**: 37-pin D-sub connection for digital or analog interface (TTL 4 inputs, 6 outputs; 3 analog inputs, 10 outputs)

10 **X104**: 9-pin D-sub connection for universal relay interface (2x relay changeover contacts)

Left side panel

12 **X31** (below protective cover): USB 2.0 Hi-Speed connection (type A) for printers, input devices or USB mass storage devices

5.4 Connecting encoders

> For encoders with an EnDat 2.2 interface: If the corresponding encoder input has already been assigned to an axis in the device settings, then the encoder is automatically detected upon restart, and the settings are adapted. Alternatively, you can assign the encoder input after you have connected the encoder.

- Comply with the pin layout
- Remove and save the dust protection cap
- Route the cables depending on the mounting variant

Further information: "Assembly of the product", Page 44

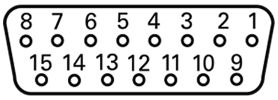
- Connect the encoder cables tightly to the respective connections

Further information: "Device overview", Page 51

- If the cable connectors include mounting screws, do not overtighten them

Pin layout of X1, X2, X3, X4

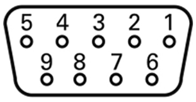
1 V_{PP}, 11 μA_{PP}, EnDat 2.2



	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1 V_{PP}	A+	0 V	B+	U_P	/	/	R–	/
11 μA_{PP}	I_{1+}		I_{2+}		/	Internal shield	I_{0+}	/
EnDat	/		/		DATA		/	CLOCK
	9	**10**	**11**	**12**	**13**	**14**	**15**	
1 V_{PP}	A–	Sense 0 V	B–	Sense U_P	/	R+	/	
11 μA_{PP}	I_{1-}		I_{2-}		/	I_{0+}	/	
EnDat	/		/		$\overline{\text{DATA}}$	/	$\overline{\text{CLOCK}}$	

Pin layout of X21, X22, X23, X24

TTL



1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
/	U_{a1}	$\overline{U_{a1}}$	U_{a2}	$\overline{U_{a2}}$	0 V	U_p	$\overline{U_{a0}}$	U_{a0}

5.5 Connecting a digital camera

Connecting a USB digital camera

- Note the following pin layout
- Remove and save the dust protection caps
- Route the cables based on the mounting variant

Further information: "Assembly of the product", Page 44

- Connect the camera to the USB Type-A port X32. Make sure the USB cable connector is fully inserted

Further information: "Device overview", Page 51

Pin layout of X32

1	2	3	4
DC 5 V	Data (–)	Data (+)	GND

Connecting an Ethernet digital camera

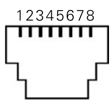
- Note the following pin layout
- Remove and save the dust protection caps
- Route the cables based on the mounting variant

Further information: "Assembly of the product", Page 44

- Connect the camera to the Ethernet port X117 using a standard CAT.5 cable. The cable connector must firmly engage in the port

Further information: "Device overview", Page 51

Pin layout of X117



1	2	3	4	5	6	7	8
D1+ (TX+)	D1- (TX-)	D2+ (RX+)	D3+	D3–	D2– (RX–)	D4+	D4–

5.6 Connecting an optical edge detector

- Note the following pin layout
- Remove and save the dust protection caps
- Route the optical waveguides in accordance with the mounting variant

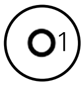
Further information: "Assembly of the product", Page 44

> - Adhere to the manufacturer's specifications regarding the maximum bend radius of the fiber-optic cable

- Connect the fiber-optic cable of the light source (reference) to connection X107
- Connect the optical waveguide from the projection screen to port X108

Further information: "Device overview", Page 51

Pin layout of X107, X108

	
	1
	In

5.7 Connecting touch probes

> The following touch probes can be connected to the unit:
> - HEIDENHAIN TS 248 touch probe
> - HEIDENHAIN KT 130 edge finder
> - Renishaw touch trigger probe
>
> **Further information:** "Items supplied and accessories", Page 36

- Comply with the pin layout
- Remove and save the dust protection cap
- Route the cables depending on the mounting variant

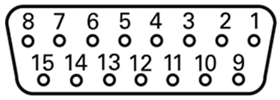
Further information: "Assembly of the product", Page 44

- Connect the touch probe firmly

Further information: "Device overview", Page 51

- If the cable connectors include mounting screws, do not overtighten them

Pin layout of X112



1	2	3	4	5	6	7	8
LED+	B 5 V	B 12 V	/	DC 12 V	DC 5 V	/	GND
9	**10**	**11**	**12**	**13**	**14**	**15**	
/	/	TP	GND	TP	/	LED–	

B – Probe signals, readiness
TP – Touch Probe, normally closed

5.8 Wiring switching inputs and outputs

> Depending on the peripherals to be connected, the connection work may need to be carried out by an electrical specialist.
>
> Example: Safety Extra Low Voltage (SELV) exceeded
>
> **Further information:** "Personnel qualification", Page 31

> The product fulfills the requirements of standard IEC 61010-1 only if the power to the peripheral devices is supplied from a secondary circuit with current limitation as per IEC 61010-1$^{\text{3rd Ed.}}$, Section 9.4 or with power limitation as per IEC 60950-1$^{\text{2nd Ed.}}$, Section 2.5 or from a Class 2 secondary circuit as specified in UL1310.
>
> In place of IEC 61010-1$^{\text{3rd Ed.}}$, Section 9.4, the corresponding sections of standards DIN EN 61010-1, EN 61010-1, UL 61010-1 and CAN/CSA-C22.2 No. 61010-1can be used, and, in place of IEC 60950-1$^{\text{2nd Ed.}}$, Section 2.5, the corresponding sections of standards DIN EN 60950-1, EN 60950-1, UL 60950-1, CAN/CSA-C22.2 No. 60950-1 can be applied.

- Wire switching inputs and outputs in accordance with the following pin layout
- Remove and save the dust protection cap
- Route the cables depending on the mounting variant

Further information: "Assembly of the product", Page 44

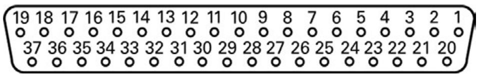
- Connect the connecting cables of the peripherals tightly to their connectors

Further information: "Device overview", Page 51

- If the cable connectors include mounting screws, do not overtighten them

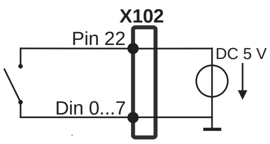
> The digital or analog inputs and outputs must be assigned in the device settings of the respective switching function.

Pin layout of X102

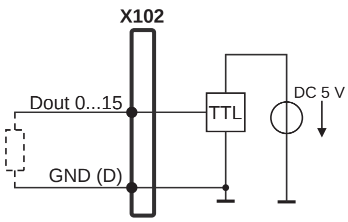


1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
GND	Din 1	Din 3	Din 4	Din 6	GND	Dout 0	Dout 2
9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Dout 4	GND	Dout 6	Dout 8	Dout 10	GND	Dout 12	Dout 14
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**
/	/	GND	Din 0	Din 2	DC 5 V	Din 5	Din 7
25	**26**	**27**	**28**	**29**	**30**	**31**	**32**
GND	Dout 1	Dout 3	Dout 5	GND	Dout 7	Dout 9	Dout 11
33	**34**	**35**	**36**	**37**			
GND	Dout 13	Dout 15	/	/			

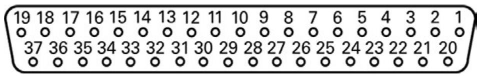
Digital inputs:



Digital outputs:



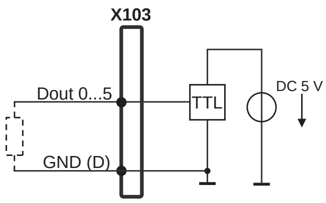
Pin layout of X103



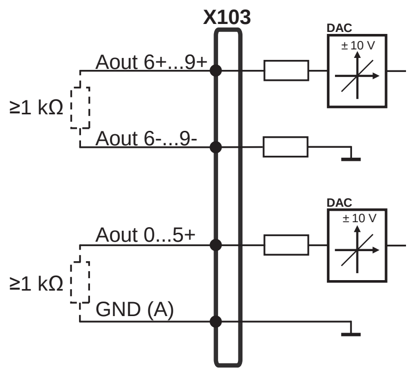
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
GND (D)	Din 1	Din 3	DC 5V (A)[1]	Ain 1	GND (A)	Dout 0	Dout 2
9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Dout 4	GND (D)	Aout 0	Aout 2	Aout 4	GND (A)	Aout 6+	Aout 7+
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Aout 8+	Aout 9+	GND (A)	Din 0	Din 2	DC 5 V (D)	Ain 0	Ain 2
25	**26**	**27**	**28**	**29**	**30**	**31**	**32**
GND (A)	Dout 1	Dout 3	Dout 5	GND (D)	Aout 1	Aout 3	Aout 5
33	**34**	**35**	**36**	**37**			
GND (A)	Aout 6–	Aout 7–	Aout 8–	Aout 9–			

1) Index ≥ A

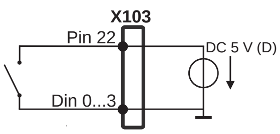
Digital outputs:



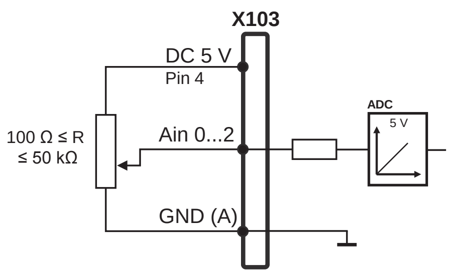
Analog outputs:



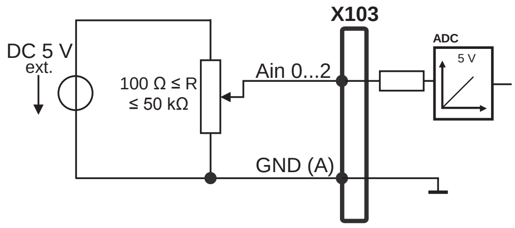
Digital inputs:



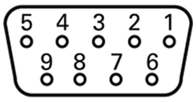
Analog inputs (Index ≥ A):



Analog inputs DC 5 V ext.:



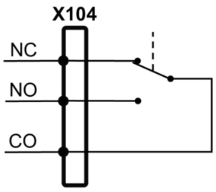
Pin layout of X104



1	2	3	4	5	6	7	8	9
R-0 NO	R-0 NC	/	R-1 NO	R-1 NC	R-0 CO	/	/	R-1 CO

CO – Change Over
NO – Normally Open
NC – Normally Closed

Relay outputs:



5.9 Connecting a printer

Connecting a USB printer

- Comply with the pin layout
- Remove and save the dust protection cap
- Route the cables based on the mounting variant

Further information: "Assembly of the product", Page 44

- Connect USB printer to USB Type-A port (X31, X32, X33, X34). Make sure the USB cable connector is fully inserted

Further information: "Device overview", Page 51

Pin layout X31, X32, X33, X34

1	2	3	4
DC 5 V	Data (–)	Data (+)	GND

Connecting an Ethernet printer

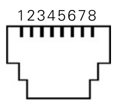
- Comply with the pin layout
- Remove and save the dust protection cap
- Route the cables based on the mounting variant

Further information: "Assembly of the product", Page 44

- Connect the Ethernet printer to the Ethernet port X116 using a standard CAT.5 cable. The cable connector must firmly engage in the port

Further information: "Device overview", Page 51

Pin layout of X116



1	2	3	4	5	6	7	8
D1+ (TX+)	D1- (TX-)	D2+ (RX+)	D3+	D3–	D2– (RX–)	D4+	D4–

5.10 Connecting a barcode scanner

> The following barcode scanners can be connected to the product:
> - COGNEX DataMan 8600 (with serial module for USB)

- Note the following pin layout
- Remove and save the dust protection caps
- Route the cables based on the mounting variant

Further information: "Assembly of the product", Page 44

- Connect barcode scanner to USB Type-A port (X31, X32, X33, X34). Make sure the USB cable connector is fully inserted

Further information: "Device overview", Page 51

Pin layout X31, X32, X33, X34

1	2	3	4
DC 5 V	Data (–)	Data (+)	GND

5.11 Connecting input devices

- Comply with the pin layout
- Remove and save the dust protection cap
- Route the cables based on the mounting variant

Further information: "Assembly of the product", Page 44

- Connect USB mouse or USB keyboard to USB Type-A port (X31, X32, X33, X34). Make sure the USB cable connector is fully inserted

Further information: "Device overview", Page 51

Pin layout X31, X32, X33, X34

1	2	3	4
DC 5 V	Data (–)	Data (+)	GND

5.12 Connecting a network peripheral

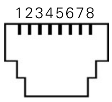
- Comply with the pin layout
- Remove and save the dust protection cap
- Route the cables depending on the mounting variant

Further information: "Assembly of the product", Page 44

- Connect the network peripheral to Ethernet port X116 using a standard CAT.5 cable. The cable connector must firmly engage in the port

Further information: "Device overview", Page 51

Pin layout of X116



1	2	3	4	5	6	7	8
D1+ (TX+)	D1- (TX-)	D2+ (RX+)	D3+	D3–	D2– (RX–)	D4+	D4–

5.13 Connecting the line voltage

> **⚠ WARNING**
>
> **Risk of electric shock!**
>
> Improper grounding of electrical devices may result in serious personal injury or death by electric shock.
>
> ▶ Always use 3-wire power cables
>
> ▶ Make sure the ground wire is correctly connected to the ground of the building's electrical installations

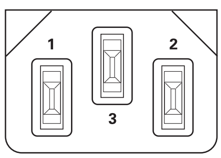
> **⚠ WARNING**
>
> **Fire hazard due to wrong power cable!**
>
> Use of a power cable that does not meet the requirements of the mounting location may cause a fire hazard.
>
> ▶ Use only a power cable that meets at least the national requirements of the respective country in which the product is mounted

▶ Comply with the pin layout

▶ Connect the power connection to a 3-wire grounded power outlet using a power cable that meets requirements

Further information: "Device overview", Page 51

Pin layout X100



1	2	3
L/N	N/L	⏚

6

Basic operation

6.1 Overview

This chapter describes the user interface, operating elements, and basic functions of the unit.

6.2 Using the touchscreen and input devices

6.2.1 Touchscreen and input devices

The operating elements on the user interface of the unit are operated via a touchscreen or a connected USB mouse.

To enter data, you can use the screen keyboard of the touchscreen or a connected USB keyboard.

> **NOTICE**
>
> **Malfunctions of the touchscreen caused by humidity or contact with water!**
>
> Humidity or water can impair the proper functioning of the touchscreen.
>
> ▶ Protect the touchscreen from humidity or contact with water
>
> **Further information:** "Product data", Page 540

6.2.2 Gestures and mouse actions

To activate, switch or move the operating elements of the user interface, you can use the unit's touchscreen or a mouse. Gestures are used to operate the touchscreen and the mouse.

> ℹ The gestures for operating the touchscreen may differ from the gestures for operating the mouse.
>
> If the gestures for operating the touchscreen differ from those for operating the mouse, then these instructions describe both operating options as alternative actions.
>
> The alternative actions for operating the touchscreen or the mouse are identified by the following symbols:
>
>  Operation using the touchscreen
>
>  Operation using the mouse

The following overview describes the different gestures for operating the touchscreen or the mouse:

Tapping	
	Means touching the screen briefly with your fingertip
	Means pressing the left mouse button once

The actions initiated by tapping include

- Selection of menus, features or parameters
- Entering characters with the screen keyboard
- Closing dialogs
- Displaying and hiding the main menu in the **Measure** menu
- Displaying and hiding the Inspector in the **Measure** menu

Holding (long press)

Means touching the screen and holding your finger(s) on it for a few seconds

Means pressing the left mouse button once and holding it down

The actions initiated by holding are

- Quickly changing the values in input fields with plus and minus buttons

Dragging

Is a combination of long press and then swipe, moving a finger over the touchscreen when at least the starting point of motion is defined

Means pressing the left mouse button once and holding it down while moving the mouse; at least the starting point of the motion is defined

The actions initiated by dragging include

- Scrolling through lists and texts
- Positioning the measuring tools
- Opening the **Details** dialog in the Inspector

Two-finger drag

Refers to the movement of two fingers across the touchscreen when at least the starting point of the movement is clearly defined

Refers to pressing the right mouse button once and holding it down while moving the mouse; at least the starting point of the movement is defined

Two-finger dragging initiates the following action

- In the **Measure** menu, moving an image section within the field of view of a camera in the workspace
  Further information: "Moving an image section", Page 92
- In the **Measure** menu, moving the features view within the workspace

6.3 General operating elements and functions

The operating elements described below are available for configuration and operating the product via the touchscreen or input devices.

Screen keyboard

With the screen keyboard, you can enter text into the input fields of the user interface. Depending on the input field, a numeric or alphanumeric screen keyboard is shown.

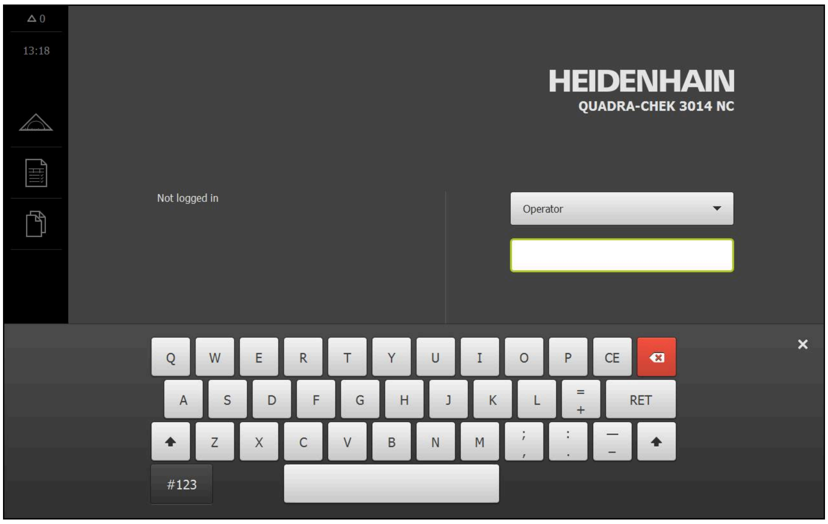


Figure 9: Screen keyboard

- ▶ To enter values, tap an input field
- \> The input field is highlighted
- \> The screen keyboard is displayed
- ▶ Enter text or numbers
- \> The correctness of the entry in the input field is shown with a green check mark
- \> If the entry is incomplete or incorrect, a red exclamation mark is displayed. In this case, the entry cannot be completed
- ▶ To apply the values, confirm the entry with **RET**
- \> The values are displayed
- \> The screen keyboard disappears

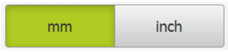
Input fields with plus and minus buttons

To adjust a numerical value, use the **+** (plus) and **-** (minus) buttons to the left and right of the numerical value.

- ▶ Tap **+** or **-** until the desired value is displayed
- ▶ Long-press **+** or **-** to scroll through the values more quickly
- \> The selected value is displayed

Toggle switch

Use the toggle switch to switch between functions.



- ▶ Tap the desired function
- > The active function is shown in green
- > The inactive function is shown in light gray

Slide switch

With the sliding switch, you can activate or deactivate a function.

- ▶ Drag the slider to the desired position

or

- ▶ Tap the slider
- > The function is activated or deactivated

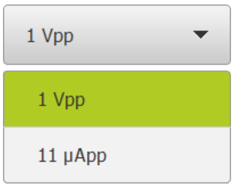
Slider

Use the slider (horizontal or vertical) to continuously adjust values.

- ▶ Drag the slider to the desired position
- > The selected value is displayed graphically or in percent

Drop-down list

Buttons that open drop-down lists are indicated by a triangle pointing down.

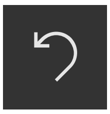


- ▶ Tap the button
- > The drop-down list opens
- > The active entry is highlighted in green
- ▶ Tap the desired entry
- > The selected entry is applied

Undo

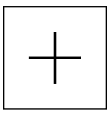
With this button, you can undo the last action.

Processes that have already been concluded cannot be undone.



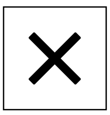
- ▶ Tap **Undo**
- > The last action is undone

Add



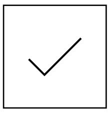
- ▶ To add a feature, tap **Add**
- > The new feature is added

Close



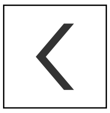
- ▶ Tap **Close** to close a dialog

Confirm



- Tap **Confirm** to conclude an activity

Back



- Tap **Back** to return to the higher level in the menu structure

6.4 QUADRA-CHEK 3000 – switch-on and switch-off

6.4.1 Switching on the QUADRA-CHEK 3000

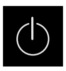
> Before using the product, you need to perform the commissioning and setup steps. Depending on the purpose of use, you may have to configure additional setup parameters.
>
> **Further information:** "Commissioning", Page 135

- Turn the power switch on
  The power switch is located on the rear side of the product
- > The unit powers up. This can take a moment
- > If automatic user login is active and the last user who logged in was of the **Operator** type, the user interface opens with the **Measure** menu
- > If automatic user login is not active, the **User login** menu is displayed
  Further information: "User login and logout", Page 71

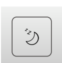
6.4.2 Activating and deactivating the energy saving mode

If you will not be using the unit for a while, you should activate the energy-saving mode. This switches the unit to an inactive state without interrupting the power supply. The screen is switched off in this state.

Activating energy-saving mode



- Tap **Switch off** in the main menu



- Tap **Energy-saving mode**
- > The screen switches off

Deactivating energy-saving mode

- Tap anywhere on the touchscreen
- > An arrow appears at the bottom of the screen
- Drag the arrow up
- > The screen is switched on and shows the user interface last displayed

6.4.3 Switching off the QUADRA-CHEK 3000

NOTICE

Damage to the operating system!

Disconnecting the power source while the product is on can damage the operating system of the product.

- Use the **Switch-off** menu to shut down the product
- Do not disconnect the power source while the product is on
- Do not turn the power switch off until the product has shut down

- Tap **Switch off** in the main menu

- Tap **Shut down**
- > The operating system shuts down
- Wait until the following message appears on the screen: **You can switch off the device now.**
- Turn the power switch off

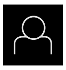
6.5 User login and logout

In the **User login** menu, you can log in and out of the product as a user.

Only one user can be logged in to the product at a time. The logged-in user is displayed. Before a new user can log in, the logged-in user has to log out.

The product provides various authorization levels that grant the user full or restricted access to management and operation functionality.

6.5.1 User login



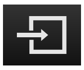
- Tap **User login** in the main menu
- Select the user in the drop-down list
- Tap the **Password** input field
- Enter the user's password

User	Default password	Target group
OEM	oem	Commissioner, machine tool builder
Setup	setup	Setup engineer, system configurer
Operator	operator	Operator

Further information: "Logging in for Quick Start", Page 242

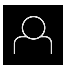
> If the password does not match the default password, ask a **Setup** user or **OEM** user for the assigned password.
>
> If the password is no longer known, contact a HEIDENHAIN service agency.

- Confirm entry with **RET**



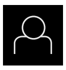
- Tap **Log in**
- > The user is logged in and the **Measure** menu is displayed

The user login icon in the main menu shows whether the logged-in user has extended authorizations.

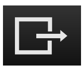
Icon	Authorization level
	Standard authorizations (user type **operator**)
	Extended authorizations (all other user types)

Further information: "Target groups according to user types", Page 24

6.5.2 User logout



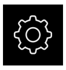
- Tap **User login** in the main menu



- Tap **Log out**
- > The user is logged out
- > All functions of the main menu are inactive, except for **Switch off**
- > The product can only be used again after a user has logged in

6.6 Setting the language

The user interface language is English. You can change to another language, if desired.



- Tap **Settings** in the main menu

- Tap **User**
- > The logged-in user is indicated by a check mark
- Select the logged-in user
- > The language selected for the user is indicated by a national flag in the **Language** drop-down list
- Select the flag for the desired language from the **Language** drop-down list
- > The user interface is displayed in the selected language

6.7 Performing the reference mark search after startup

> If the reference mark search after unit start is active, then all of the unit's functions will be disabled until the reference mark search has been successfully completed.
>
> **Further information:** "Reference marks (Encoder)", Page 515

> The reference mark search does not need to be performed for serial encoders with EnDat interface, because the axes are automatically homed.

If the reference mark search is active on the unit, then a wizard will ask you to traverse the reference marks of the axes.

- After logging in, follow the instructions of the wizard
- > The Reference symbol stops blinking upon successful completion of the reference mark search

Further information: "Operating elements of the position display", Page 117

Further information: "Activating the reference mark search", Page 143

6.8 User interface

6.8.1 User interface after switch-on

Factory default user interface

The illustration shows the user interface the way it looks when you switch on the product for the first time.

This user interface will also be displayed after the product has been reset to its factory default settings.

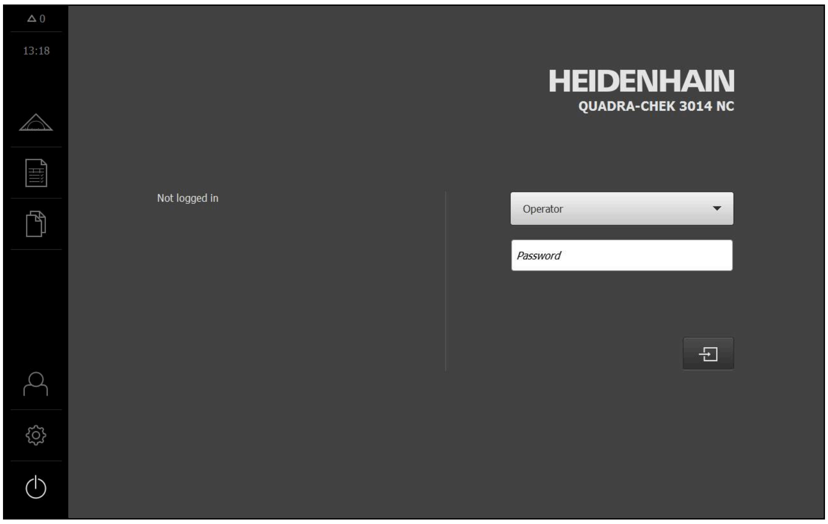


Figure 10: The user interface in the product’s factory default setting

User interface after startup

If automatic user login is activated, and the last user who logged in was of the **Operator** type, then the product displays the **Measure** menu with the workspace and the Inspector after starting up.

Further information: "Measure menu", Page 76

If automatic user login is not activated, then the product opens the **User login** menu.

Further information: "User login menu", Page 86

6.8.2 Main menu of the user interface

User interface with the QUADRA-CHEK 3000 VED software option

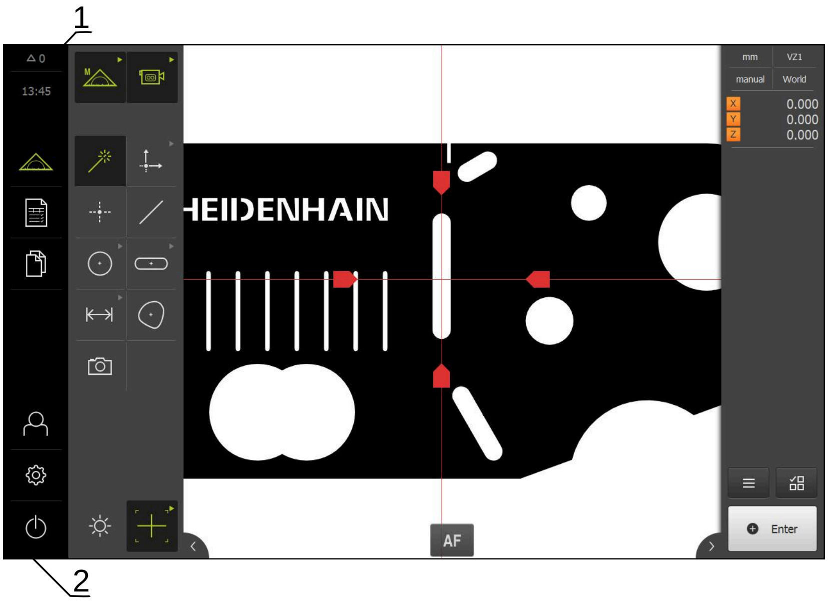
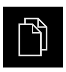


Figure 11: User interface with the QUADRA-CHEK 3000 VED software option

1 Message display area, which displays the time and the number of unclosed messages
2 Main menu with controls for controlling and configuring the product

Main menu operating elements

Control	Function
	**Message** Display of an overview of all messages as well as the number of messages that have not been closed **Further information:** "Messages", Page 132
	**Measure** Manual measurement, construction, or definition of features by means of measuring programs and predefined geometries **Further information:** "Measure menu", Page 76
	**Measurement report** Creation of measurement reports based on templates; creation and management of measurement report templates **Further information:** "Measurement report menu", Page 84
	**File management** Management of the files that are available on the product **Further information:** "File management menu", Page 85

Control	Function
	User login Login and logout of the user **Further information:** "User login menu", Page 86 If a user with additional permissions (Setup or OEM user type) is logged in, then the gear symbols appears.
	Settings Settings of the product, such as setting up users, configuring sensors, or updating the firmware **Further information:** "Settings menu", Page 87
	Switch-off Shutdown of the operating system or activation of power-saving mode **Further information:** "Switch-off menu", Page 88

6.8.3 Measure menu

Activation

- Tap **Measure** in the main menu
- > The user interface for measuring, constructing, and defining is displayed

Measure menu without software option

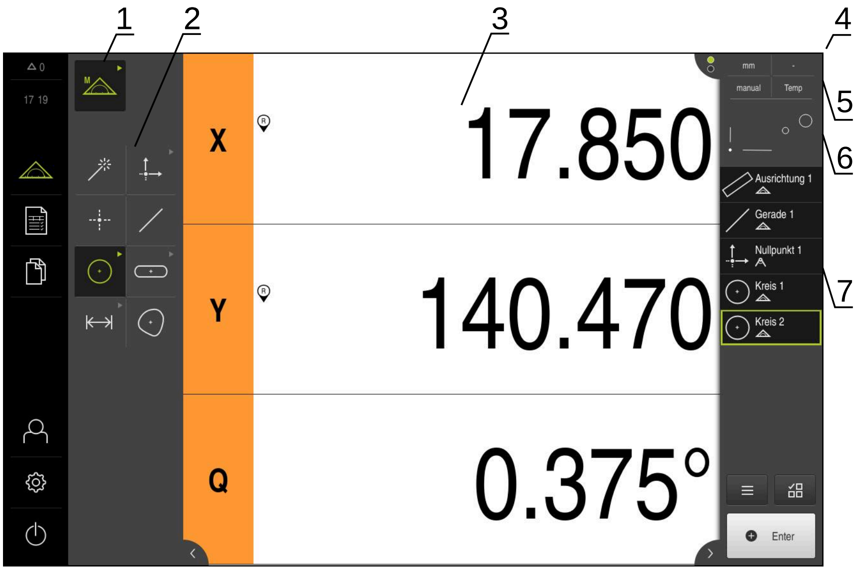


Figure 12: **Measure** menu without software option

1 Function palette providing functions for manual measuring and defining
2 Geometry palette from which you can select the geometry to be measured, constructed, or defined
3 Workspace, e.g. with actual position display (current axis position) or features view (graphical representation)
4 Inspector (includes 5, 6, 7)
5 Quick access menu for basic settings
6 Preview of the view currently not displayed in the workspace (position preview or features preview)
7 Feature list (measured, constructed, and defined features) or program step list (current measuring program)

Measure menu with QUADRA-CHEK 3000 VED software option

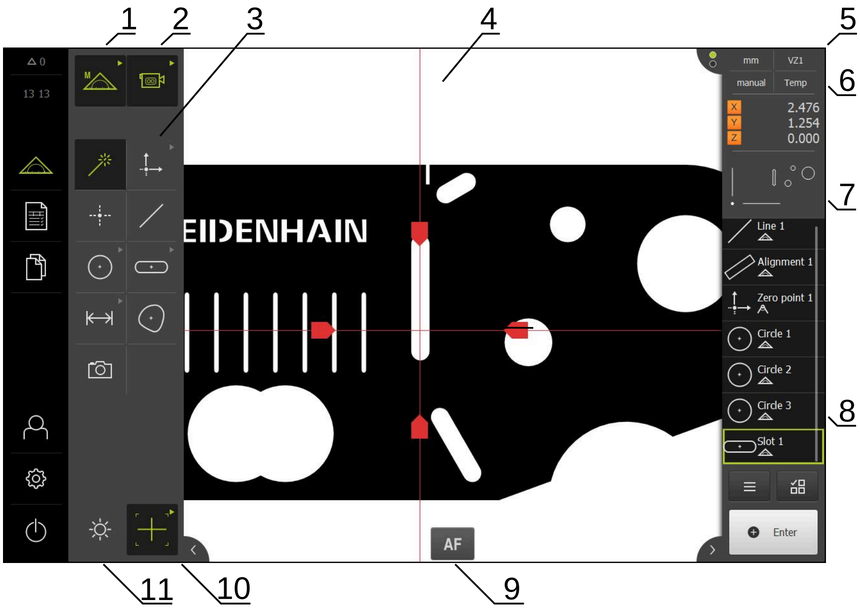


Figure 13: **Measure** menu with QUADRA-CHEK 3000 VED software option

1 Function palette providing functions for manual measuring and defining
2 Sensor palette from which you can select the sensor for measuring point acquisition (software option)
3 Geometry palette from which you can select the geometry to be measured, constructed, or defined
4 Workspace, e.g. with live image or features view (graphical representation)
5 Inspector (includes 6, 7, 8)
6 Quick access menu for basic settings
7 Preview of the views currently not displayed in the workspace (live image preview, position preview, or features preview)
8 Feature list (measured, constructed, and defined features) or program step list (current measuring program)
9 Controls and settings specific to the selected sensor or measuring tool, e.g. Autofocus (software option)
10 Tool palette for selecting and configuring the measuring tool (sensor-specific)
11 Lighting palette providing settings for lighting adjustment (sensor-specific)

Measure menu with QUADRA-CHEK 3000 OED software option

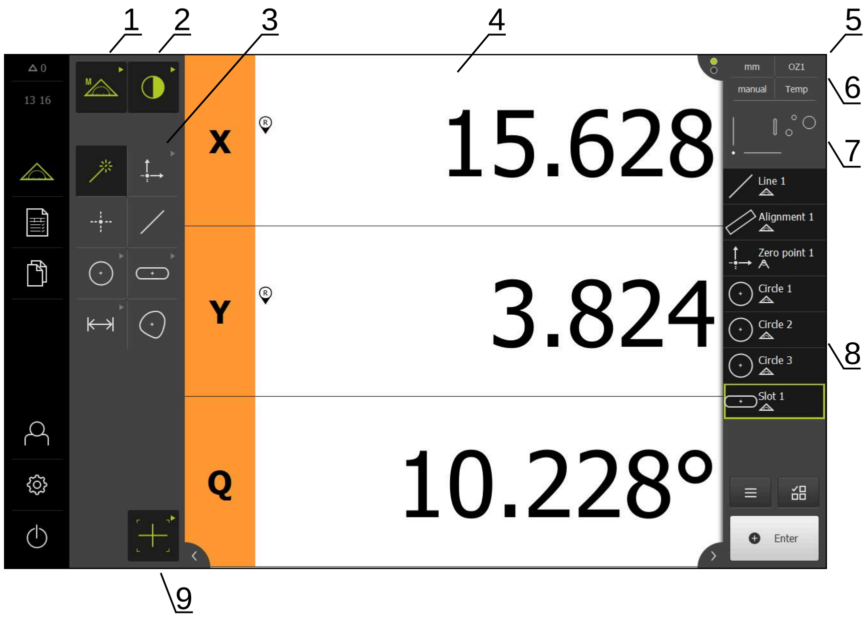


Figure 14: **Measure** menu with QUADRA-CHEK 3000 OED software option

1 Function palette providing functions for manual measuring and defining
2 Sensor palette from which you can select the sensor for measuring point acquisition (software option)
3 Geometry palette from which you can select the geometry to be measured, constructed, or defined
4 Workspace, e.g. with actual position display (current axis position) or features view (graphical representation)
5 Inspector (includes 6, 7, 8)
6 Quick access menu for basic settings
7 Preview of the view currently not displayed in the workspace (position preview or features preview)
8 Feature list (measured, constructed, and defined features) or program step list (current measuring program)
9 Tool palette for selecting and configuring the measuring tool (sensor-specific)

Measure menu with QUADRA-CHEK 3000 3D software option

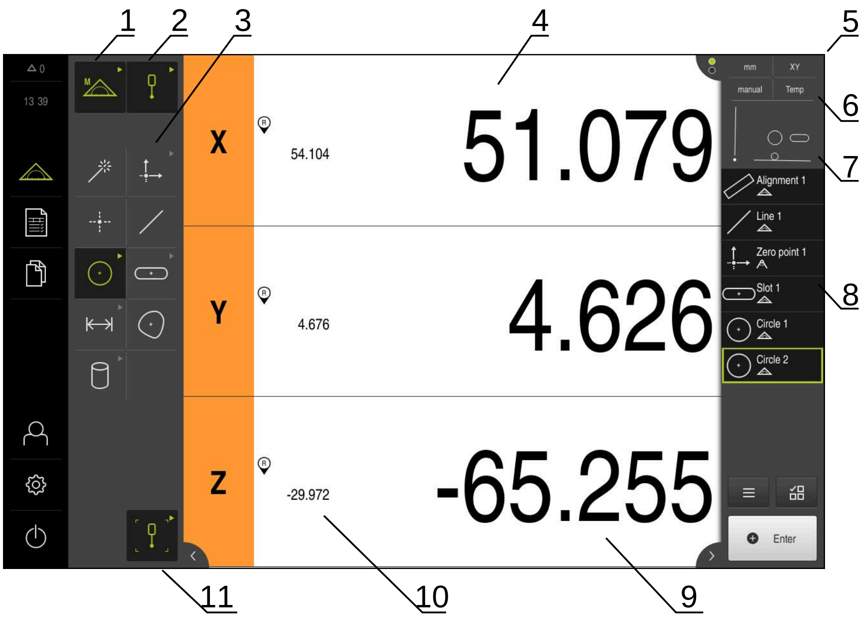


Figure 15: **Measure** menu with QUADRA-CHEK 3000 3D software option

1 Function palette providing functions for manual measuring and defining
2 Sensor palette from which you can select the sensor for measuring point acquisition (software option)
3 Geometry palette from which you can select the geometry to be measured, constructed, or defined
4 Workspace, e.g. with position display (axis position) or features view (graphical representation)
5 Inspector (includes 6, 7, 8)
6 Quick access menu for basic settings
7 Preview of the view currently not displayed in the workspace (position preview or features preview)
8 Feature list (measured, constructed, and defined features) or program step list (current measuring program)
9 Current axis position
10 Position of the last measuring point
11 The tool palette allows you to select and calibrate the stylus (sensor-specific)

Function palette

In the function palette, you can select the function to be used for creating a new feature.

Selecting the function

- ▶ Tap the control showing the current function, e.g. **Manual measuring**
- > The function palette displays the available functions
- ▶ Select the desired function

Controls of the function palette

Manual measuring	Defining
	

Further information: "Manual measuring function", Page 88

Further information: "The Define function", Page 116

Sensor palette (software option)

The sensor palette allows you to select the sensor to be used for measuring point acquisition. If only one sensor is available, it will be selected automatically.

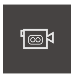
Prerequisites

- The sensor is connected to the product
- The corresponding software option has been enabled

Selecting the sensor

- ▶ Tap the control showing the current sensor, e.g. **VED sensor**
- > The sensor palette displays the available sensors
- ▶ Select the desired sensor
- > The sensor is activated
- > The geometry palette and the sensor-specific tool palette are displayed

Controls of the sensor palette

Video edge detection (VED)	Optical edge detection (OED)	Touch probe (TP)
		

Further information: "Controls for measuring with an OED sensor", Page 110
Further information: "Controls for measuring with a VED sensor", Page 89
Further information: "Controls for measuring with a TP sensor", Page 113

> Changing sensors during a measuring task (multi-sensor function) is currently not supported.
> - To avoid measuring errors, always use the same sensor for all steps of a measuring task

Geometry palette

The geometry palette allows you to select the geometry to be measured, constructed, or defined. As an alternative, you can use the automatic geometry detection function called **Measure Magic**. The geometries available on the geometry palette depend on the selected function and the activated sensor.

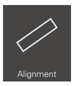
Selecting geometry

Some geometries are grouped. Grouped controls are identified by an arrow.

- If a control is grouped, tap the control that shows an arrow
- > All controls of the group are available for selection
- Select the desired geometry

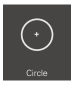
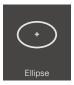
Controls of the geometry palette

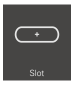
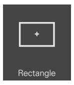
Measure Magic

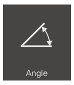

Zero point	Alignment	Reference plane	
			Prerequisite for **Reference plane**: The Z axis must have been configured

Point

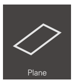

Line


Circle	Arc	Ellipse
		

Slot	Rectangle
	

Distance	Angle
	

Blob


Plane	Sphere	Cone	Cylinder
			

Prerequisite for **Plane**, **Sphere**, **Cone**, **Cylinder**: The TP sensor has been activated (software option)

Snapshot	
	Prerequisite for **Snapshot**: The VED sensor has been activated (software option)

Tool palette (sensor-specific)

In the tool palette, select the measuring tool to be used for the measuring point acquisition. Each sensor has its own tool palette. In the **Measuring tool settings** dialog box of the tool palette, you can configure measuring tools.

Prerequisites

- A sensor must have been activated (software option)

Selecting the measuring tool

- ▶ Tap the control showing the current measuring tool, e.g. the crosshairs or the stylus
- > The tool palette shows all of the available measuring tools and the **Measuring tool settings** dialog box
- ▶ Select the desired measuring tool
- ▶ Change the measuring tool settings, if required
- ▶ Tap **Close**
- > Your changes are applied

Further information: "Overview of the VED measuring tools", Page 90
Further information: "Overview of the OED measuring tools", Page 111
Further information: "Overview of the TP measuring tools", Page 113

6.8.4 Measurement report menu

Activation

- Tap **Measurement report** in the main menu
- > The user interface for displaying and creating the measurement reports appears

Short description

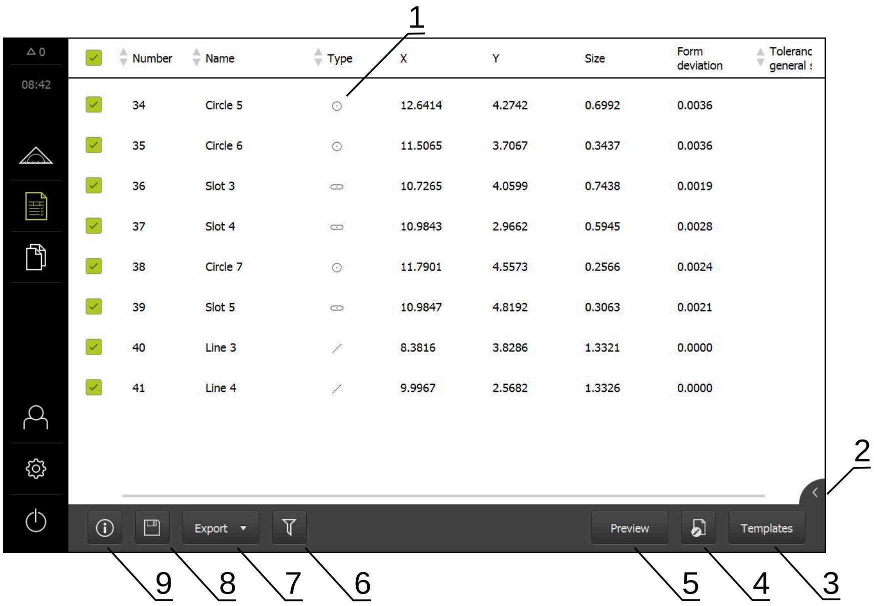


Figure 16: **Measurement report** menu

1 List of measured features and their properties
2 Opens the features preview
3 Displays the measurement report templates
4 Edit the current template
5 Print preview of the current measurement report
6 Filter for the list of measured features
7 Exports the current measurement report
8 Saves the current measurement report
9 Display information on the current report

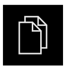
The **Measurement report** menu shows a list of the measured features, depending on the selected measurement report template.

In the **Measurement report** menu, you can select the contents and template to be used for your measurement reports. Measurement reports can be saved, exported, and printed. In the template editor, you can edit measurement report templates and create custom templates.

Further information: "Measurement reports", Page 433

6.8.5 File management menu

Calling up



- Tap **File management** in the main menu
- > The file management user interface is displayed

Short description

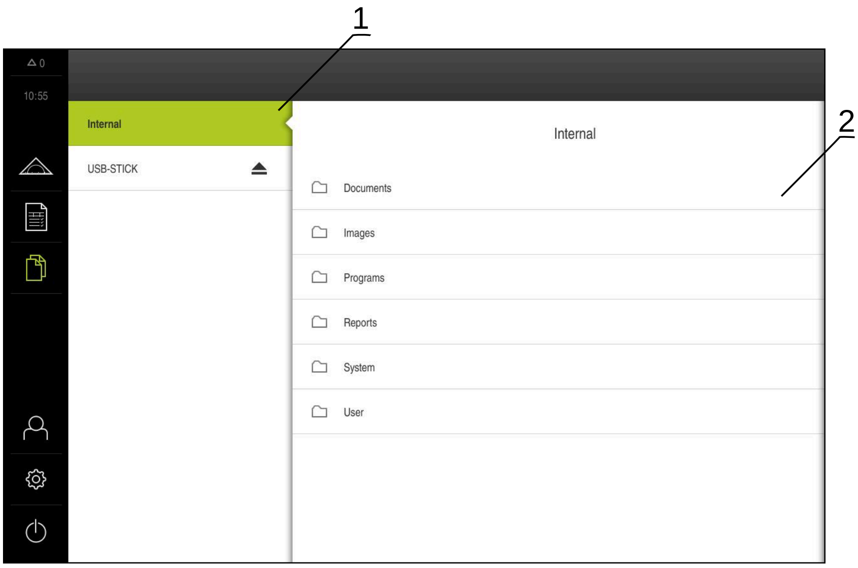


Figure 17: **File management** menu

1 List of available storage locations
2 List of folders in the selected storage location

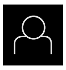
The **File management** menu shows an overview of the files stored in the product's memory.

Any connected USB mass storage products (FAT32 format) or available network drives are shown in the list of storage locations. The USB mass storage products and the network drives are displayed with their name or drive designation.

Further information: "File management", Page 451

6.8.6 User login menu

Calling up



- Tap **User login** in the main menu
- \> The user interface for user login and logout is displayed

Short description

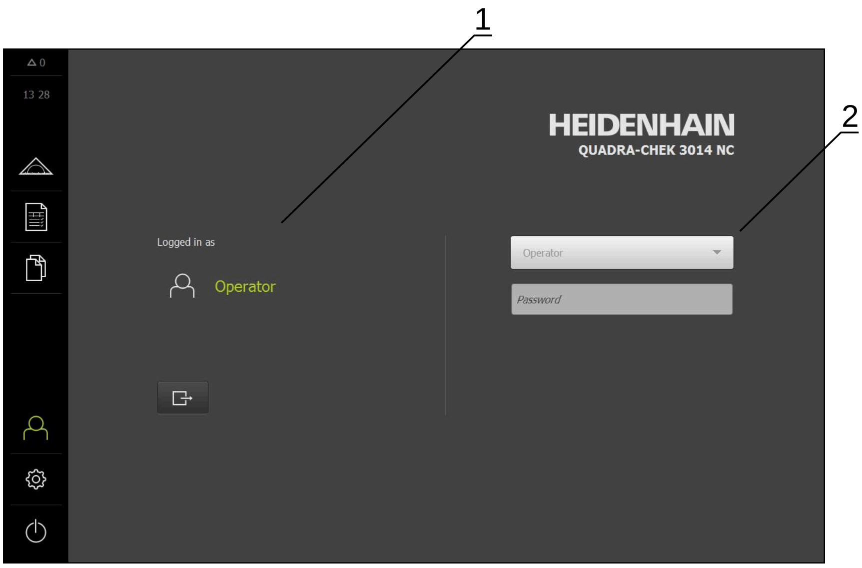


Figure 18: **User login** menu

1 Display of the logged-in user
2 User login

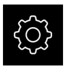
The **User login** menu shows the logged-in user in the column on the left. The login of a new user is displayed in the right-hand column.

To log in another user, the logged-in user must first log out.

Further information: "User login and logout", Page 71

6.8.7 Settings menu

Calling up



- ▶ Tap **Settings** in the main menu
- > The user interface for the product settings is displayed

Short description

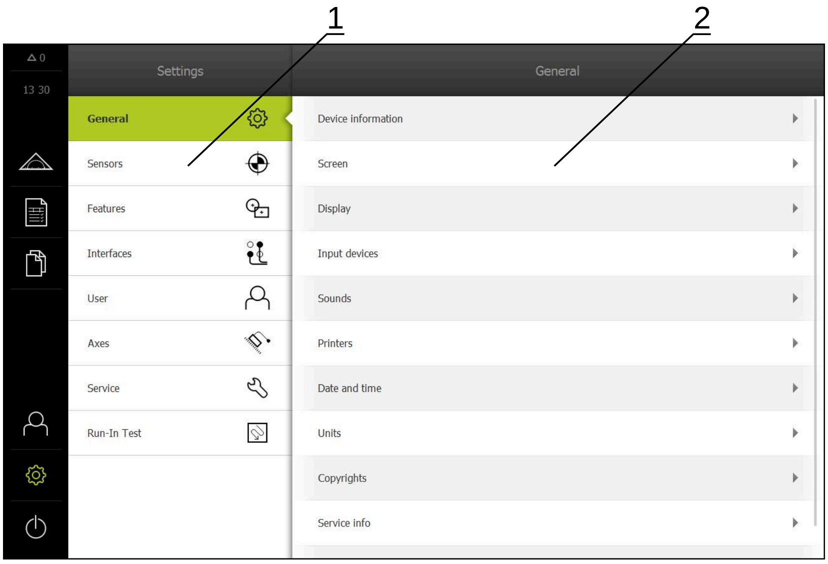


Figure 19: **Settings** menu

1 List of setting options
2 List of setting parameters

The **Settings** menu shows all of the options for configuring the product. With the setting parameters, you can adapt the product to on-site requirements.

Further information: "Settings", Page 459

> The product provides various authorization levels that grant the user full or restricted access to management and operation functionality.

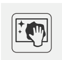
6.8.8 Switch-off menu

Activation

- ▶ Tap **Switch off** in the main menu
- > The operating elements for shutting down the operating system, for activating the energy-saving mode and for activating the cleaning mode are displayed

Short description

The **Switch off** menu provides the following options:

Operating element	Function
	**Shut down** Shuts down the operating system
	**Energy saving mode** Switches the screen off and puts the operating system into energy-saving mode
	**Cleaning mode** Switches the screen off; the operating system continues unchanged

Further information: "QUADRA-CHEK 3000 – switch-on and switch-off", Page 70

Further information: "Cleaning the screen", Page 526

6.9 Manual measuring function

With the **Manual measuring** function, you can perform the following operations on a feature:

- Measure, i.e. create from acquired measuring points
- Construct, i.e. create from existing features

> ℹ For a detailed description of the individual activities, please refer to the "Measuring" chapter and to the following chapters.

6.9.1 Measuring features

To measure a contour, such as a circle, acquire measuring points distributed on the contour. Depending on the type of geometry selected, a certain number of measuring points must be acquired. The positions of these measuring points refer to the coordinate system selected on the product. The product calculates a new feature from the acquired measuring points (point cloud).

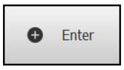
To acquire measuring points manually, e.g. by using crosshairs at the measuring microscope or profile projector, proceed as follows:

▶ Tap **Measure** in the main menu

▶ Select **Manual measuring** in the function palette

▶ Select the desired geometry in the geometry palette e.g. **Circle**

▶ On the measuring machine, move to the desired position on the measured object

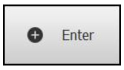


▶ To acquire the measuring point, tap **Enter** in the Inspector

> A new feature is added to the feature list. The symbol of the feature corresponds to the selected geometry

> The number of acquired measuring points is shown next to the symbol

▶ Move to next measuring point



▶ To acquire the measuring point, tap **Enter** in the Inspector

▶ To acquire more measuring points, repeat these steps

> When the minimum number of measuring points for the selected geometry has been reached, the **Finish** button appears in the new feature

▶ Tap **Finish** to complete the measuring point acquisition

> The feature is calculated based on the acquired measuring points

> The measurement result preview appears

6.9.2 Measurement with a sensor

For measuring point acquisition, you can use the following sensors on the measuring machine:

- VED sensor, e.g. a camera (QUADRA-CHEK 3000 VED software option)
- OED sensor, e.g. an optical waveguide (QUADRA-CHEK 3000 OED software option)
- TP sensor, e.g. a touch probe (QUADRA-CHEK 3000 3D software option)

Once a sensor is activated, the associated measuring tools (tool palette) and, if applicable, other controls are available.

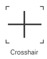
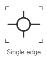
6.9.3 Controls for measuring with a VED sensor

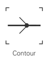
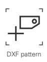
Prerequisites

- The VED sensor has been activated (software option)
- A live image is displayed in the workspace

Overview of the VED measuring tools

If a VED sensor is active, the tool palette includes the following measuring tools.

Control	Measuring tool	Functions and characteristics
	Crosshair	■ Manual acquisition of single measuring points ■ No automatic acquisition of light-to-dark transitions ■ Zoom function available for pixel-precise positioning ■ Alignment and position adjustable
	Single edge	■ Active measuring tool ■ Automatic acquisition of single measuring points ■ Acquisition of light-to-dark transitions ■ Size of search range adjustable ■ Alignment and position adjustable ■ Supports measuring point detection (CF)
	Circle	■ Active measuring tool ■ Automatic acquisition of multiple measuring points, e.g. on circles and circular arcs ■ Acquisition of light-to-dark transitions ■ Size of search range adjustable ■ Scan direction adjustable ■ Search range angle adjustable ■ Position adjustable ■ Supports measuring point detection (CF)
	Buffer	■ Active measuring tool ■ Automatic acquisition of multiple measuring points at edges ■ Acquisition of light-to-dark transitions ■ Size of search range adjustable ■ Alignment and position adjustable ■ Supports measuring point detection (CF)

Control	Measuring tool	Functions and characteristics
	Contour	■ Active measuring tool ■ Automatic acquisition of multiple measuring points at contours ■ Acquisition of light-to-dark transitions ■ Independent positioning of the start and end points of the search range ■ Size of search range adjustable ■ Scan direction adjustable ■ Alignment and position adjustable ■ Supports measuring point detection (CF)
	DXF template	■ Visual comparison of contours between template and measured object ■ No automatic acquisition of light-to-dark transitions ■ Manual and automatic orientation and positioning adjustable
	Auto contour	■ Active measuring tool ■ Captures all closed contours in the live image of the camera or within a search area ■ Automatic acquisition of multiple measuring points at contours ■ Acquisition of light-to-dark transitions ■ Size of search area adjustable

Further information: "Using VED measuring tools", Page 92

Using VED measuring tools

Moving an image section

The live image can be moved within the field of view because the field of view of the camera image is usually larger than the image section in the workspace.

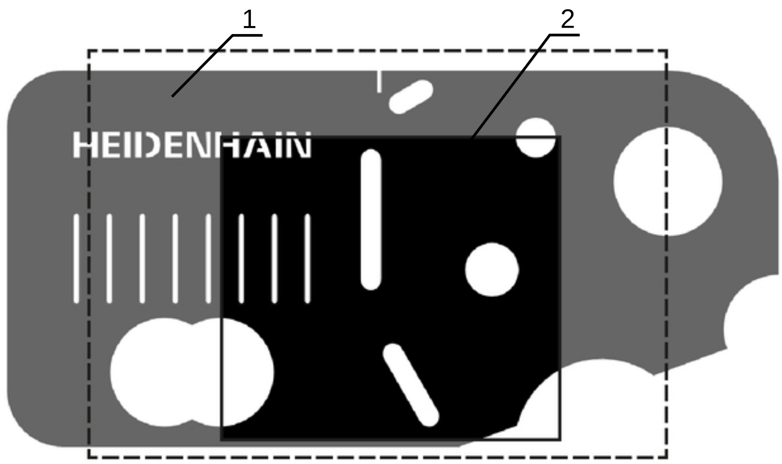


Figure 20: Field of view of the camera and detail of the live image

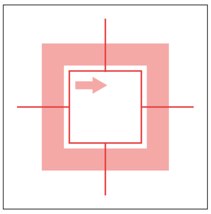
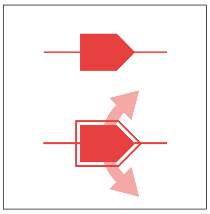
1 Field of view of the camera
2 Image section (live image)

- ▶ In the workspace, drag the image section with two fingers to the desired position

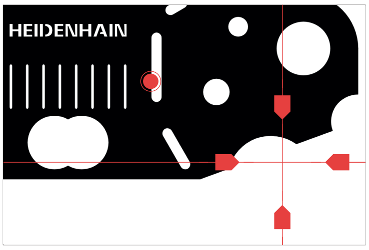
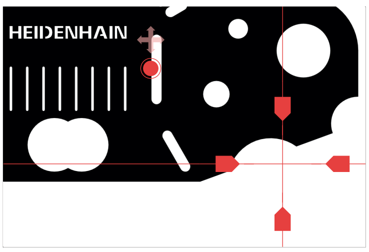
- ▶ In the workspace, drag the image section with the right mouse button to the desired position
- > The image section is moved within the camera's field of view

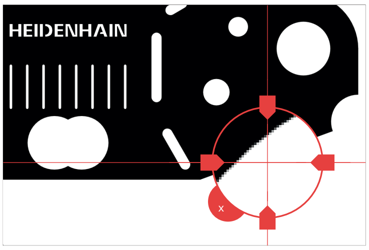
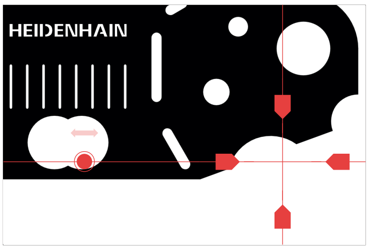
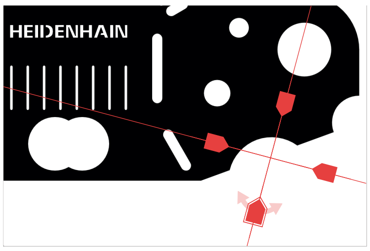
Search area and handle

If you select a measuring tool in the tool palette, the measuring tool is displayed in the live image. You can adjust the search area and alignment of the measuring tool by using the following controls at the contours of the measured object.

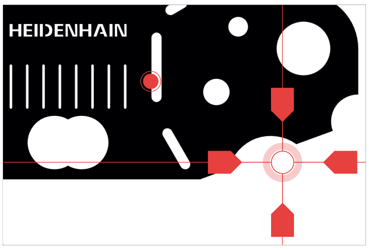
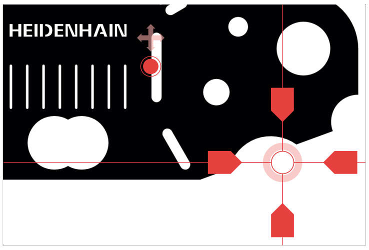
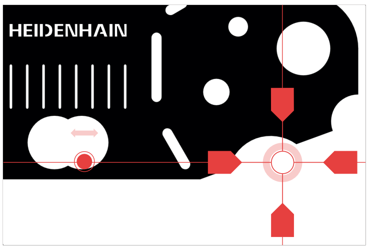
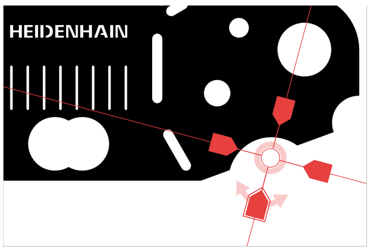
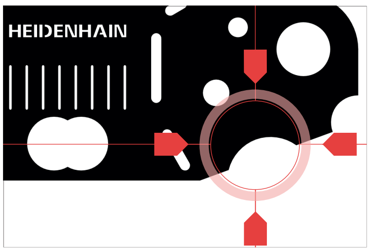
Image	Meaning
	**Search area** The following measuring tools have an edge that indicates the search area of the tool: ■ Single **edge** ■ **Circle** ■ **Buffer** ■ **Auto contour** The edge of the **Contour** measuring tool indicates the end point of measuring point acquisition. The scan direction of the search area is indicated by an arrow, if appropriate.
	**Handles** The handles are located on the edge or the axes of the measuring tools. Active handles are shown with an outline around the handle. The direction of motion of the active handle is indicated by arrows next to the handle.

Crosshairs

Display	Activity
	**Relocating the crosshairs** ▶ Tap the desired position in the live image ▶ Double-click the desired position in the live image with the left mouse button > The crosshairs jump to the selected position
	**Shifting the crosshairs** ▶ Touch a place in the live image and drag the crosshairs to the desired position

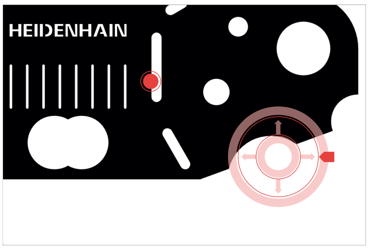
Display	Activity
	**Zooming** To precisely position the measuring tool, you can use the zoom function to magnify the immediate vicinity of the crosshairs.  ▶ Long-press the crosshairs or their vicinity  ▶ Double-click the live image with the right mouse button ▶ Drag the magnifying glass with the crosshairs to the desired position > The crosshairs move with motion reduction ▶ To exit the zoom function, tap **X** on the edge of the magnifying glass You can change the motion reduction of the zoom function in the settings of the measuring tool.
	**Moving the crosshairs in an axis** ▶ Touch an axis of the crosshairs and drag the crosshairs along the axis to the desired position > The crosshairs move with motion reduction
	**Aligning the crosshairs** ▶ Touch a handle of the crosshairs and drag the crosshairs to the desired orientation

Single edge

Display	Activity
	**Relocating the single edge**  ▶ Tap the desired position in the live image  ▶ Double-click the desired position in the live image with the left mouse button > The single edge jumps to the selected position
	**Shifting the single edge** ▶ Touch a place in the live image and drag the single edge to the desired position
	**Moving the single edge in an axis** ▶ Touch an axis of the single edge and drag the single edge along the axis to the desired position > The single edge moves with motion reduction
	**Aligning the single edge** ▶ Touch a handle of the single edge and drag the single edge to the desired orientation
	**Resizing the search range** ▶ Touch the edge of the search range and drag it to the desired size

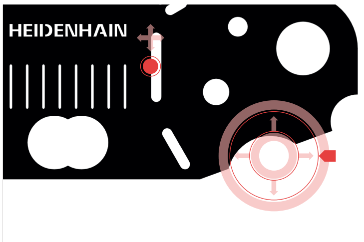
Circle

Display | **Activity**



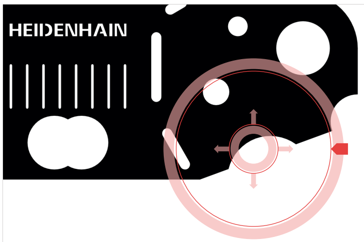
Relocating the circle

- ▶ Tap the desired position in the live image
- ▶ Double-click the desired position in the live image with the left mouse button
- > The circle jumps to the selected position



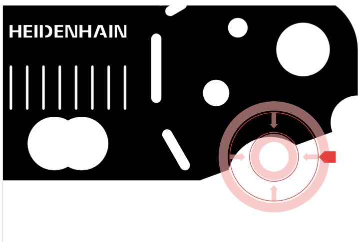
Shifting the circle

- ▶ Touch a place in the live image and drag the circle to the desired position



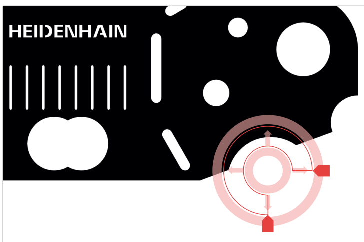
Resizing the search range

- ▶ Touch the outer edge of the search range and drag it to the desired size
- > The size of the inner edge changes proportionally
- ▶ Touch the inner edge of the search range and drag it to the desired size



Reversing the scan direction of the search range

- ▶ Touch the inner edge of the search range and drag it over the outer edge
- > The arrows indicate the changed scan direction

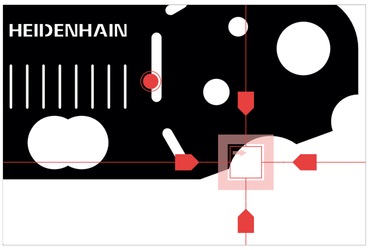
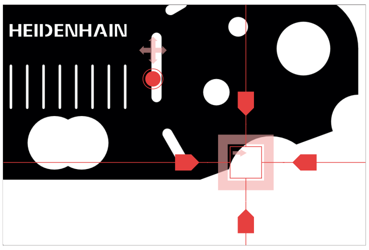
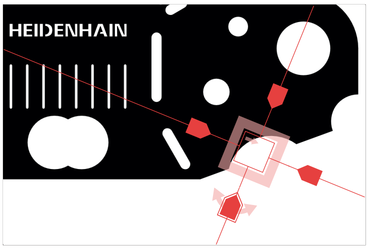
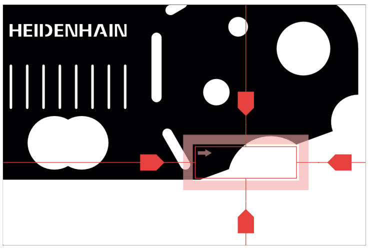


Adjusting the search range angle

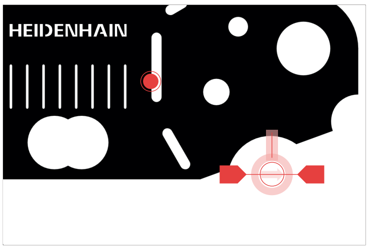
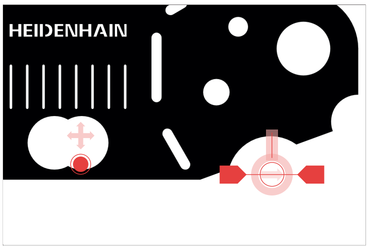
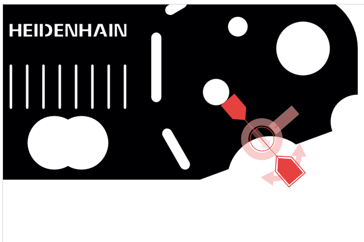
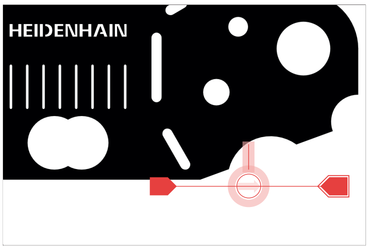
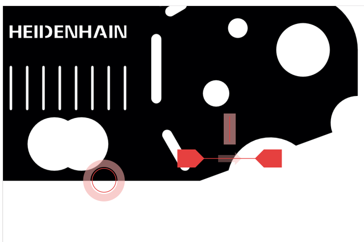
To limit the search range, you can adjust the search range angle. This makes it possible, for example, to capture measuring points on circular arcs.

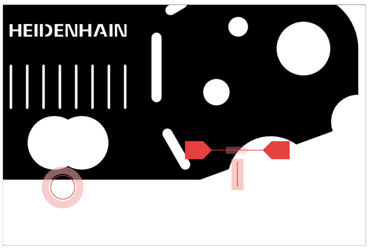
- ▶ Touch the handle of the circle and drag the handle along the outer edge
- > The search range is inside the circular arc delimited by the handles

Buffer

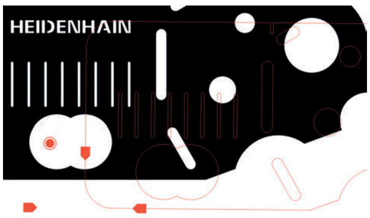
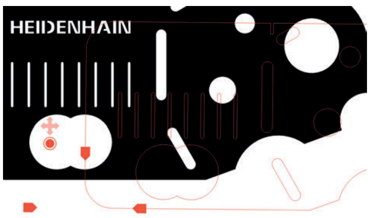
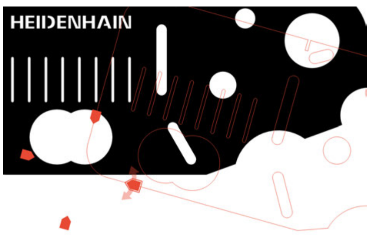
Display	Activity
	**Relocating the buffer**  ▶ Tap the desired position in the live image  ▶ Double-click the desired position in the live image with the left mouse button > The buffer jumps to the selected position
	**Shifting the buffer** ▶ Touch a place in the live image and drag the buffer to the desired position
	**Aligning the buffer** ▶ Touch a handle of the buffer and drag the buffer to the desired orientation
	**Resizing the search range** ▶ Touch the edge of the search range and drag it to the desired size > The search range is changed along the axis at an equal distance from the center

Contour

Display	Activity
	**Relocating the contour**  ▶ Tap the desired position in the live image  ▶ Double-click the desired position in the live image with the left mouse button > The contour jumps to the selected position
	**Shifting the contour** ▶ Touch a place in the live image and drag the contour to the desired position
	**Aligning the contour** ▶ Touch a handle of the contour and drag the contour to the desired orientation
	**Resizing the contour** ▶ Touch a handle of the contour and drag the contour to the desired size > The contour is changed along the axis at an equal distance from the center
	**Separating start point and end point** To measure a contour, you can separate the start point and the end point of measuring point acquisition. The measuring points are acquired between the contour and the edge of the circle, depending on the search direction. ▶ Touch the search range (circle) and drag it to the desired position > The position of the contour remains unchanged

Display	Activity
	**Adjusting the search direction** The indicator at the contour shows the search direction along the measured object for the acquisition of measuring points. The measuring points are acquired between the contour as the start point and the circle as the end point. ▶ Touch the indicator at the contour and drag the indicator to the other side of the contour > The search direction of the measuring point acquisition is changed

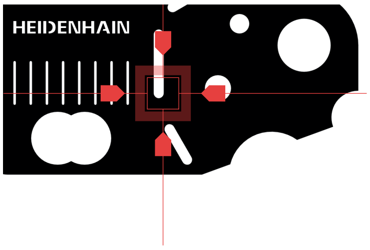
DXF template

Display	Activity
	**Displacing the template**  ▶ Tap the desired position in the live image  ▶ Double-click the desired position in the live image with the left mouse button > The template jumps to the selected position
	**Moving the template** ▶ Touch a place in the live image and drag the template to the desired position
	**Aligning the template** ▶ Touch a handle of the template and drag the template to the desired orientation

Auto contour

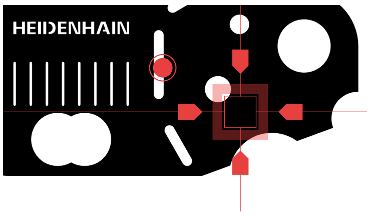
The **Auto contour** measuring tool captures any closed contours that are located within a defined search area or the entire live image of the camera. Detected contours are displayed with a green outline.

Image | **Activity**



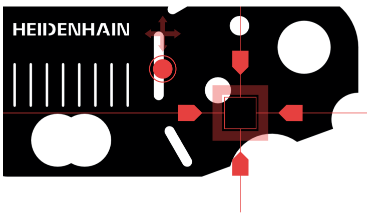
Displaying the search area

- ▶ To limit the search area, tap **Search area** in the workspace
- > The search area is displayed
- > Contours that are completely enclosed in the search area are displayed with a green outline and will be included in the measurement
- ▶ To include all measured objects in the live image of the camera, tap **Search area** again
- > The search area is hidden
- > Contours that are completely located within the live image of the camera are displayed with a green outline and will be included in the measurement



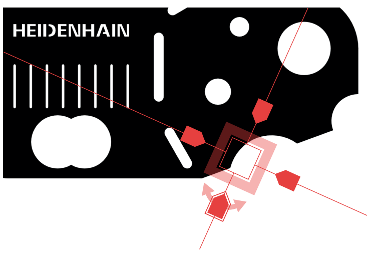
Offsetting the search area

- ▶ Tap the desired position in the live image
- ▶ Double-click the desired position in the live image with the left mouse button
- > The search area is moved to the selected position



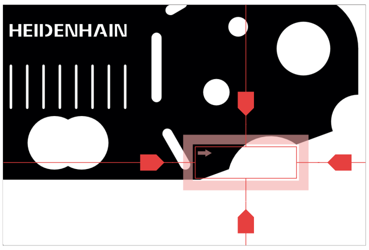
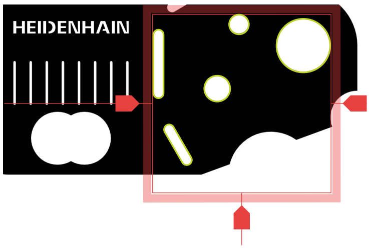
Moving the search area

- ▶ Touch a position in the live image and drag the search area to the desired position



Aligning the search area

- ▶ Touch a handle of the search area and drag the search area to the desired orientation

Image	Activity
	**Resizing the search area** ▶ Touch the edge of the search area and drag it to the desired size > The search area is resized along the axis at an equal distance from the search area center
	**Confirming the measuring point acquisition** Detected contours are displayed with a green outline in the live image ▶ To acquire a single feature, tap the contour outlined in green > The new feature is displayed in the feature list ▶ To acquire all features, tap **Enter** > The new features are displayed in the feature list

Configuring VED measuring tools

In the **Measuring tool settings** dialog, you can customize the settings for each measuring tool individually.

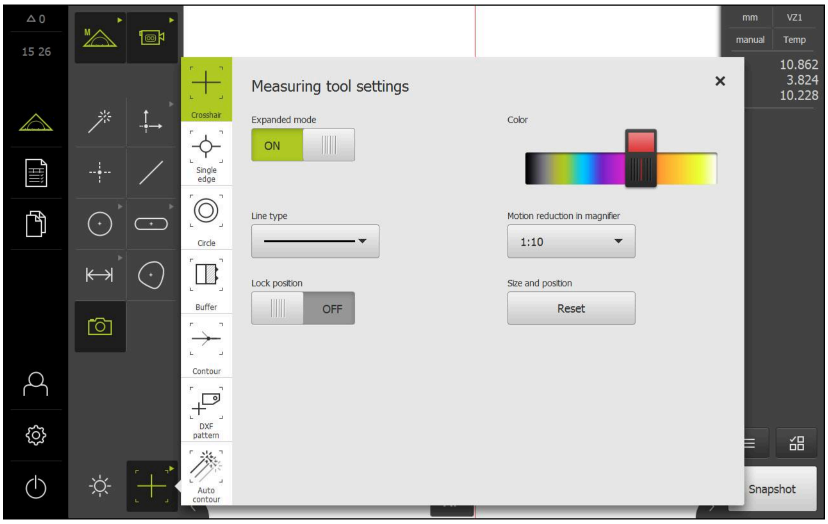
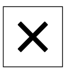
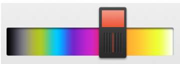
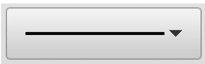


Figure 21: **Measuring tool settings** dialog for VED measuring tools

- ▶ Select the desired measuring tool in the **tool palette**
- > The **Measuring tool settings** dialog shows the available parameters for the selected measuring tool
- ▶ Change the settings as required



- ▶ Tap **Close** to close the dialog
- > Your changes are saved
- > The icon on the tool palette shows the current measuring tool

Control	Function	Available for
	**Expanded mode** Extension of crosshair, single edge and buffer **Crosshair:** The lines of the crosshair are extended to the edge of the workspace. The extensions can be used for alignment and for fine positioning with motion reduction. **Single edge:** The search area is extended with the crosshair. The expanded mode can be used for alignment and for fine positioning with motion reduction. **Buffer:** The search area is extended with the crosshair. The expanded mode can be used for alignment.	▪ Crosshair ▪ Single edge ▪ Buffer
	**Color** Color of the measuring tool.	All measuring tools
	**Line type** Line type of the measuring tool.	All measuring tools
	**Lock position** The measuring tool is fixed at the center of the workspace. The object of measurement must be positioned manually in the search area.	▪ Crosshair ▪ Single edge
	**Motion reduction in zoom** Motion reduction of the zoom function at a ratio of 1:10 or 1:5. Selecting 1:1 deactivates the motion reduction. The motion reduction applies to the movement of the zoom function in the live image. The motion reduction in zoom is independent of the motion reduction of the expanded mode.	▪ Crosshair
	**Maximum number of points to be measured** Maximum number of measuring points acquired with one entry (**Enter**).	▪ Circle ▪ Buffer
	**Number of points to be measured** Number of measuring points acquired with one entry (**Enter**).	▪ Contour

Control	Function	Available for
	ℹ **Number of points to be measured** is taken into account if the **Distance of points to be measured (pixel)** parameter is set to "**0**."	
– n +	**Distance of points to be measured (pixel)** Distance between the measuring points that are acquired with one entry (**Enter**).	▪ Contour ▪ Auto contour
– n +	**Minimum length of a contour (pixel)** Minimum length that a contour must have to be detected as a feature.	▪ Auto contour
– n +	**Frame rate for contour detection (fps)** Number of frames per second to be used for contour detection.	▪ Auto contour
– n +	**Buffer width for program playback (pixel)** Width of the additional search area. ℹ When running a measuring program, the search area around a contour is extended by the defined width.	▪ Auto contour
Select	**Selection of the DXF template** Selection of the DXF file compared with the object of measurement. The selected path is indicated above the selection button. ℹ The DXF file must contain no constructions consisting of splines.	▪ DXF template
mm inch	**Unit for DXF file** Setting of the unit of display for the **DXF template**. Millimeters and inches are available.	▪ DXF template
ON	**Align pattern** The template is aligned with the constructed zero point.	▪ DXF template

Control	Function	Available for
Reset	**Size and position** Depending on the selected measuring tool, the size, alignment, and position are reset to the default values. The default position is at the center of the camera's field of view.	■ Crosshair ■ Single edge ■ Circle ■ Buffer ■ Contour ■ DXF template ■ Auto contour

VED controls in the workspace

Depending on the selected measuring tool, further controls are available in the workspace.

Control	Function	Available for
	Contrast bar **Further information:** "Contrast bar", Page 105	■ Single edge ■ Circle ■ Buffer ■ Contour
	Edge detection mode **Further information:** "Edge detection mode", Page 104	■ Circle ■ Buffer ■ Contour
AF	**Autofocus (AF)** **Further information:** "Autofocus (software option)", Page 106	■ Crosshair ■ Single edge ■ Circle ■ Buffer ■ Contour
	Search area **Further information:** "Auto contour", Page 100	■ Auto contour
CF	**Measuring point detection** **Further information:** "Measuring point detection (CF)", Page 107	■ Single edge ■ Circle ■ Buffer ■ Contour

Edge detection mode

By selecting the edge detection mode, you can define the acquisition direction for light-to-dark transitions during automatic edge detection.

Control	Function	Available for
	■ Edge detection mode	■ Circle ■ Buffer ■ Contour
	■ Light-to-dark edge detection	
	■ Edge detection in both directions (automatic)	

Contrast bar

You can adjust the contrast threshold continuously using the **Contrast bar** slider.

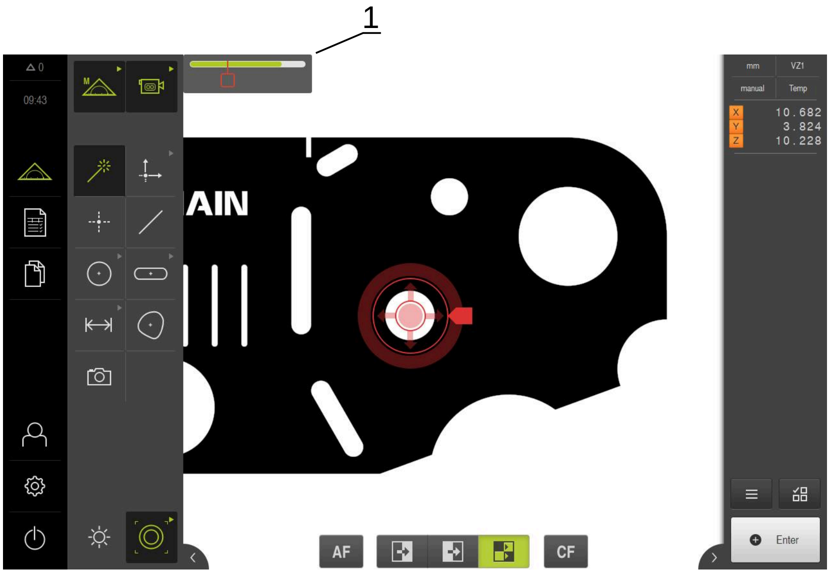


Figure 22: **Measure** menu with **Contrast bar**

1 Slider

Operating element	Function	Available for
	**Contrast bar** The position of the slider corresponds to the current contrast threshold The colored section corresponds to the value range between minimum and maximum contrast	■ Single edge ■ Circle ■ Buffer ■ Contour

Showing or hiding the contrast bar in the workspace

▶ In the quick access menu, drag the **ON/OFF** slider to the desired position

Modifying the contrast threshold

If you change the position of the measuring tool, the minimum and maximum contrasts are redetermined automatically. The contrast bar displays the determined value range as a colored section. The color of this section indicates whether the contrast threshold is within the permissible range:

- Green: The contrast threshold is within the permissible range; a measuring point acquisition is possible
- Gray: The contrast threshold is not within the permissible range; a measuring point acquisition is not possible

▶ In order to acquire measuring points, make sure to drag the slider into the colored section

> The section is then displayed in green

> The contrast threshold is within the permissible range

> Individual settings determine whether an operator of the **Operator** type may adjust the contrast threshold or not.

Further information: "Adjusting the contrast settings", Page 186

Further information: "Contrast settings", Page 478

Autofocus (software option)

The **Autofocus (AF)** function helps you determine the focal plane. A wizard guides you through this procedure. While you move the measurement tool on the z axis, the product determines the position in which the contours of the measured object are best in focus.

Prerequisites

- Z axis has been configured
- The VED sensor has been activated (software option)
- **Autofocus (AF)** function is enabled (software option)

Control	Function	Available for
AF	**Autofocus** Starts the wizard for determining the focal plane	■ Crosshair ■ Single edge ■ Circle ■ Buffer ■ Contour

Determining the focal plane

- Tap **Measure** in the main menu
- Select **Manual measuring** in the function palette
- If multiple sensors are available, select **VED sensor** in the sensor palette
- > The geometry palette and the VED measuring tools are displayed
- > The workspace shows the camera's live image
- In the quick access menu, select the magnification that is set on the measuring machine
- Select one of the following measuring tools
  - Crosshair
  - Single edge
  - Circle
  - Buffer
  - Contour
- Tap **Autofocus**
- Follow the instructions of the wizard
- > The wizard determines the optimum position on the Z axis
- Tap **Close** to close the wizard
- Move to the determined Z axis position

Measuring point detection (CF)

The **Measuring point detection (CF)** function finds and identifies measuring points within the search area of the measuring tool. When you move the measuring tool or adjust the search area, the product runs a new search. You can acquire the displayed measuring points as usual.

> The measuring point detection function helps you to detect contours at low contrasts. Activating this function can affect the processing power, however.

Control	Function	Available for
CF	**Measuring point detection** Activates measuring point detection within the search area of the measuring tool.	■ Single edge ■ Circle ■ Buffer ■ Contour

Activating measuring point detection

- Select one of the following measuring tools
  - Single edge
  - Circle
  - Buffer
  - Contour

- Tap **Measuring point detection**
- Position the measuring tool above the desired contour
- > The detected measuring points are marked with a red square
- Tap **Enter** in the Inspector

- To measure the displayed points, tap **Finish** in the new feature

- To deactivate the function, tap **Measuring point detection** again

Lighting palette

You can adapt the lighting of the measuring machine to the current lighting conditions using the controls of the lighting palette.

Prerequisites

- A light unit is connected to the product
- Lighting has been configured in the device settings
- The VED sensor has been activated (software option)

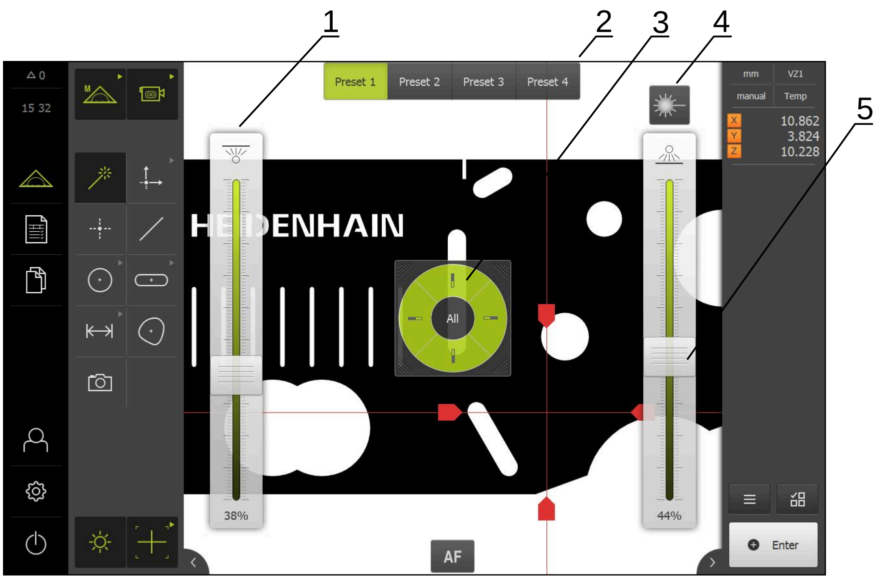
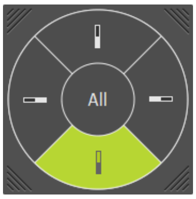


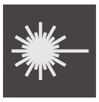
Figure 23: Controls of the **lighting palette**

1 Slider
2 Preset controls
3 Segment switch for selecting the reflected-light segments
4 Laser pointer
5 Slider

Controls of the lighting palette

> The functions available on the lighting palette depend on the connected light unit and the device settings.

Operating element	Meaning
	**Lighting palette** Hides/shows the lighting palette
	**Preset** switch for saving and recalling lighting settings. The active preset is displayed in green. Any changes will automatically be saved to the active preset.
	**Transmitted light** slider for setting the light intensity for the transmitted light.
	**Segment switch** for selecting the reflected-light segments. To select all segments, use **All**. The selected segments are displayed in green. The function varies depending on the type of lighting selected: ■ **A transmitted light + 4 x AD reflected light**: Reflected-light segments are activated or deactivated by selecting them. The slider controls the light intensity for all reflected-light segments, regardless of the selection ■ **A trans.light + 4 x A refl.light + D laser pointer**: The slider controls only the light intensity for the selected reflected-light segments > If **All** is used to select all segments, the slider is reset to the minimum value. The light intensity can now be controlled for all segments simultaneously. ■ **AD trans.light + 4 x AD refl.light + AD coaxial light + exposure time**: Reflected-light segments are activated or deactivated by selecting them. The slider controls the light intensity for all reflected-light segments, regardless of the selection
	**Reflected light** slider for setting the light intensity for the reflected-light segments.

Operating element	Meaning
	**Laser pointer** control for switching a connected laser pointer on and off. When the laser pointer is on, the control is displayed in green.
	**Coaxial light** slider for setting the light intensity for the coaxial light.
	**Camera exposure time** slider for setting the exposure time for the camera.

Further information: "Adjusting the lighting", Page 180

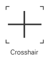
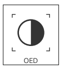
6.9.4 Controls for measuring with an OED sensor

Prerequisites

- The OED sensor has been activated (software option)

Overview of the OED measuring tools

If an OED sensor is activated, the tool palette includes the following measuring tools.

Symbol	Measuring tool	Functions and characteristics
	Crosshair	■ Manual acquisition of single measuring points ■ No automatic acquisition of light-to-dark transitions
	OED	■ Active measuring tool ■ Acquisition of light-to-dark transitions ■ Buffering of a single measuring point (manual confirmation required) If the OED sensor traverses an edge, a measuring point is buffered in the clipboard. If the OED sensor traverses a further edge, the buffered measuring point is overwritten. By tapping **Enter**, the previously buffered measuring point is added to the feature calculation.
	Auto OED	■ Active measuring tool ■ Automatic acquisition of measuring points, e.g. on circles and circular arcs ■ Acquisition of light-to-dark transitions If the OED sensor traverses an edge, a measuring point is automatically acquired and added to the feature calculation.

Configuring OED measuring tools

In the **Measuring tool settings** dialog, you can adjust the contrast settings and the OED offset settings using a teach sequence. These settings apply to all OED measuring tools, regardless of which measuring tool was selected for the teach sequence. All changes are transferred to the **Settings** menu.

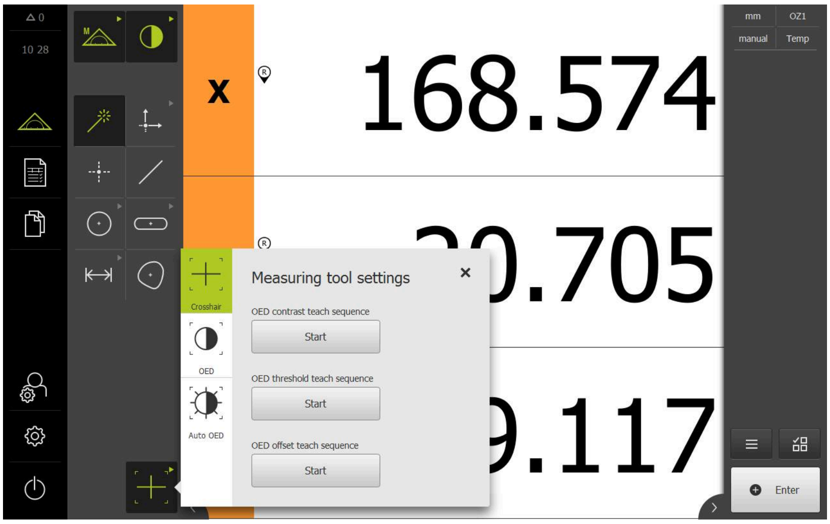
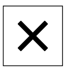


Figure 24: **Measuring tool settings** dialog for OED measuring tools

- ▶ In the quick access menu, select the magnification that is set on the measuring machine

- ▶ In the **tool palette**, select any desired OED measuring tool, e.g. **Auto OED**
- > The **Measuring tool settings** dialog shows the available parameters
- ▶ Determine the desired parameters during the teach sequence



- ▶ Tap **Close** to close the dialog
- > The parameters are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Operating element	Meaning
Start	**OED contrast teach sequence** Starts the teach sequence for adjusting the contrast settings to the current light conditions **Further information:** "Adjusting the contrast settings", Page 191
Start	**OED threshold teach sequence** Starts the teach sequence for adjusting the threshold settings for edge detection **Further information:** "Adjusting the threshold settings", Page 192
Start	**OED offset teach sequence** Starts the teach sequence for determining the offset between the crosshairs and the OED sensor **Further information:** "Configuring offset settings", Page 192

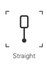
6.9.5 Controls for measuring with a TP sensor

Prerequisites

- The TP sensor has been activated (software option)
- At least one stylus has been created in the device settings

Overview of the TP measuring tools

If a TP sensor is activated, the tool palette includes all styli for which you created settings. In the tool palette, you can select the stylus to be used for the measuring point acquisition. In the **Measuring tool settings** dialog, you can calibrate the selected stylus.

Control	Function
	Straight stylus
	Star-type stylus

Further information: "Touch probe (TP)", Page 484

Calibrating a stylus

Before you can use a stylus for measuring, it must be calibrated. For this purpose, measure the calibration sphere whose diameter you indicated in the device settings. Place at least three measuring points on the circumference and one on the top of the calibration sphere.

The first stylus you calibrate is defined as the main stylus. All other styli refer to the main stylus. If you re-calibrate the main stylus, you need to re-calibrate the other styli as well.

> If you are using a star-type stylus, each stylus tip must be calibrated.

If you are using an indexed swiveling stylus, repeat the calibration procedure for each axis and each angular value required for measurement.

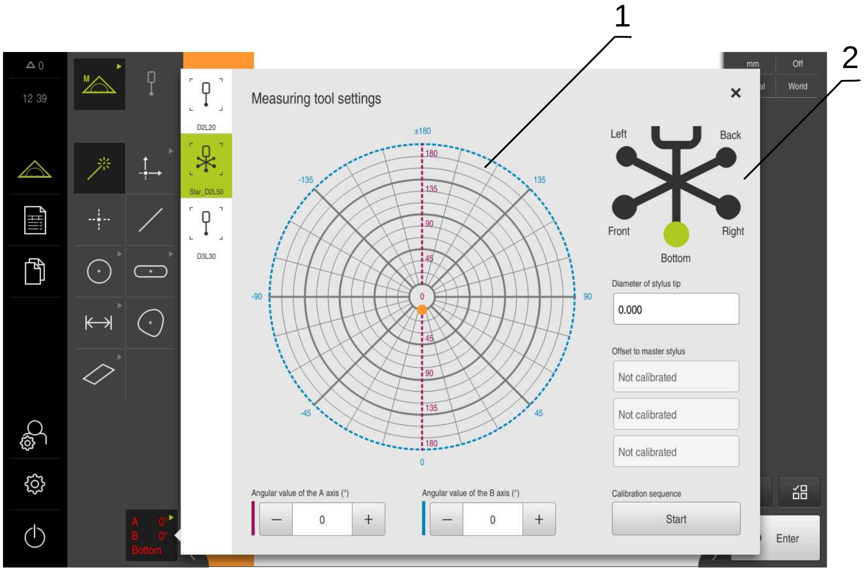


Figure 25: **Measuring tool settings** dialog for TP measuring tools

1 Graphical representation for selection of the angle values for indexed swiveling styli
2 Graphical representation for selection of the stylus tip for star-type styli

In the graphical representation of indexed swiveling styli, you can select a stylus position in order to calibrate it then. The scale corresponds to the range of adjustment of the touch probe head that is indicated in the settings.

Further information: "Probe head", Page 486

The calibrated positions and the selected position are marked by dots. The colors of the dots have the following meaning:

Color	Meaning
Orange	Position has been selected but not yet calibrated
Green	Position has been selected and calibrated
Dark gray	Position has not yet been selected and calibrated

- Select the desired stylus in the tool palette
- > The **Measuring tool settings** dialog shows the available parameters for the selected stylus
- If you are using a star-type stylus, tap the first stylus tip in the graphics
- > The selected stylus tip is displayed in green
- If you are using an indexed swiveling stylus, select the first angular value in the graphical representation or in the input fields
- Enter the diameter of the stylus tip
- To start the calibration, tap **Start**
- Follow the instructions of the wizard
- If you are using a star-type stylus, repeat this procedure for each stylus tip
- If you are using an indexed swiveling stylus, repeat the procedure for each axis and each angular value

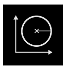
- > When the icon in the tool bar is displayed in green, the stylus is fully calibrated

Further information: "Touch probe (TP)", Page 484

6.10 The Define function

Activation

▶ Tap **Measure** in the main menu



▶ Select **Define** in the function palette

> The controls and input fields of the **Define** function are displayed

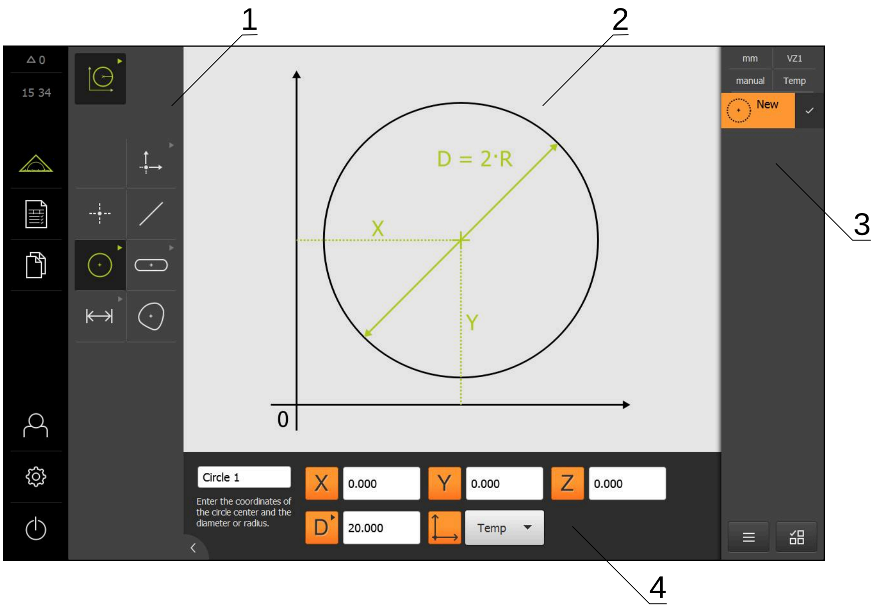


Figure 26: The **Define** function with **circle** geometry

1 Geometry palette
2 Display of the geometry
3 Feature list in the Inspector
4 Input fields for the geometry parameters (geometry-specific)

For a detailed description of the individual activities, please refer to the "Measuring" chapter and to the following chapters.

6.11 Position display

The unit's position display shows the axis positions and additional information about the configured axes (if applicable).

6.11.1 Operating elements of the position display

Symbol	Meaning
X	Axis key **Axis key functions:** ■ Tapping the axis key: opens the input field for position value ■ Holding down the axis key: sets the current position as zero point
	Reference mark search performed successfully
	Reference mark search not performed or no reference mark detected

6.12 Customizing the workspace

In the **Measure** menu, you can enlarge the workspace by hiding the main menu, the submenu, or the Inspector. In addition, there are several ways to customize the features view.

Activation

- ▶ Tap **Measure** in the main menu
- > The user interface for measuring, constructing, and defining is displayed

6.12.1 Hiding and showing the main menu and submenu

- ▶ Tap the **tab**
- > The main menu is hidden
- ▶ Tap the **tab** again
- > The submenu is hidden
- > The arrow changes direction
- ▶ To show the submenu, tap the **tab**
- ▶ To show the main menu, tap the **tab** again

6.12.2 Hiding or displaying the Inspector

The Inspector can only be hidden when using the **Manual measuring** function.

- ▶ Tap the **tab**
- > The Inspector is hidden
- > The arrow changes direction
- ▶ To display the Inspector, tap the **tab**

6.13 Working in the features view

The **Manual measuring** function is available in the features view.

In the features view, you can do the following:

- Customize the view
- Select or deselect features
- Add annotations to features
- Show or hide annotations

Activation

- ▶ Tap **Measure** in the main menu
- > The user interface for measuring, constructing, and defining is displayed
- ▶ In the Inspector, tap **Features preview**
- > The features view is displayed in the workspace
- > The current content of the workspace is displayed in the Inspector

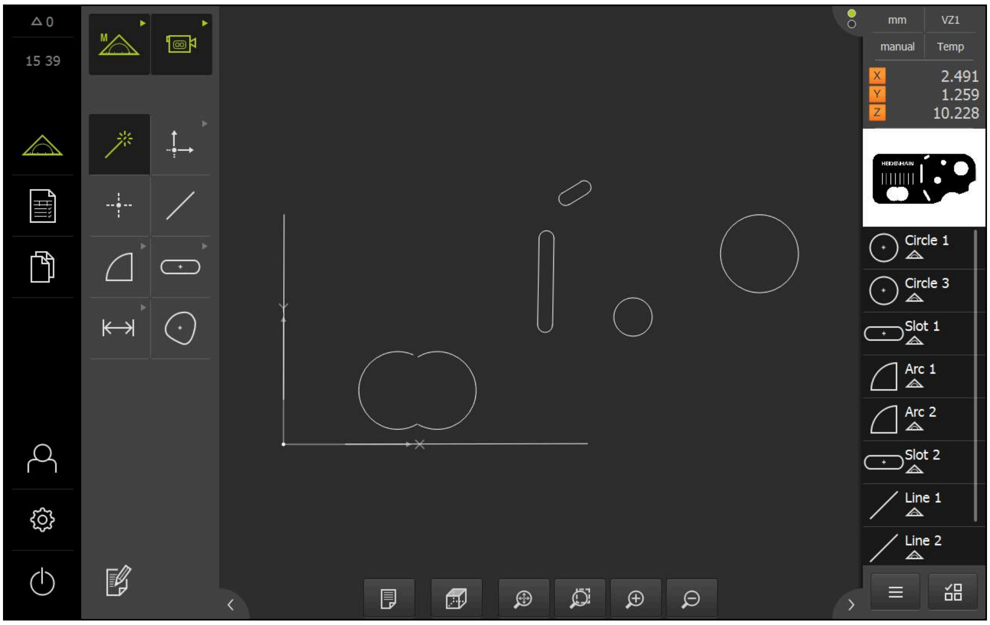


Figure 27: Workspace with **features view**

6.13.1 Resizing the features view

Zoom to all	Zoom to selection	Magnify graphic	Reduce graphic
			

Depending on the area available for the workspace, the controls may be grouped.

- ▶ To display all controls, tap **Zoom functions**

6.13.2 Rotating the 3-D features view

Prerequisite

- QUADRA-CHEK 3000 3D software option is activated

Top view	Page view	Front view	45° from right	45° from left
				

The controls are grouped.

- ▶ To show all controls, tap the control visible in the current view

6.13.3 Selecting or deselecting features

- ▶ To select a feature, tap it in the features view
- > The selected feature is displayed in green in the features view and in the feature list
- ▶ To add more features to the selection, tap them
- ▶ To deselect a feature, tap it again

> You can construct a new feature from the selected features, e.g. by moving or copying them.
> **Further information:** "Constructing features", Page 331

6.13.4 Editing annotations

You can add an annotation to every feature in the features view, e.g. measurement information or informational texts.

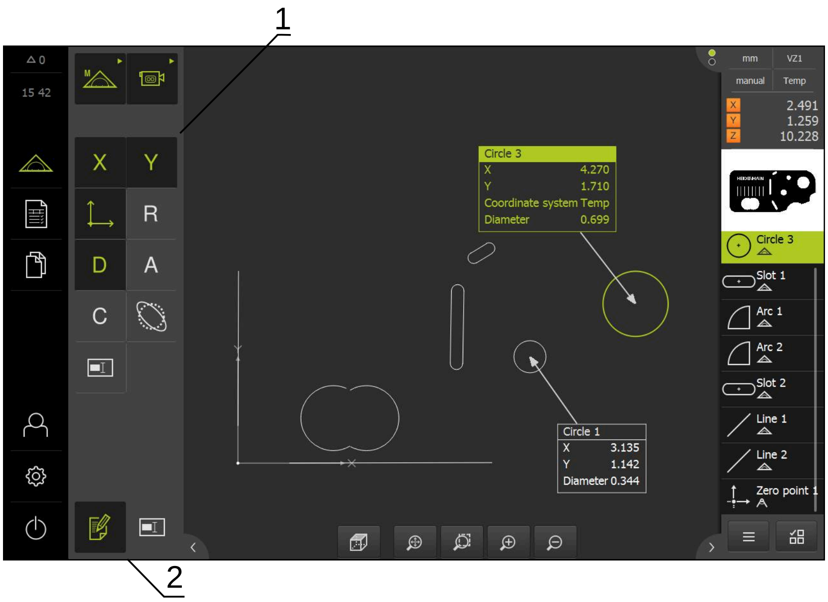


Figure 28: Feature with annotations in the features view

1 Operating elements for adding annotations to one or more features
2 The **Edit annotations** operating element

> The operating elements for adding annotations are displayed if the edit mode for annotations is activated and if at least one feature is selected in the feature list. The available operating elements depend on the geometry type of the selected feature.

Edit annotations	
	Control activates the edit mode for annotations

Coordinate value X	Coordinate value Y	Coordinate system	Radius	Diameter
X	Y		R	D

Angle	Starting angle	End angle	Length	Width
Θ	$Θ_S$	$Θ_E$	L	W

Surface	Circumfer-ence	Form deviation	Note
A	C		

Display annotations	
	This control shows or hides stored annotations; the control is only displayed in the workspace while the editing mode is deactivated

6.14 Using the Inspector

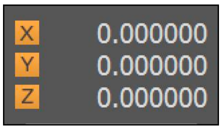
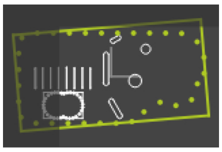
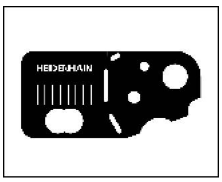
The Inspector is only available in the **Measure** menu.

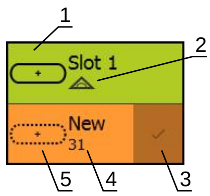
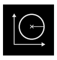
Activation

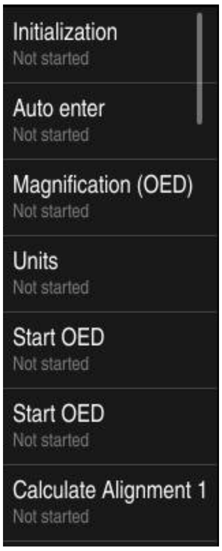
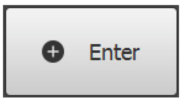
- ▶ Tap **Measure** in the main menu
- > The user interface for measuring, constructing and defining is displayed

6.14.1 Controls of the Inspector

The Inspector contains the following areas and controls:

Control	Function
	**Quick access menu** The quick access menu displays the current settings for manual measuring, constructing, and defining: ■ Unit for linear values (Millimeters or Inch) ■ Magnification used ■ Type of measuring point acquisition (automatic or manual) ■ Coordinate system used ▶ To adjust the settings of the quick access menu, tap the quick access menu **Further information:** "Adjusting settings in the quick access menu", Page 125
	**Position preview** The position preview displays the current axis positions. If no reference mark search has been performed, the axis positions are displayed in red. **Further information:** "Conducting the reference mark search", Page 243 ▶ To display the position preview in the workspace, tap the **Position preview** > The position display is now shown in the workspace > The current content of the workspace is displayed in the Inspector
	**Features preview** The features preview displays a reduced view of the measured, constructed, and defined features. The current image section of the live image is highlighted. ▶ To display the features view in the workspace, tap the **Features preview** > The features view is now shown in the workspace > The current content of the workspace is displayed in the Inspector **Further information:** "Working in the features view", Page 118
	**Live image preview** The live image preview displays a reduced view of the live image. ▶ To display the live image preview in the workspace, tap **Live image preview** > The live image is now displayed in the workspace > The current content of the workspace is displayed in the Inspector

<table>
<tr><th>Control</th><th>Function</th></tr>
<tr><td>
</td><td>
Feature list
The feature list lists all measured, constructed, or defined features. The feature list provides the following information:
■ 1: Feature with symbol, name, and consecutive number
■ 2: Function that was used for creating the feature
<table>
<tr><th>Symbol</th><th>Meaning</th></tr>
<tr><td></td><td>Measured feature</td></tr>
<tr><td></td><td>Constructed feature</td></tr>
<tr><td></td><td>Defined feature</td></tr>
</table>
■ 3: Completes the measuring point acquisition
■ 4: Number of measuring points that have been acquired
■ 5: Newly acquired feature with symbol
Each feature contains details on the measurement results as well as selectable tolerances.
▶ To display the measured values and adjust the tolerances, drag a feature into the workspace
> The Details dialog with its Overview and Tolerance tabs opens in the workspace
Further information: "Measurement evaluation", Page 380
Further information: "Defining tolerances", Page 385
▶ To select or deselect features, tap the features one after another
> The selected features are highlighted in green
▶ To delete a feature, drag the feature to the right and out of the Inspector
</td></tr>
<tr><td>
</td><td>
Measurement result preview
After completion of a measurement process, the measurement result preview appears in the workspace and displays information about the measured feature. For each geometry type, it is possible to define the parameters to be displayed in the measurement result preview. Which parameters are available depends on the specific geometry type.
Further information: "Configuring the measurement result preview", Page 229
You can adjust the coordinate system in the measurement result preview.
Further information: "Setting the feature's center point as the zero point", Page 373
Further information: "Adopting the alignment of a feature", Page 375
You can send contents from the measurement result preview to a computer via the RS-232 interface.
Further information: "Configuring the measured value output", Page 231
</td></tr>
</table>

Control	Function
	**Program step list** The program step list shows all actions that occur during the measurement. It is displayed instead of the feature list in the Inspector. The program steps can be combined and saved as a measuring program. **Further information:** "Programming", Page 415
	**Auxiliary functions** The auxiliary functions include the following: ■ Switching the display between feature list and program step list ■ Creating, saving, and opening a program ■ Calling the program control in the workspace ■ Opening and saving a coordinate system ■ Deleting selected features or all features from the feature list **Further information:** "Adjusting the auxiliary functions of the Inspector", Page 128
	**Feature selection** Multiple selection of features of the same geometry type ▶ Tap **Feature selection** ▶ To select all features of a geometry type in the feature list, tap the desired geometry type ▶ Confirm with **OK** > The selected features are highlighted in green
 	**Enter** Acquisition of measuring points with the following options: ■ If measuring point acquisition is deactivated, then the measuring points will be acquired manually ■ If automatic measuring point acquisition is active, then a red dot will be shown in the control. The measuring points will be acquired after expiration of the set dead time

6.14.2 Adjusting settings in the quick access menu

In the quick access menu, you can adjust the following settings:

- Unit for linear values (**Millimeters** or **Inch**)
- Unit for angular values (**Radian**, **Decimal degrees** or **Deg-Min-Sec**)
- Type of coordinate system
- Type of measuring point acquisition
- Dead time for automatic measuring point acquisition
- Selection of the coordinate system
- Automatic generation of coordinate systems
- Projection

If an OED sensor is activated (software option), the following additional settings are available:

- Selection of magnification

If a VED sensor is activated (software option), the following additional settings are available:

- Display of contrast bar
- Orientation of contrast bar
- Selection of magnification

> The available functions depend on the configuration of the product and the enabled software options.

Setting the units of measure

Before you start measuring, you need to set the desired units of measure in the Inspector's quick access menu.

- ▶ Tap the **Quick access menu** in the Inspector
- ▶ Select the desired **Unit for linear values**
- ▶ Select the desired **Unit for angular values**
- ▶ To close the quick access menu, tap **Close**
- > The selected units are displayed in the **quick access menu**

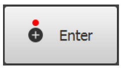
Selecting the type of coordinate system

Depending on the measuring task, you can set the type of coordinate system (**Cartesian** or **Polar**) in the Inspector's quick access menu.

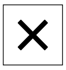
- ▶ Tap the **Quick access menu** in the Inspector
- ▶ Select the desired **Type of coordinate system**
- ▶ To close the quick access menu, tap **Close**
- > The positions are displayed in the **position preview** in accordance with the selected coordinate system

Setting automatic measuring point acquisition

You can acquire measuring points automatically or manually one at a time. The automatic acquisition (auto enter) function automatically enters the measuring points as soon as the measuring tool has remained at a standstill above the measuring point for a short period of time. You can activate or deactivate this function and set the standstill time ("timeout").



- Tap the **Quick access menu** in the Inspector
- Activate or deactivate **Auto enter**
- > When **Auto enter** is activated, a red dot is shown in the **Enter** button
- Set the **Auto enter timeout in ms** (150 ms to 10 000 ms)
- > As soon as the measuring tool has remained at a standstill above a measuring point for longer than the selected period of time, the measuring tool automatically enters one or more measuring points

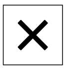


- To close the quick access menu, tap **Close**
- > The **manual** or **auto** status is indicated in the quick access menu

Selecting the coordinate system

The currently selected coordinate system is displayed in the quick access menu. The selected coordinate system will be assigned to new features. You can switch between the coordinate systems in the quick access menu.

The default setting is the coordinate system of the measuring plate designated **World**. If you determine a new zero point or acquire a reference feature, then the product changes to the temporary coordinate system designated **Temp**. If you rename the coordinate system, then its new designation appears in the quick access menu, and you can assign the coordinate system to individual features.



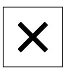
- Tap the **Quick access menu** in the Inspector
- Select the desired **Coordinate system**
- To close the quick access menu, tap **Close**
- > The selected coordinate system is displayed in the quick access menu
- > The position display always references the selected coordinate system
- > If you generate new features, then the selected coordinate system will be assigned to the features

Further information: "Working with coordinate systems", Page 370

Creating a coordinate system automatically

If you activate the **Create coordinate system automatically** setting and then determine a new zero point, then the product switches over to the new coordinate system designated **COSx** (x = sequential number).

- Tap the **Quick access menu** in the Inspector
- Activate the **Create coordinate system automatically** function with the **ON/OFF** slide switch



- To close the quick access menu, tap **Close**

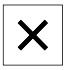
Further information: "Working with coordinate systems", Page 370

Selecting the magnification

If an optical sensor is activated, then you can take the optical magnification of the measured object into account. To do this, select in the quick access menu the magnification suitable for the optics. The number of available magnification levels depends on the configuration of the measuring machine.

> The optical magnification must match the magnification that is set in the product.

> For measurements using a VED sensor: In order to ensure that the live image is focused in the workspace, it may be necessary to adjust the working distance between the measured object and the camera.



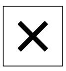
- Tap the **Quick access menu** in the Inspector
- Select the desired magnification suitable for the optics
- To close the quick access menu, tap **Close**
- > The selected magnification is displayed in the **quick access menu**

> When measuring with a VED sensor: If the selected magnification has not yet been set, the pixel size of the sensor must be determined in the **Settings** menu.
>
> **Further information:** "Determining the pixel sizes", Page 187

Show contrast bar

If you show the **contrast bar** slide switch in the workspace, then you can use it to steplessly adjust the contrast threshold.

- Tap the **Quick access menu** in the Inspector
- Show the contrast bar with the **ON/OFF** slide switch
- Select the desired orientation in the **Orientation of contrast bar** field
  - **Horizontal**: The contrast bar is shown horizontally in the workspace
  - **Vertical**: The contrast bar is shown vertically in the workspace



- To close the quick access menu, tap **Close**

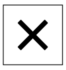
Further information: "Contrast bar", Page 105

Selecting the projection plane

If you select a projection plane and then measure, construct, or define a feature, then the feature will be projected onto the selected plane. The values of the third axis are not included in the feature calculation. You will thus generate a 2-D feature.

- Tap the **Quick access menu** in the Inspector
- Select the desired **Projection**

> If you select **Off**, the object will be located in space (3-D).



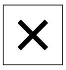
- To close the quick access menu, tap **Close**
- > The selected projection is displayed in the **quick access menu**

6.14.3 Adjusting the auxiliary functions of the Inspector

Switching between feature list and program step list

The feature list shows the acquired features whereas the program step list shows the program steps of the measuring program.

- Tap **Auxiliary functions** in the Inspector
- Select the **Feature list** or **Program step list** display
- Activating the program step list also activates the display of the program control in the workspace



- Tap **Close** to close the auxiliary functions

Further information: "Programming", Page 415

Creating, saving and opening a measuring program

With the auxiliary functions of the Inspector, you can:

- Create a new measuring program
- Save acquired features as a measuring program
- Open a saved measuring program
- Show the program control

Creating a measuring program

- ▶ Tap **Auxiliary functions** in the Inspector
- ▶ To create a new measuring program, tap **New**
- ▶ Tap **OK** in the dialog
- > A new measuring program is created
- > The auxiliary functions are closed

Saving a measuring program

- ▶ Tap **Auxiliary functions** in the Inspector
- ▶ To save acquired features as a measuring program, tap **Save as**
- ▶ In the dialog, select the storage location, e.g. **Internal/Programs**
- ▶ Tap the input field
- ▶ Enter a name for the measuring program
- ▶ Confirm your input with **RET**
- ▶ Tap **Save as**
- > The measuring program is saved
- > The auxiliary functions are closed

Opening a measuring program

- Tap **Auxiliary functions** in the Inspector
- To open a measuring program, tap **Open**

> If you open a measuring program, then the current measuring program will be closed. All unsaved changes in the current measuring program will be lost.
>
> - Save any changes made to the current measuring program before opening another measuring program
>
> **Further information:** "Saving a measuring program", Page 298

- Confirm the message with **OK**
- > The **Internal**/**Programs** folder is now displayed
- Navigate to storage location of the measuring program
- Tap the name of the measuring program
- Tap **Select**
- > The user interface for measuring, constructing and defining appears
- > The program step list containing the program steps of the measuring program is displayed
- > The selected measuring program is displayed on the program control

Displaying the program control

- Tap **Auxiliary functions** in the Inspector
- To display the program control in the workspace, tap **Control**
- > The program control is displayed
- Tap **Close** to close the auxiliary functions

Further information: "Programming", Page 415

Saving and opening a coordinate system

With the auxiliary functions of the Inspector, you can:

- Save a user-defined coordinate system as a 5RF file
- Open a saved coordinate system

Further information: "Working with coordinate systems", Page 370

Saving a coordinate system

- In the quick access menu, select the user-defined coordinate system

- Tap **Auxiliary functions** in the Inspector
- Tap **Save as**
- In the dialog, select the storage location, e.g. **Internal/Programs**
- Tap the input field
- Enter the file name
- Confirm your input with **RET**
- Tap **Save as**
- > The coordinate system is saved

Opening a coordinate system

- Tap **Auxiliary functions** in the Inspector
- Tap **Open**
- In the dialog, select the storage location, e.g. **Internal/Programs**
- Tap the desired file
- Confirm entry with **Select**
- > The new coordinate system is displayed in the quick access menu

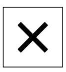
Deleting features

With the auxiliary functions of the Inspector, you can delete multiple features simultaneously.

- Select the features in the feature list

- Tap **Auxiliary functions** in the Inspector
- To delete the selected features from the feature list, tap **Delete selection**
- To delete all features from the feature list, tap **Delete all**

> Reference features, such as a zero point, alignment, or reference plane, cannot be deleted as long as other features are referenced to them.



- Tap **Close** to close the auxiliary functions

6.14.4 Expanding the feature list or program step list

If the feature list or program step list includes at least one feature or program step, it can be expanded.

- ▶ Tap the switch
- > The feature list or program step list is expanded
- > The lower switch is displayed in green

- ▶ Tap the switch
- > The previous view will be restored
- > The upper switch is displayed in green

6.15 Messages and audio feedback

6.15.1 Messages

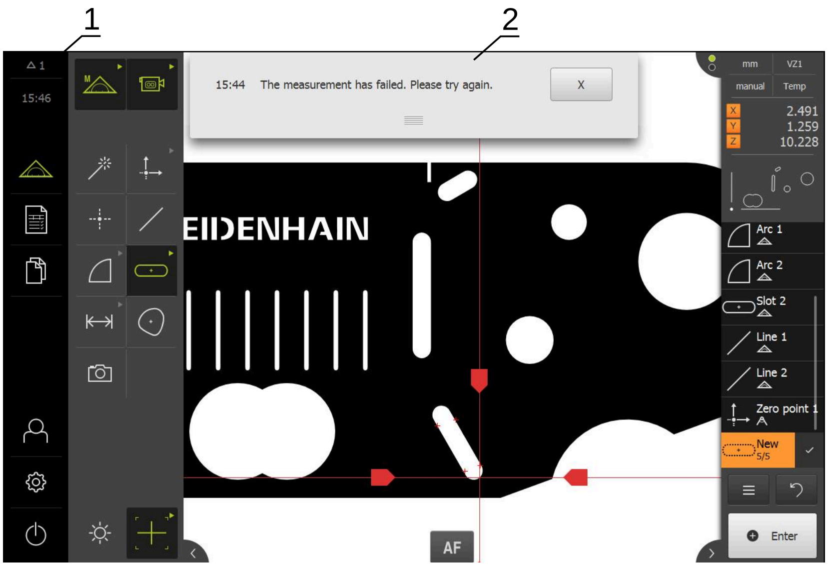


Figure 29: Display of messages in the workspace

1 Message display area, displays the time and the number of unclosed messages
2 Message list

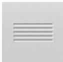
The messages that appear at the top of the workspace can be triggered by, for example, operator errors, uncompleted processes, or successfully completed measuring programs.

The messages are displayed upon occurrence of the message cause or via tapping on the **Messages** display area at the top left of the screen.

Viewing messages

- ▶ Tap **Messages**
- > The message list opens

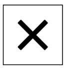
Resizing the display area



- To enlarge the message display area, drag the **handle** down
- To make the message display area smaller, drag the **handle** up
- To close the display area, drag the **handle** up out of the screen
- \> The number of unclosed messages is indicated in **Messages**

Closing messages

Depending on the content of the messages, you can close messages by means of the following operating elements:



- To close an informational message, tap **Close**
- \> The message disappears

or

- To close a message that potentially has an effect on the application, tap **OK**
- \> If applicable, the message will now be taken into account by the application
- \> The message disappears

6.15.2 Wizard

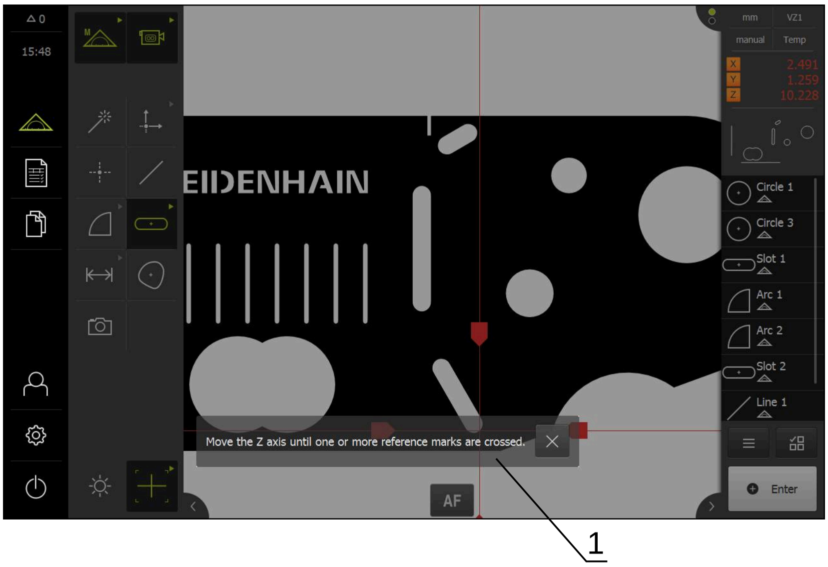
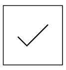


Figure 30: Display of messages in the wizards

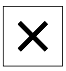
1 Wizard (example)

The wizard assists you in carrying out action steps, programs, or teach processes.
You can move the wizard within the workspace .
The following operating elements of the wizard are shown based on the action step or process.

- To return to the last action step or to repeat the process, tap **Undo**



- To confirm the displayed action step, tap **Confirm**
- > The wizard proceeds to the next step or completes the process



- Tap **Close** to close the wizard

6.15.3 Audio feedback

The product can provide audio feedback to indicate user actions, completed processes or malfunctions.
The available sounds are grouped into categories. The sounds differ within a category.
You can define the audio feedback settings in the **Settings** menu.
Further information: "Sounds", Page 464

7

Commissioning

7.1 Overview

This chapter contains all the information necessary for commissioning the product.

During commissioning, the machine manufacturer's commissioning engineer (**OEM**) configures the product for use on the specific measuring machine.

The settings can be reset to the factory defaults.

Further information: "Reset", Page 521

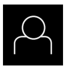
> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

> The following steps must be performed only by qualified personnel.
>
> **Further information:** "Personnel qualification", Page 31

7.2 Logging in for commissioning

7.2.1 User login

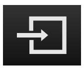
To commission the product, the **OEM** user must log in.



- Tap **User login** in the main menu
- If required, log out the user who is currently logged in
- Select the **OEM** user
- Tap the **Password** input field
- Enter the password "**oem**"

> If the password does not match the default password, ask a **Setup** user or **OEM** user for the assigned password.
>
> If the password is no longer known, contact a HEIDENHAIN service agency.

- Confirm the entry with **RET**



- Tap **Log in**
- > The user is logged in
- > The product opens the **Measure** menu

7.2.2 Performing the reference mark search after startup

If the reference mark search after unit start is active, then all of the unit's functions will be disabled until the reference mark search has been successfully completed.

Further information: "Reference marks (Encoder)", Page 515

The reference mark search does not need to be performed for serial encoders with EnDat interface, because the axes are automatically homed.

If the reference mark search is active on the unit, then a wizard will ask you to traverse the reference marks of the axes.

- After logging in, follow the instructions of the wizard
- > The Reference symbol stops blinking upon successful completion of the reference mark search

Further information: "Operating elements of the position display", Page 117

Further information: "Activating the reference mark search", Page 143

7.2.3 Setting the language

The user interface language is English. You can change to another language, if desired.

- Tap **Settings** in the main menu
- Tap **User**
- > The logged-in user is indicated by a check mark
- Select the logged-in user
- > The language selected for the user is indicated by a national flag in the **Language** drop-down list
- Select the flag for the desired language from the **Language** drop-down list
- > The user interface is displayed in the selected language

7.2.4 Changing the password

You must change the password to prevent unauthorized configuration.
The password is confidential and must not be disclosed to any other person.

- Tap **Settings** in the main menu
- Tap **User**
- > The logged-in user is indicated by a check mark
- Select the logged-in user
- Tap **Password**
- Enter the current password
- Confirm entry with **RET**
- Enter the new password and repeat it
- Confirm entry with **RET**
- Tap **OK**
- Close the message with **OK**
- > The new password is available the next time the user logs in

7.3 Steps for commissioning

> The following commissioning steps build on each other.
> - To correctly commission the product, make sure to perform the steps in the order described here

Prerequisite: You are logged on as a user of the **OEM** type (see "Logging in for commissioning", Page 136).

Basic settings

- Activating the Software options
- Setting the date and time
- Setting the units of measure

Configuring the axes

For EnDat interfaces:	For 1 V_{PP} or 11 μA_{PP} interfaces:	For TTL interfaces:
■ Configuring axes for encoders with EnDat interface ■ Performing error compensation for linear encoders ■ Ascertaining the line count per revolution	■ Activating the reference mark search ■ Configuring the axes for encoders with a 1 V_{PP} or 11 μA_{PP} interface ■ Performing error compensation for linear encoders ■ Ascertaining the line count per revolution	■ Activating the reference mark search ■ Configuring axes for encoders with TTL interface ■ Performing error compensation for linear encoders ■ Ascertaining the output signals per revolution

Configuring the sensor (software option)		
For VED sensors:	For OED sensors:	For TP sensors:
■ Setting the camera ■ Setting the magnification ■ Adjusting the lighting ■ Setting the camera orientation ■ Adjusting the contrast settings ■ Determining the pixel sizes ■ Configuring parcentric and parfocal error compensation ■ Configuring the field of view compensation	■ Adjusting the contrast settings ■ Configuring offset settings	■ Preparing the calibration ■ Setting the Probe head ■ Setting the Probe body ■ Adding Styli

OEM area

- Adding documentation
- Adding a startup screen
- Configuring the unit for screenshots

Backing up data

- Back up settings
- Back up user files

NOTICE

Loss of or damage to configuration data!

If the product is disconnected from the power source while it is on, the configuration data can be lost or corrupted.

▶ Back up the configuration data and keep the backup for recovery purposes

7.3.1 Basic settings

Activating the Software options

Additional **Software options** can be enabled on the product via a **License key**.

> You can view the enabled **Software options** on the overview page.
> **Further information:** "Checking the Software options", Page 141

Requesting license key

You can request a license key by using the following procedure:

- Reading out device information for the license key request
- Creating a license key request

Reading out device information for the license key request

- Tap **Settings** in the main menu.
- Tap **General**
- Tap **Device information**
- > An overview of the device information appears
- > The product designation, ID number, serial number, and firmware version are displayed
- Contact a HEIDENHAIN service agency and submit the displayed device information in order to request a license key for the product
- > The license key and the license file are generated and sent by e-mail

Creating a license key request

- Tap **Settings** in the main menu.
- Tap **Service**
- Tap **Software options**
- To request a software option that is available for a fee, tap **Request options**
- To request a free trial option, tap **Request trial options**
- To select the desired software option, tap its check mark
- For the QUADRA-CHEK 3000 AEI1 software option specify the number of additional encoder inputs by tapping **-** or **+**

> To deselect an entry, tap the check mark for the respective software option

- Tap **Creating a request**
- In the dialog, select the storage location in which you want to save the license key request
- Enter a suitable file name
- Confirm entry with **RET**
- Tap **Save as**
- > The license key request is created and saved in the selected folder
- If the license key request is stored on the unit, move the file to a connected USB mass storage device (FAT32 format) or to the network drive
  Further information: "Moving a file", Page 454
- Contact a HEIDENHAIN service agency and submit the file you created in order to request a license key for the product
- > The license key and the license file are generated and sent by e-mail

Activating a license key

You can activate a license key by

- Reading the license key from the provided license file into the product
- Entering the license key manually into the product

Uploading license key from license file

- Tap **Settings** in the main menu
- Tap **Service**
- Open in the sequence
  - **Software options**
  - **Activate options**
- Tap **Read license file**
- Select the license file in the file system, on the USB mass storage device or on the network drive
- Confirm your selection with **Select**
- Tap **OK**
- > The license key is activated
- Tap **OK**
- > You may need to restart the product, depending on the software option
- Confirm the restart with **OK**
- > The activated software option is available

Entering license key manually

- Tap **Settings** in the main menu
- Tap **Service**
- Open in the sequence
  - **Software options**
  - **Activate options**
- Enter the license key into the **License key** input field
- Confirm the entry with **RET**
- Tap **OK**
- > The license key is activated
- Tap **OK**
- > You may need to restart the product, depending on the software option
- Confirm the restart with **OK**
- > The activated software option is available

Checking the Software options

On the overview page, you can check which **Software options** are enabled for the product.

- Tap **Settings** in the main menu
- Tap **Service**
- Open in the sequence
  - **Software options**
  - **Overview**
- > A list of enabled **Software options** is displayed

Setting the date and time

- Tap **Settings** in the main menu
- Tap **General**
- Tap **Date and time**
- > The set values are displayed in the following format: Year, month, day, hour, minute
- To set the date and time in the middle line, drag the columns up or down
- Tap **Set** to confirm
- Select the desired format from the **Date format** list:
  - MM-DD-YYYY: Display as month, day, year
  - DD-MM-YYYY: Display as day, month, year
  - YYYY-MM-DD: Display as year, month, day

Further information: "Date and time", Page 466

Setting the units of measure

You can set various parameters to define the units of measure, rounding methods and decimal places.

- Tap **Settings** in the main menu
- Tap **General**
- Tap **Units**
- To set a unit of measure, tap the corresponding drop-down list and select the unit
- To set the rounding method, tap the corresponding drop-down list and select the rounding method
- To set the number of decimal places displayed, tap **-** or **+**

Further information: "Units", Page 466

7.3.2 Configuring the axes

The procedure varies depending on the interface type of the connected encoder:

- Encoders with EnDat interface:
  The encoder applies the parameters automatically

  Further information: "Configuring axes for encoders with EnDat interface", Page 143
- Encoders with 1 V_{pp} or 11 μA_{pp} or TTL interface:
  The parameters must be configured manually

For the parameters of HEIDENHAIN encoders that are typically connected to the product, refer to the overview of typical encoders.

Further information: "Overview of typical encoders", Page 149

Activating the reference mark search

The product uses the reference marks to reference the machine table to the machine. If the reference mark search has been activated, a wizard appears on startup of the product and asks the user to move the axes for the reference mark search.

Requirement: The installed encoders have reference marks that have been configured in the axis parameters.

> The reference mark search does not need to be performed for serial encoders with EnDat interface, because the axes are automatically homed.

> The automatic reference mark search on startup of the product can be canceled depending on the configuration.
>
> **Further information:** "Reference marks (Encoder)", Page 515

- Tap **Settings** in the main menu
- Tap **Axes**
- Open in the sequence
  - **General settings**
  - **Reference marks**
- Use the **ON/OFF** slide switch to activate the **Reference mark search after unit start** function
- > The reference marks must be traversed every time the product is started
- > The functions of the product will only be available after the reference mark search has been completed
- > The Reference symbol stops blinking upon successful completion of the reference mark search
  Further information: "Operating elements of the position display", Page 117

Configuring axes for encoders with EnDat interface

If the corresponding encoder input has already been assigned to an axis, a connected encoder with EnDat interface is automatically detected upon restart, and the settings are adapted. Alternatively, you can assign the encoder input after you have connected the encoder.

Requirement: An encoder with EnDat interface is connected to the product.

> The configuration procedure is the same for each axis. The procedure will now be explained using one axis as an example.

- Tap **Settings** in the main menu

- Tap **Axes**
- Tap the axis name or **Not defined** if appropriate
- If applicable, select the axis name for the axis in the **Axis name** drop-down list
- Tap **Encoder**
- Select the connection for the corresponding encoder from the **Encoder input** drop-down list:
  - X1
  - X2
  - X3
  - X4
- > The available encoder information is transmitted to the product
- > The settings are updated
- Select the type of encoder from the **Encoder model** drop-down list:
  - **Linear encoder**
  - **Angle encoder**
  - **Angle encoder as linear encoder**
- If you selected **Angle encoder as linear encoder**, then enter the **Mechanical ratio**
- If you selected **Angle encoder**, then select the **Display mode**
- Tap **Reference point displacement**
- Use the **ON/OFF** slide switch to activate or deactivate **Reference point displacement** (calculation of the offset between the reference mark and the machine zero point)
- If activated, enter the offset value for **Reference point displacement**
- Confirm the entry with **RET**

or

- To apply the current position as the offset value, tap **Apply** under **Current position for reference point shift**

- To switch to the previous display, tap **Back**
- > To view the electronic ID label of the encoder, tap **ID label**
- > In order to see the results of the encoder diagnosis, tap **Diagnosis**

Further information: "<Axis name> (settings of the axis)", Page 510

Configuring the axes for encoders with a 1 V_{PP} or 11 μA_{PP} interface

> The configuration procedure is the same for each axis. The procedure will now be explained using one axis as an example.

- Tap **Settings** in the main menu
- Tap **Axes**
- Tap the axis name or **Not defined** if applicable
- If applicable, select the axis name for the axis in the **Axis name** drop-down list
- Tap **Encoder**
- Select the connection for the corresponding encoder from the **Encoder input** drop-down list:
  - **X1**
  - **X2**
  - **X3**
  - **X4**
- Select the type of incremental signal from the **Incremental signal** drop-down list:
  - **1 Vpp**: Sinusoidal voltage signal
  - **11 µApp**: Sinusoidal current signal
- Select the encoder model from the **Encoder model** drop-down list:
  - **Linear encoder**: Linear axis
  - **Angle encoder**: Rotary axis
  - **Angle encoder as linear encoder**: A rotary axis is displayed as a linear axis
- Depending on the selection, enter further parameters:
  - For **Linear encoder**, enter the **Signal period** (see " Linear encoders", Page 149)
  - For **Angle encoder**, enter the **Line count** (see "Angle encoders", Page 150), or determine it using a teach sequence (see "Ascertaining the line count per revolution", Page 174)
  - For an **Angle encoder as linear encoder**, enter the **Line count** and the **Mechanical ratio**
- Confirm each input with **RET**
- For **Angle encoder**, select the **Display mode** if applicable
- Tap **Reference marks**
- Select the reference mark from the **Reference mark** drop-down list:
  - **None**: There is no reference mark
  - **One**: The encoder has one reference mark
  - **Coded**: The encoder has distance-coded reference marks
- If the linear encoder has coded reference marks, enter the **Maximum traverse path** (see " Linear encoders", Page 149)

- If the angle encoder has coded reference marks, enter the parameter for the **Nominal increment** (see "Angle encoders", Page 150)
- Confirm the entry with **RET**
- Use the **ON/OFF** slide switch to activate or deactivate **Inversion of reference mark pulses**
- Tap **Reference point displacement**
- Use the **ON/OFF** slide switch to activate or deactivate **Reference point displacement** (calculation of the offset between the reference mark and the machine zero point)
- If activated, enter the offset value for **Reference point displacement**
- Confirm the entry with **RET**
- To apply the current position as the offset value, tap **Apply** under **Current position for reference point shift**
- In order to switch to the previous display, tap **Back** twice
- In the **Analog filter frequency** drop-down list, select the frequency of the low-pass filter for suppressing high-frequency interference signals:
  - **33 kHz**: Interference frequencies above 33 kHz
  - **400 kHz**: Interference frequencies above 400 kHz
- Use the **ON/OFF** slide switch to activate or deactivate the **Terminating resistor** function

> The terminating resistor is automatically deactivated for incremental signals of the current signal type (11 μA_{PP})

- Select the type of error monitoring from the **Error monitor** drop-down list:
  - **Off**: Error monitoring not active
  - **Amplitude**: Error monitoring of the signal amplitude
  - **Frequency**: Error monitoring of the signal frequency
  - **Frequency & amplitude**: Error monitoring of the signal amplitude and signal frequency
- Select the desired counting direction from the **Counting direction** drop-down list:
  - **Positive**: The direction of traverse is in the counting direction of the encoder
  - **Negative**: The direction of traverse is opposite to the counting direction of the encoder

Further information: "<Axis name> (settings of the axis)", Page 510

Configuring axes for encoders with TTL interface

> The configuration procedure is the same for each axis. The procedure will now be explained using one axis as an example.

- Tap **Settings** in the main menu
- Tap **Axes**
- Tap the axis name or **Not defined** if applicable
- If applicable, select the axis name for the axis in the **Axis name** drop-down list
- Tap **Encoder**
- Select the connection for the corresponding encoder from the **Encoder input** drop-down list:
  - **X21**
  - **X22**
  - **X23**
  - **X24**
- Select the encoder model from the **Encoder model** drop-down list:
  - **Linear encoder**: Linear axis
  - **Angle encoder**: Rotary axis
  - **Angle encoder as linear encoder**: A rotary axis is displayed as a linear axis
- Depending on the selection, enter further parameters:
  - For **Linear encoder**, enter the **Signal period** (see " Linear encoders", Page 149)
  - For **Angle encoder** enter the **Output signals per revolution** (see "Angle encoders", Page 150), or determine them in a teach sequence (see "Ascertaining the output signals per revolution", Page 175)
  - For **Angle encoder as linear encoder**, enter the **Output signals per revolution** and the **Mechanical ratio**
- Confirm each input with **RET**
- For **Angle encoder**, select the **Display mode** if applicable
- Tap **Reference marks**
- Select the reference mark from the **Reference mark** drop-down list:
  - **None**: There is no reference mark
  - **One**: The encoder has one reference mark
  - **Coded**: The encoder has distance-coded reference marks
  - **Reverse coded**: The encoder has inverse-coded reference marks
- If the linear encoder has coded reference marks, enter the **Maximum traverse path** (see " Linear encoders", Page 149)
- If the angle encoder has coded reference marks, enter the parameter for the **Nominal increment** (see "Angle encoders", Page 150)

- Confirm the entry with **RET**
- If the encoder has coded reference marks, select the interpolation type from the **Interpolation** drop-down list:
  - **None**
  - **2-fold**
  - **5-fold**
  - **10-fold**
  - **20-fold**
  - **50-fold**
- Use the **ON/OFF** slide switch to activate or deactivate **Inversion of reference mark pulses**
- Tap **Reference point displacement**
- Use the **ON/OFF** slide switch to activate or deactivate **Reference point displacement** (calculation of the offset between the reference mark and the machine zero point)
- If activated, enter the offset value for **Reference point displacement**
- Confirm the entry with **RET**
- To apply the current position as the offset value, tap **Apply** under **Current position for reference point shift**

- In order to switch to the previous display, tap **Back** twice
- Use the **ON/OFF** slide switch to activate or deactivate the **Terminating resistor** function
- Select the type of error monitoring from the **Error monitor** drop-down list:
  - **Off**: Error monitoring not active
  - **Frequency**: Error monitoring of the signal frequency
- Select the desired counting direction from the **Counting direction** drop-down list:
  - **Positive**: The direction of traverse is in the counting direction of the encoder
  - **Negative**: The direction of traverse is opposite to the counting direction of the encoder

Further information: "<Axis name> (settings of the axis)", Page 510

Overview of typical encoders

The following overview lists the parameters of the HEIDENHAIN encoders that are typically connected to the product.

> When connecting other encoders, refer to the encoder's documentation for the required parameters.

Linear encoders

Encoder series	Interface	Signal period	Reference mark	Maximum traverse path
LS 328C	TTL	20 µm	Coded / 1000	20 mm
AK LIDA 27	TTL	20 µm	One	-
		4 µm		
		2 µm		
AK LIDA 47	TTL	4 µm	One	-
		4 µm	Coded / 1000*)	20 mm
		2 µm	One	-
		2 µm	Coded / 1000*)	20 mm
LS 388C	1 V_{PP}	20 µm	Coded / 1000	20 mm
AK LIDA 28	1 V_{PP}	200 µm	One	-
AK LIDA 48	1 V_{PP}	20 µm	One	-
AK LIF 48	1 V_{PP}	4 µm	One	-

*) "Coded / 1000" only in conjunction with the LIDA 4x3C scale

Examples of absolute encoders that are typically used

Encoder series	Interface	Measuring step
AK LIC 411	EnDat 2.2	1 nm 5 nm 10 nm
LIC 211 scanning head	EnDat 2.2	50 nm 100 nm

Angle encoders

Encoder series	Interface	Line count/ outputs signals per revolution	Reference mark	Nominal increment
RON 225	TTLx2	18000	One	-
RON 285	1 V_{PP}	18000	One	-
RON 285C	1 V_{PP}	18000	Coded	20°
RON 785	1 V_{PP}	18000	One	-
RON 785C	1 V_{PP}	18000	Coded	20°
RON 786	1 V_{PP}	18000	One	-
RON 786C	1 V_{PP}	18000	Coded	20°
ROD 220	TTLx2	18000	One	-
ROD 280	1 V_{PP}	18000	One	-
ROD 280C	1 V_{PP}	18000	Coded	20°

The formulae below enable you to calculate the nominal increment of the distance-coded reference marks with angle encoders:

Nominal increment = 360° ÷ number of reference marks × 2

Nominal increment = (360° × nominal increment in signal periods) ÷ line count

Performing error compensation for linear encoders

Mechanical influences such as guideway error, tilting in the end positions, mounting surface tolerances, or poor mounting (Abbe error) can cause measuring errors. With error compensation, the unit can automatically compensate for systematic measuring errors during measuring point acquisition. Through the comparison of nominal and actual values, one or more compensation factors can be defined and applied during subsequent measurements.

A distinction is made between the following methods:

Configuring error compensation for individual axes

- Linear error compensation (LEC): The compensation factor is calculated based on the specified length of a calibration standard (nominal length) and the actual distance traversed (actual length). The compensation factor is applied linearly to the entire measuring range.
- Segmented linear error compensation (SLEC): The axis is divided into multiple segments with the help of a maximum of 200 supporting points. A distinct compensation factor is defined and applied for every segment.

Configuring error compensation across axes

- Nonlinear error compensation (NLEC): By means of a maximum of a 99 supporting points, the measuring range is divided into a grid with multiple subareas. For every subarea, a distinct compensation factor is determined and applied.
- Squareness error compensation: The compensation factor is determined by comparing the nominal angle of the spatial axes with the measurement result. The compensation factor is applied to the entire measuring range.
- 3-D error compensation (VEC): Linear errors, rotational errors and squareness errors are compensated based on a compensation-value table. The compensation is applied to a defined measuring range.

NOTICE

Subsequent modifications to the encoder settings can result in measuring errors

If encoder settings such as the encoder input, encoder model, signal period, or reference marks are changed, previously determined compensation factors may no longer apply.

- If you change encoder settings, then you need to reconfigure the error compensation

For all methods, the actual error curve must be exactly measured (e.g., with the help of a comparator measuring device or calibration standard).

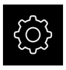
Linear error compensation and segmented linear error compensation cannot be combined with each other.

3-D error compensation cannot be combined with nonlinear error compensation or squareness error compensation.

If you enable a reference point shift, then you need to reconfigure the error compensation. This helps you avoid measuring errors.

Configuring linear error compensation (LEC)

With linear error compensation (LEC) the product applies a compensation factor that is calculated from the specified length of a reference standard (nominal length) and the actual traverse path (actual length). The compensation factor is applied to the complete measuring range.



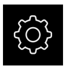
- Tap **Settings** in the main menu

- Tap **Axes**
- Select the axis
- Open in the sequence
  - **Error compensation**
  - **Linear error compensation (LEC)**
- Enter the length of the reference standard (nominal length)
- Confirm the entry with **RET**
- Enter the length of the actual traverse path determined by measure (actual length)
- Confirm the entry with **RET**
- Use the **ON/OFF** slider to activate the **Compensation** function

Further information: "Linear error compensation (LEC)", Page 517

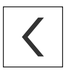
Configuring segmented linear error compensation (SLEC)

For a segmented linear error compensation (SLEC), you divide the axis into short segments by defining up to 200 supporting points. The deviations between the actual distance traversed and the segment length in the individual segments determine the compensation values that compensate the mechanical influences acting on the axis.



- Tap **Settings** in the main menu

- Tap **Axes**
- Select the axis
- Open in the sequence
  - **Error compensation**
  - **Segmented linear error compensation (SLEC)**
- Use the **ON/OFF** slider to deactivate the **Compensation** function
- Tap **Create table of supporting points**
- Tap **+** or **-** to set the desired **Number of supporting points** (max. 200)
- Enter the desired **Spacing of the supporting points**
- Confirm the entry with **RET**
- Enter a value in **Start point**
- Confirm the entry with **RET**
- Tap **Create** to create the table of supporting points
- > The table of supporting points is created
- > The table lists the **supporting point positions (P)** and the **compensation values (D)** of the individual segments
- Enter the compensation value (D) **"0.0"** for supporting point **0**
- Confirm the entry with **RET**
- Enter the measured compensation value into the **compensation value (D)** input field for each supporting point created
- Confirm the entry with **RET**



- To switch to the previous display, tap **Back** twice
- Use the **ON/OFF** slider to activate the **Compensation** function
- > The error compensation for the axis is applied

Further information: "Segmented linear error compensation (SLEC)", Page 517

Adjusting an existing table of supporting points

After a table of supporting points for segmented linear error compensation has been created, this table can then be modified as needed.

- Tap **Settings** in the main menu
- Tap **Axes**
- Select the axis
- Open in the sequence
  - **Error compensation**
  - **Segmented linear error compensation (SLEC)**
- Use the **ON/OFF** slider to deactivate the **Compensation** function
- Tap **Table of supporting points**
- > The table lists the **supporting point positions (P)** and the **compensation values (D)** of the individual segments
- Adjust the **compensation value (D)** for the supporting points
- Confirm the entries with **RET**
- To switch to the previous display, tap **Back**
- Use the **ON/OFF** slider to activate the **Compensation** function
- > The adjusted error compensation for the axis is applied

Further information: "Segmented linear error compensation (SLEC)", Page 517

Configuring Nonlinear error compensation (NLEC)

For a **Nonlinear error compensation (NLEC)** the measuring range is divided into a grid of identically sized surface segments using up to 99 supporting points. For each of the surface segments, a specific compensation factor is determined by comparing nominal and actual values (the measured values) at the supporting points.

The following options are available for measuring the nominal and actual values of the supporting points:

Acquiring nominal values

- Read deviations from the calibration standard (ACF)
- Create a table of supporting points manually

Acquiring actual values

- Import the table of supporting points (TXT or XML)
- Determine the actual values using a teach sequence
- Acquire the actual values manually

> The following specifications apply to import files:
> - File names must not contain diacritics or special characters
> - Use a point as decimal character

> In the following situations, both nominal and actual values in the existing table of supporting points will be overwritten:
> - If you change the number or spacing of the supporting points manually
> - If you import a file that contains deviating information on the number or spacing of the supporting points

Further information: "Nonlinear error compensation (NLEC)", Page 508

Deactivating the nonlinear axis error compensation

Before you can configure the **Nonlinear error compensation (NLEC)**, you first need to deactivate it.

- Tap **Settings** in the main menu
- Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- Use the **ON/OFF** slider to deactivate the **Compensation** function
- > The table of supporting points is now released for editing

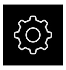
Reading deviations from the calibration standard

> The manufacturer of the calibration standard usually provides you with specifications about the deviations.

Prerequisites:

- An ACF file contains the nominal values; this file must match the import scheme of the product

  Further information: "Creating an ACF import file", Page 156
- The **Nonlinear error compensation (NLEC)** has been deactivated



- ▶ Tap **Settings** in the main menu

- ▶ Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- ▶ Tap **Read deviations of calibration standard**
- ▶ Navigate to the desired folder
- ▶ Tap the desired file (.ACF)
- ▶ Tap **Select**
- > The nominal values are imported from the file

Creating an ACF import file

To import the calibration data into the product, you must acquire these in an ACF file.

- ▶ Open a new file in the text editor of your computer
- ▶ Save the file under a unique name and the *.acf file extension
- ▶ Enter the values, separated by tab stops as shown in the schema below

> The following specifications apply to import files:
> - ▶ File names must not contain diacritics or special characters
> - ▶ Use a point as decimal character

ACF schema

The ACF file contains the nominal values of the supporting points on the X and Y axes. The nominal values have been corrected by the deviations from the calibration standard.

The following example shows a grid of 5 x 5 supporting points with a spacing of 25 mm on the X axis and 20 mm on the Y axis, oriented along the X axis.

Example

MM	X
25.0	20.0
5	5
0.0000	0.0000
25.0012	-0.0010
50.0003	-0.0006
75.0010	0.0016
100.0021	0.0000
0.00005	20.0020
25.0013	20.0021
50.0013	20.0022
75.0005	20.0023
99.9996	20.0003
-0.00010	39.9998
24.9981	39.9979
49.9999	40.0001
75.0004	40.0021
100.0019	40.0008
0.00003	59.9992
25.0000	60.0018
50.0001	60.0003
75.0020	59.9990
100.0001	60.0001
-0.00003	80.0021
24.9979	80.0004
50.0020	79.9991
75.0001	79.9985
100.0010	80.0002

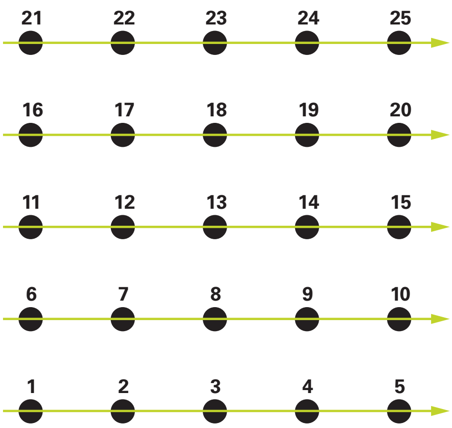
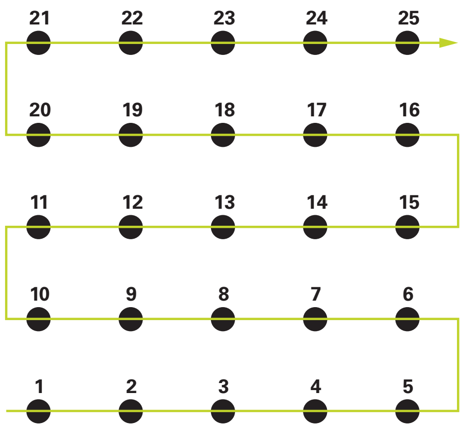
Explanation

The overview below shows the structure of the ACF import file.

Value	Explanation	Value	Explanation
MM	Millimeters (not configurable)	X	Alignment axis (X or Y)
25.0	Spacing of supporting points on the X axis	20.0	Spacing of supporting points on the Y axis
5	Number of supporting points on the X axis	5	Number of supporting points on the Y axis
0.0000	Nominal value of the first supporting point on the X axis	0.0000	Nominal value of the first supporting point on the Y axis
25.0012	Nominal value of the second supporting point on the X axis	-0.0010	Nominal value of the second supporting point on the Y axis

> The file contains an additional row with X and Y values for each supporting point.

> The supporting points can be indicated row by row or in a meander-shaped sequence. The product adapts the reading direction automatically.

Row-by-row reading direction	Meander-shaped reading direction
	

Creating a table of supporting points manually

- ▶ Tap **Settings** in the main menu
- ▶ Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- ▶ Enter the **Number of supporting points** for the first axis
- ▶ Confirm your input with **RET**
- ▶ Enter the **Spacing of the supporting points** for the first axis
- ▶ Confirm your input with **RET**
- ▶ Repeat this procedure for the second axis
- > The number and spacing of the supporting points are written to the table of supporting points
- > The existing table of supporting points is overwritten

Importing the table of supporting points

To adjust the actual values of the supporting points, you can import the following file types:

- XML: contains actual values
- TXT: contains actual values
- Extended TXT: contains deviations from the nominal values

Prerequisites:

- You have an XML or TXT file that matches the import scheme of the product
  Further information: "Creating an XML import file", Page 164
  Further information: "Creating a TXT import file", Page 160
- The **Nonlinear error compensation (NLEC)** has been deactivated

- ▶ Tap **Settings** in the main menu
- ▶ Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- ▶ Tap **Import table of supporting points**
- ▶ Navigate to the desired folder
- ▶ Tap the desired file (TXT or XML)
- ▶ Tap **Select**
- > Depending on the imported file type, the table of supporting points is adjusted as follows:
  - **XML**: The actual values are imported from the file
  - **TXT**: The actual values are imported from the file
  - **Extended TXT**: The actual values are corrected by the deviations

> **i** In order to keep the nominal values in the original table of supporting points, define the number and spacing in the import file in the same way as in the original table of supporting points. Otherwise, the nominal values will be overwritten by the grid specified in the import file. Any deviations from the calibration standard that have been read in before will be lost.

Creating a TXT import file

- Open a new file in the text editor of your computer
- Save the file under a unique name and add the *.txt file extension
- Enter the data, separated by tab stops according to one of the schemas below:
  - TXT schema: The file contains the actual values of the supporting points
  - Extended TXT schema: The file contains deviations from the theoretical nominal value

> **i** The following specifications apply to import files:
> - File names must not contain diacritics or special characters
> - Use a point as decimal character

TXT schema

The TXT file contains the actual values of the supporting points on the X and Y axes.

The following example shows a grid of 5 x 5 supporting points with a spacing of 25 mm on the X axis and 20 mm on the Y axis, oriented along the X axis.

Example

MM	X
25.0	20.0
5	5
0.0000	0.0000
25.0012	-0.0010
50.0003	-0.0006
75.0010	0.0016
100.0021	0.0000
0.00005	20.0020
25.0013	20.0021
50.0013	20.0022
75.0005	20.0023
99.9996	20.0003
-0.00010	39.9998
24.9981	39.9979
49.9999	40.0001
75.0004	40.0021
100.0019	40.0008
0.00003	59.9992
25.0000	60.0018
50.0001	60.0003
75.0020	59.9990
100.0001	60.0001
-0.00003	80.0021

MM	X
24.9979	80.0004
50.0020	79.9991
75.0001	79.9985
100.0010	80.0002

Explanation

The following overview explains the values that you can define individually. All values not listed here must be copied as is from the example. The values must be separated by tab stops.

Value	Explanation	Value	Explanation
MM	Unit of measurement: millimeters (alternatively: IN for inches)	X	Alignment axis (X or Y)
25.0	Spacing of supporting points on the X axis	20.0	Spacing of supporting points on the Y axis
5	Number of supporting points on the X axis	5	Number of supporting points on the Y axis
0.0000	Actual value of the first supporting point on the X axis	0.0000	Actual value of the first supporting point on the Y axis
25.0012	Actual value of the second supporting point on the X axis	-0.0010	Actual value of the second supporting point on the Y axis

> **i** The file contains an additional row with X and Y values for each supporting point.

Extended TXT schema

The extended TXT file contains the deviations of the supporting points from the nominal values on the X and Y axes.

The following example shows a grid with 5 x 5 supporting points with a spacing of 25 mm on the X axis and 20 mm on the Y axis.

Example

NLEC Data File

0.91

// Serial Number = CA-1288-6631-1710

MM

ON

Number of Grid Points (x, y):

5	5

Grid Block Size (x, y):

25.0	20.0

Offset:

0	0

Station (1, 1)

0.00000	0.00000

Station (2, 1)

0.00120	-0.00100

Station (3, 1)

0.00030	-0.00060

Station (4, 1)

0.00100	0.00160

Station (5, 1)

0.00210	0.00000

Station (1, 2)

0.00005	0.00200

Station (2, 2)

0.00130	0.00210

Station (3, 2)

0.00130	0.00220

Station (4, 2)

0.00050	0.00230

Station (5, 2)

-0.00040	0.00030

Station (1, 3)

-0.00010	-0.00020

Station (2, 3)

-0.00190	-0.00210

Station (3, 3)

-0.00010	0.00010

Station (4, 3)

0.00040	0.00210

Station (5, 3)

0.00190	0.00080

Station (1, 4)

NLEC Data File

0.00003	-0.00080
Station (2, 4)	
0.00000	0.00180
Station (3, 4)	
-0.00010	0.00030
Station (4, 4)	
0.00200	-0.00100
Station (5, 4)	
0.00010	0.00010
Station (1, 5)	
-0.00003	0.00210
Station (2, 5)	
-0.00210	0.00040
Station (3, 5)	
0.00200	-0.00090
Station (4, 5)	
0.00010	-0.00150
Station (5, 5)	
0.00100	0.00020

Explanation

The following overview explains the values that you can define individually. All values not listed here must be copied as is from the example.

Value		Explanation
// Serial Number = CA-1288-6631-1710		Serial number (optional)
MM		Unit of measurement: millimeters (alternatively: IN for inches)
Number of Grid Points (x, y):		
5	5	Number of supporting points on the X and Y axes
Grid Block Size (x, y):		
25.0	20.0	Spacing of the supporting points on the X and Y axes
Station (1, 1):		
0.00000	0.00000	Deviation of the first supporting point on the X and Y axes
Station (2, 1):		
0.00120	-0.00100	Deviation of the second supporting point on the X and Y axes

> The file contains a **Station (x, y)** section for each supporting point, indicating the deviations on the X and Y axes.

Creating an XML import file

To create an XML import file, you can either export the existing table of supporting points and edit it as required or create a new file from scratch.

Exporting and editing a table of supporting points

- Tap **Settings** in the main menu
- Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- Tap **Export table of supporting points**
- Select the desired location, e.g. an external storage medium
- Navigate to the desired folder
- Save file under a unique name
- Edit the values in the XML editor or in a text editor available on your computer

> The exported XML file also contains the nominal values of the supporting points (**<group id="Standard"> </group>** section). This data will not be taken into account when the file is imported. You may remove this section from the import file, if desired.

Creating a new file

- Create a new file in the XML editor or in a text editor available on your computer
- Save the file under a unique name and add the *. xml file extension
- Enter the data as shown in the schema shown below

> The following specifications apply to import files:
> - File names must not contain diacritics or special characters
> - Use a point as decimal character

XML schema

The XML file contains the actual values of the supporting points on the X and Y axes.

The following example shows a grid of 5 x 5 supporting points with a spacing of 25 mm on the X axis and 20 mm on the Y axis.

Example

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
<base id="Settings">
<group id="CellSize">
<element id="x">25</element>
<element id="y">20</element>
</group>
<group id="General">
<element id="enabled">false</element>
```

```
<?xml version="1.0" encoding="UTF-8"?>
</group>
<group id="GridSize">
<element id="x">5</element>
<element id="y">5</element>
</group>
<group id="Level0">
<element id="Position" Angle="0" Z="0" Y="0" X="0"/>
<element id="0-0" Y="0" X="0"/>
<element id="1-0" Y="-0.001" X="25.001200000000001"/>
<element id="2-0" Y="-0.00059999999999999995" X="50.000300000000003"/>
<element id="3-0" Y="0.0016000000000000001" X="75.001000000000005"/>
<element id="4-0" Y="0" X="100.0021"/>
<element id="0-1" Y="20.001999999999999" X="5.0000000000000002"/>
<element id="1-1" Y="20.002099999999999" X="25.001300000000001"/>
<element id="2-1" Y="20.002199999999998" X="50.001300000000001"/>
<element id="3-1" Y="20.002300000000002" X="75.000500000000002"/>
<element id="4-1" Y="20.000299999999999" X="99.999600000000001"/>
<element id="0-2" Y="39.9998" X="-0.0001"/>
<element id="1-2" Y="39.997900000000001" X="24.998100000000001"/>
<element id="2-2" Y="40.000100000000003" X="49.999899999999997"/>
<element id="3-2" Y="40.002099999999999" X="75.000399999999999"/>
<element id="4-2" Y="40.000799999999998" X="100.00190000000001"/>
<element id="0-3" Y="59.999200000000002" X="3.0000000000000001"/>
<element id="1-3" Y="60.001800000000003" X="25"/>
<element id="2-3" Y="60.000300000000003" X="49.999899999999997"/>
<element id="3-3" Y="59.999000000000002" X="75.001999999999995"/>
<element id="4-3" Y="60.000100000000003" X="100.0001"/>
<element id="0-4" Y="80.002099999999999" X="-3.0000000000000001"/>
<element id="3-4" Y="79.998500000000007" X="75.000100000000003"/>
<element id="2-4" Y="79.999099999999999" X="50.002000000000002"/>
<element id="4-4" Y="80.000200000000007" X="100.001"/>
</group>
</base>
<base id="version" build="0" minor="4" major="1"/>
</configuration>
```

Explanation

The following overview explains the parameters and values that you can define individually. All items not listed here must be copied as is from the example.

Group	Parameters and values (example)	Explanation
<group id="**CellSize**">	<element id="x">**25**</element>	Spacing of supporting points on the X axis. In this example: 25 mm
	<element id="y">**20**</element>	Spacing of supporting points on the Y axis. In this example: 20 mm
<group id="**GridSize**">	<element id="x">**5**</element>	Number of supporting points on the X axis. In this example: 5 supporting points
	<element id="y">**5**</element>	Number of supporting points on the Y axis. In this example: 5 supporting points
<group id="**Level0**">	<element id="0-0" Y="**0**" X="**0**"/>	Actual value of the first supporting point in mm. In this example: ■ X = 0 ■ Y = 0
	<element id="1-0" Y="**-0.001**" X="**25.001200000000001**"/>	Actual value of the supporting point in mm. In this example: ■ X = -0.001 ■ Y = 25.001200000000001
	For each supporting point, the group contains an additional element with these parameters.	

Determining the actual values using a teach sequence

This action cannot be undone.

- Tap **Settings** in the main menu
- Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- To start the teach sequence, tap **Start**
- > The wizard is displayed in the **Measure** menu
- Follow the instructions of the wizard
- Measure or construct the required feature
- Tap **Confirm** in the wizard to continue

The feature acquired last will be transferred to the table of supporting points.

- Tap **Close** to close the wizard
- > Values measured in the teach sequence are transferred as actual values to the table of supporting points
- > After the teach sequence is complete, the **Measure** menu appears

Acquire the actual values manually

- Tap **Settings** in the main menu
- Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- Tap **Table of supporting points**
- Enter the actual values of the supporting points
- Confirm each entry with **RET**

Activating the nonlinear error compensation

- Tap **Settings** in the main menu
- Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- Use the **ON/OFF** slider to activate the **Compensation** function
- > The error compensation is applied from the next measurement

Delete table of supporting points

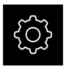
You can delete any deviations saved in the table of supporting points. This applies to deviations of the calibration standard as well as to measured or imported actual values. The number and spacing of the supporting points are maintained.

Prerequisite: Non-linear error compensation is deactivated.

- Tap **Settings** in the main menu.
- Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Nonlinear error compensation (NLEC)**
- To delete the table of supporting points, tap **Reset**
- Confirm the prompt with **OK**
- > The deviations of the calibration standard are deleted
- > The actual values of the supporting points and the nominal values are equalized

Configuring Squareness error compensation (SEC)

Squareness error compensation (SEC) enables angular errors to be compensated during measuring point acquisition. The compensation factor is determined by comparing the deviation of the actual measurement result from the nominal angle of the spatial axes. The compensation factor is applied to the entire measuring range.



- Tap **Settings** in the main menu.

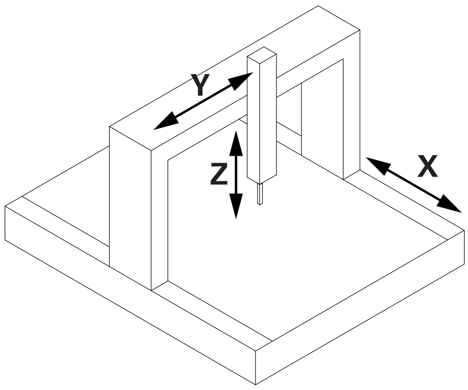
- Open in the sequence
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **Squareness error compensation (SEC)**
- > The measured values (M) and nominal values (S) of the three spatial axes are displayed
- Enter the measured values of the reference standard (= nominal values)
- Activate **Compensation** with the **ON/OFF** sliding switch
- > Squareness error compensation is applied from the next measurement

Further information: "Squareness error compensation (SEC)", Page 509

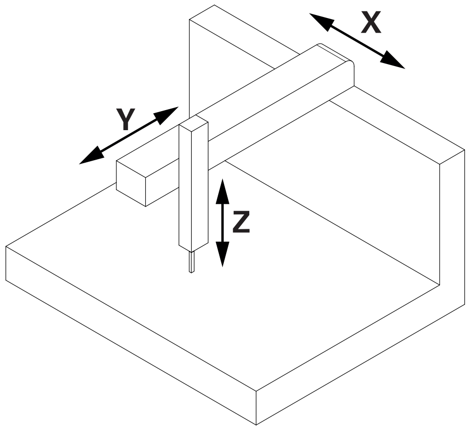
Configuring 3-D error compensation (VEC)

3-D error compensation is intended for gantry-type or cantilever-type coordinate measuring machines.

Gantry design



Cantilever design



3-D error compensation takes the 21 error sources resulting from a three-axis machine setup into account. The following errors are compensated during measuring point acquisition:

- Linear errors of the X, Y and Z axes
  - Linearity of position error
  - Horizontal straightness deviation
  - Vertical straightness deviation
- Rotational errors of the X, Y and Z axes
  - Pitch
  - Yaw
  - Roll
- Squareness error of the projection planes XY, YZ and ZX

Each compensation value consists of different parameters For rotational errors, the compensation values are calculated depending on the machine setup.

3-D error compensation is applied to a defined compensation range.

Prerequisite:

- The compensation-value table is available as a TXT file that matches the import scheme of the product

Further information: "Creating a TXT import file", Page 171

> The product does not support creation and execution of the compensation-value table.

- Tap **Settings** in the main menu.

- Open in succession:
  - **Axes**
  - **General settings**
  - **Error compensation**
  - **3-D error compensation (VEC)**

- To import the compensation values, tap **Import table of supporting points**
- Navigate to the desired folder
- Tap the desired file (TXT)
- Tap **Select**
- > The compensation values are imported from the file
- If applicable, select the setting that corresponds to the machine setup in the **Stacking order** drop-down list.
- To align the starting point of the compensation with the machine coordinates, enter the offset for each axis in the corresponding field:
  - **X offset**
  - **Y offset**
  - **Z offset**
- Activate **Compensation** with the **ON/OFF** sliding switch
- > The 3-D error compensation is applied from the next measurement

Further information: "3-D error compensation (VEC)", Page 509

Creating a TXT import file

- Open a new file in the text editor of your computer
- Save the file under a unique name and add the *.txt file extension
- Enter the data, separated by tab stops, as shown in the schema below

> The following specifications apply to import files:
> - File names must not contain diacritics or special characters
> - Use a point as decimal character

TXT schema

The compensation-value table defines the compensation range and contains the compensation values for squareness errors, linear errors and rotational errors.

Example

*** Squareness ***						
XY = 100,000 µm/M						
YZ = -200,000 µm/M						
ZX = 300,000 µm/M						
Pos (mm)	TX (µm)	TY (µm)	TZ (µm)	RX (µm/M)	RY (µm/M)	RZ (µm/M)
X						
-100						
100						
100						
X-100	10.0	10.0	10.0	100.0	100.0	100.0
X0	0.0	0.0	0.0	0.0	0.0	0.0
X100	-30.0	-30.0	-30.0	-300.0	-300.0	-300.0
Y						
-50,000						
100,000						
50,000						
Y-50	10.0	10.0	10.0	100.0	100.0	100.0
Y0	0.0	0.0	0.0	0.0	0.0	0.0
Y50	-20.0	-20.0	-20.0	-200.0	-200.0	-200.0
Y100	30.0	30.0	30.0	300.0	300.0	300.0
Z						
-50,000						
100						
25						
Z-50	20.0	20.0	20.0	200.0	200.0	200.0
Z-25	10.0	10.0	10.0	100.0	100.0	100.0
Z0	0.0	0.0	0.0	0.0	0.0	0.0
Z25	20.0	20.0	20.0	200.0	200.0	200.0
Z50	-30.0	-30.0	-30.0	-300.0	-300.0	-300.0
Z75	40.0	40.0	40.0	400.0	400.0	400.0
Z100	50.0	50.0	50.0	500.0	500.0	500.0

Explanation

> Linear compensation values are given in micrometers. The compensation values for squareness and rotation are given in micrometers per meter (unit of the strain).

Squareness error compensation section:

The ***** Squareness ***** section contains the compensation values for squareness error compensation.

Parameter	Explanation
XY	Compensation value of the XY projection plane Unit: Micrometer per meter
YZ	Compensation value of the YZ projection plane Unit: Micrometer per meter
ZX	Compensation value of the ZX projection plane Unit: Micrometer per meter

Linear and rotational error compensation section

The header contains the following parameters:

Parameter	Explanation
Item	Position value Unit: millimeters
TX	Compensation value of linear position deviation Unit: micrometers
TY	Compensation value of horizontal straightness deviation (in viewing direction of the axis) Unit: micrometers
TZ	Compensation value of vertical straightness deviation (in viewing direction of the axis) Unit: micrometers
RX	Compensation value of rotation about the X axis Unit: Micrometer per meter
RY	Compensation value of rotation about the Y axis Unit: Micrometer per meter
RZ	Compensation value of rotation about the Z axis Unit: Micrometer per meter

This is followed by one section per axis in the sequence X, Y, and Z. The first three values in each section define the compensation range.

Example	Explanation
X	Section with compensation values for the X axis
-100	Starting position of error compensation on the X axis
100	End position of error compensation on the X axis
100	Spacing of supporting points on the X axis

This is followed by several lines with compensation values.

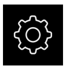
Example:

Pos (mm)	TX (µm)	TY (µm)	TZ (µm)	RX (µm/M)	RY (µm/M)	RZ (µm/M)
X-100	10.0	10.0	10.0	100.0	100.0	100.0

The compensation values in a line refer to the position given in column 1. Each line must contain all of the six compensation values. The number of lines varies and can be different from axis to axis.

Ascertaining the line count per revolution

For angle encoders with interfaces of the type 1 V_{PP} or 11 μA_{PP} you can use a teach sequence to ascertain the exact line count per revolution.



- Tap **Settings** in the main menu

- Tap **Axes**
- Tap the desired axis designation or **Not defined**, if applicable
- If applicable, select the name of the axis in the **Axis name** drop-down list.
- Tap **Encoder**
- From the **Encoder model** drop-down list, select the **Angle encoder** type
- For **Display mode** select the **- ∞ ... ∞** option
- Tap **Reference marks**
- Select one of the following options from the **Reference mark** drop-down list:
  - **None**: There is no reference mark
  - **One**: The encoder has one reference mark

- In order to switch to the previous axis, tap **Back**
- To start the teach sequence, tap **Start**
- > The teach sequence is started and the wizard is displayed
- Follow the instructions of the wizard
- > The line count determined during the teach sequence is transferred to the **Line count** field

The ascertained line count remains stored if you select a different display mode after the teach sequence.

Further information: "Settings for encoders with interfaces of the type 1 V_{PP} or 11 A_{PP}", Page 512

Ascertaining the output signals per revolution

For angle encoders with interfaces of the type TTL you can use a teach sequence to ascertain the exact quantity of output signals per revolution.

- Tap **Settings** in the main menu
- Tap **Axes**
- Tap the desired axis designation or **Not defined**, if applicable
- If applicable, select the name of the axis in the **Axis name** drop-down list.
- Tap **Encoder**
- From the **Encoder model** drop-down list, select the **Angle encoder** type
- For **Display mode** select the **- ∞ ... ∞** option
- Tap **Reference marks**
- Select one of the following options from the **Reference mark** drop-down list:
  - **None**: There is no reference mark
  - **One**: The encoder has one reference mark
- In order to switch to the previous axis, tap **Back**
- To start the teach sequence, tap **Start**
- > The teach sequence is started and the wizard is displayed
- Follow the instructions of the wizard
- > The number of output signals determined during the teach sequence is transferred to the **Output signals per revolution** field

> The ascertained quantity of output signals remains stored if you select a different display mode after the teach sequence.

Further information: "Settings for encoders with interfaces of the TTL type", Page 514

7.3.3 Configuring a VED sensor

If the QUADRA-CHEK 3000 VED software option is enabled, the VED sensor needs to be configured. This section describes the configuration procedure.

Setting the camera

> The product supports the use of a connected camera. Connecting more than one camera can lead to faulty settings and incorrect measurement results.
>
> If no camera is detected, the product will switch to the virtual camera. In this case, the live image will show the 2-D demo part.

Setting the USB camera

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Camera**
- > The list of available cameras is displayed
- > USB cameras are indicated by **(USB)** at the end of their name
- Tap the USB camera you want to use
- Tap **Activate** first, if necessary, to activate an inactive camera
- > The camera is activated
- > The first lines show the camera data
- Select the desired pixel format from the **Pixel format** drop-down list
- Tap **-** or **+** to set the **Pixel clock (MHz)**
- Tap **-** or **+** to set the **Frame rate (fps)**
- Tap **-** or **+** to set the **Detail: Width**
- Tap **-** or **+** to set the **Detail: Height**
- Tap **-** or **+** to set the **Detail: X position**
- Tap **-** or **+** to set the **Detail: Y position**
- Drag the **slider** to the desired position to adjust the **Master gain**
- Drag the **slider** to the desired position to adjust the **Red gain**
- Drag the **slider** to the desired position to adjust the **Green gain**
- Drag the **slider** to the desired position to adjust the **Blue gain**
- Tap **-** or **+** to set the **Exposure time (µs)**
- > The new camera settings are applied

Further information: "Camera", Page 470

Setting the Ethernet camera

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Camera**
- > The list of available cameras is displayed
- > Ethernet cameras are indicated by **(GigE)** at the end of their name
- Tap the Ethernet camera you want to use
- Tap **Activate** first, if necessary, to activate an inactive camera
- > The camera is activated
- > The first lines show the camera data
- Select the desired pixel format from the **Pixel format** drop-down list
- Tap **Network settings**
- > The **Network settings** dialog appears
- Depending on the network environment, activate or deactivate **DHCP** with the **ON/OFF** slider
- In the dialog, enter the **IPv4 address** and **IPv4 subnet mask** you want to use
- Confirm each entry with **ON/OFF**
- Save the settings in the dialog with **OK**
- > The dialog is closed
- Tap **-** or **+** to set the **Pixel clock (MHz)**
- Tap **-** or **+** to set the **Frame rate (fps)**
- Tap **-** or **+** to set the **Detail: Width**
- Tap **-** or **+** to set the **Detail: Height**
- Tap **-** or **+** to set the **Detail: X position**
- Tap **-** or **+** to set the **Detail: Y position**
- Drag the **slider** to the desired position to adjust the **Master gain**
- Drag the **slider** to the desired position to adjust the **Red gain**
- Drag the **slider** to the desired position to adjust the **Green gain**
- Drag the **slider** to the desired position to adjust the **Blue gain**
- Tap **-** or **+** to set the **Exposure time (µs)**
- > The new camera settings are applied

Further information: "Camera", Page 470

Activating the virtual camera

To try out examples described in these instructions, you can activate a virtual camera. When you use the virtual camera, an image of the 2-D demo part is displayed in the live image.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Camera**
- > The list of available cameras is displayed
- Tap the virtual camera you want to use
- Tap **Activate** first, if necessary, to activate an inactive camera
- > The camera is activated

Replacing the live image of the virtual camera

When you use a virtual camera, an image is displayed in the workspace. You can replace this image with an image of your choice, provided that a geometry in that image is known and can be used for determining the pixel size.

> Only images in PNG and JPG file formats and with an image size of 1280 x 1024 px can be displayed.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Camera**
- > The list of available cameras is displayed
- Tap the virtual camera you want to use
- Tap **Activate** first, if necessary, to activate an inactive camera
- To select the source for the image displayed in the workspace, tap **Image directory**
- Select the folder and confirm with **OK**
- > The image stored in the selected folder is displayed in the workspace

Further information: "Camera", Page 470

Setting the magnification

For camera systems with adjustable optical magnifications, the pixel size must be determined for each magnification. This ensures the correct size ratio between the live image and the measured object during a measurement. Before the pixel sizes can be determined for the magnifications, the magnifications provided by the measuring machine need to be entered into the product.

Further information: "Determining the pixel sizes", Page 187

The number of magnifications depends on the measuring machine connected to the product.

Adjusting the magnification

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Magnifications**
- Set a magnification in the camera system, e.g. 1.0
- Tap **VED Zoom 1**, for example
- Tap the **Description** input field
- Adapt the existing description
- Confirm the entry with **RET**
- Tap the **Acronym for quick access menu** input field
- Adapt the existing acronym
- Confirm the entry with **RET**
- > The magnification list shows the magnification together with the adapted information

Further information: "Magnifications", Page 472

Adding a magnification

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Magnifications**
- Set a magnification in the camera system, e.g. 2.0
- Tap **Add**
- Tap the **Description** input field
- Enter a description for the magnification you have set
- Confirm the entry with **RET**
- Tap the **Acronym for quick access menu** input field
- Enter a meaningful acronym
- Confirm the entry with **RET**
- > The acronym is needed for selecting the magnification in the quick access menu of the Inspector
- Tap **Add**
- > The new magnification appears in the magnification list

Further information: "Magnifications", Page 472

Removing magnifications

Magnifications that are no longer needed can be removed from the list.

> Only inactive magnifications can be removed.

- Tap **Measure** in the main menu
- Tap the **quick access menu** in the Inspector
- Select a magnification that is not to be deleted
- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Magnifications**
- > The active magnification is indicated by a check mark
- Tap the inactive magnification that you want to remove
- Tap **Remove**
- To confirm the removal, tap **Remove** in the dialog
- > The magnification is removed from the magnification list

Adjusting the lighting

Linking the lighting to the magnification

The light intensity that reaches the VED sensor, e.g. through the camera optics, decreases with increasing magnification. To compensate the reduced brightness, you can link the lighting to the magnification.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Lighting**
- Tap **General settings**
- To activate or deactivate the link between the lighting and the magnification, drag the **ON/OFF** slider to the desired position
- > When the link is active, the lighting settings are saved for the respective magnification
- > When the link is not active, you need to manually adjust the lighting if you change the magnification

Lighting configurations

The range of lighting functions depends on the light unit of the connected measuring machine.

The product supports the following configurations:

- **A transmitted light + 4 x AD reflected light**
- **A trans.light + 4 x A refl.light + D laser pointer**
- **AD trans.light + 4 x AD refl.light + AD coaxial light + exposure time**

Further information: "Lighting", Page 473

Setting the A transmitted light + 4 x AD reflected light lighting

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Lighting**
- > The list of available lighting configurations is displayed
- Tap **A transmitted light + 4 x AD reflected light**
- If necessary, tap **Activate** to activate an inactive lighting
- Select the desired analog output from the **Analog output for transmitted light** drop-down list
- Select the desired analog output from the **Analog output for reflected light** drop-down list
- Select the desired digital output from the **Digital output for front segment** drop-down list
- Select the desired digital output from the **Digital output for rear segment** drop-down list
- Select the desired digital output from the **Digital output for left segment** drop-down list
- Select the desired digital output from the **Digital output for right segment** drop-down list
- > The lighting can now be adjusted with the **lighting palette**.

Further information: "Lighting", Page 473

Setting the A trans.light + 4 x A refl.light + D laser pointer lighting

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Lighting**
- > The list of available lighting configurations is displayed
- Tap **A trans.light + 4 x A refl.light + D laser pointer**
- If necessary, tap **Activate** to activate an inactive lighting
- Select the desired analog output from the **Analog output for transmitted light** drop-down list
- Select the desired analog output from the **Analog output for front segment** drop-down list
- Select the desired analog output from the **Analog output for rear segment** drop-down list
- Select the desired analog output from the **Analog output for left segment** drop-down list
- Select the desired analog output from the **Analog output for right segment** drop-down list
- Select the desired digital output from the **Digital output for laser pointer** drop-down list
- > The lighting can now be adjusted with the **lighting palette**.

Further information: "Lighting", Page 473

Setting AD trans.light + 4 x AD refl.light + AD coaxial light + exposure time lighting

Activating the lighting

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Lighting**
- > The list of available lighting configurations is displayed
- Tap **AD trans.light + 4 x AD refl.light + AD coaxial light + exposure time**
- If necessary, tap **Activate** to activate an inactive lighting

> Use the **ON/OFF** slider to activate or deactivate the transmitted light, reflected light, coaxial light, and camera exposure time individually.

Configuring the transmitted light

- Tap **Transmitted light**
- > The **Function** slider is in its **ON** position: Transmitted light is activated
- Select the desired digital output from the **Digital output** drop-down list
- Select the desired analog output from the **Analog output** drop-down list
- To specify the minimum output voltage at the analog output, enter the desired value in the **Minimum selectable voltage** field
- To specify the maximum output voltage at the analog output, enter the desired value in the **Maximum selectable voltage** field
- To specify the threshold position of the **Transmitted light** slider (lighting palette) for switching off the transmitted light, enter the desired percentage in the **Slider threshold for "light off"** field
- Tap **Back**

Configuring the reflected light

- Tap **Reflected light**
- > The **Function** slider is in its **ON** position: Reflected light is activated

> Select an analog output for each segment. Depending on the light unit and configuration, you can additionally select a digital output for each segment.

- Select the desired analog output from the **Analog output for front segment** drop-down list
- Select the desired analog output from the **Analog output for rear segment** drop-down list
- Select the desired analog output from the **Analog output for left segment** drop-down list
- Select the desired analog output from the **Analog output for right segment** drop-down list
- To specify the minimum output voltage at the analog output, enter the desired value in the **Minimum selectable voltage** field
- To specify the maximum output voltage at the analog output, enter the desired value in the **Maximum selectable voltage** field
- To specify the threshold position of the **Reflected light** slider (lighting palette) for switching off the reflected light, enter the desired percentage in the **Slider threshold for "light off"** field
- Tap **Back**

Configuring the coaxial light

- ▶ Tap **Coaxial light**
- > The **Function** slider is in its **ON** position: Coaxial light is activated
- ▶ Select the desired digital output from the **Digital output** drop-down list
- ▶ Select the desired analog output from the **Analog output** drop-down list
- ▶ To specify the minimum output voltage at the analog output, enter the desired value in the **Minimum selectable voltage** field
- ▶ To specify the maximum output voltage at the analog output, enter the desired value in the **Maximum selectable voltage** field
- ▶ To specify the threshold position of the **Coaxial light** slider (lighting palette) for switching off the coaxial light, enter the desired percentage in the **Slider threshold for “light off”** field
- ▶ Tap **Back**

Configuring the camera exposure time

- ▶ Tap **Camera exposure time**
- > The **Function** slider is in its **ON** position: The camera exposure time is activated
- ▶ To specify the setting range of the **Camera exposure time** slider (lighting palette), enter the desired values
  - **Minimum exposure time**: Lower limit value of the setting range
  - **Maximum exposure time**: Upper limit value of the setting range
- > The **Camera exposure time** slider in the lighting palette represents the defined setting range
- > The lighting can now be adjusted in the **lighting palette** (see "Lighting palette", Page 108)

Further information: "Lighting", Page 473

Setting the camera orientation

A slight skew of the camera relative to the measuring plate of the measuring machine can be compensated to a small extent by using the camera orientation function.

> If the skew cannot be compensated by the product, a mechanical alignment needs to be performed.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Camera orientation**
- Tap **Start**
- > The teach sequence is started
- > The wizard is displayed in the **Measure** menu
- Follow the instructions of the wizard
- > The successful measurement of the camera skew is displayed
- Tap **Confirm** to confirm the measured camera skew
- > The measured value is displayed in **Camera skew**
- > The value can be adjusted by direct entry
- Tap **Undo** to repeat the teach sequence
- Tap **Close** to close the wizard

Further information: "Camera orientation", Page 481

Adjusting the contrast settings

The contrast threshold defines the contrast value starting from which a light-to-dark transition is recognized as an edge. The higher the defined contrast threshold, the higher the contrast of the measured transition must be.

This section explains how to set the contrast threshold manually or how to adjust it to the current light conditions using a teach sequence.

Alternatively, you can also adjust the contrast threshold with the contrast bar in the **Measure** menu.
Further information: "Show contrast bar", Page 127 and Page 105

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Contrast settings**
- Select the **Edge algorithm** for the edge detection
  - **Automatic**: The edge is defined automatically
  - **First edge**: The first transition ≥ the contrast threshold is defined as an edge
  - **Strongest edge**: The strongest transition ≥ the contrast threshold is defined as an edge
- In the **Contrast threshold value for edge detection** field, enter the desired contrast threshold value and do not superimpose the camera image (setting range: **0 ... 255**)

or

- To start the teach sequence, tap **Start**
- > The teach sequence is started and the **Measure** menu is displayed
- Select the **lighting palette**
- Adjust the sliders to achieve the highest possible contrast at the edge
- Tap **Confirm** in the wizard to confirm the positioning of the measuring tool and the lighting settings
- > The values in the **Contrast threshold value for edge detection** and **Contrast** fields will be adjusted automatically, based on the selected edge algorithm
- > The teach sequence is complete
- Tap **Undo** to repeat the teach sequence
- Tap **Close** to close the wizard

Further information: "Contrast settings", Page 478

Determining the pixel sizes

When measuring with a VED sensor, the measurement is performed in the live image obtained by the product. To ensure that the size of the live image matches that of the measured object, the pixel size must be determined for each magnification.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in succession:
  - **Video edge detection (VED)**
  - **Pixel sizes**
- Tap **Magnification**
- Select the desired magnification
- In **Calibration standard diameter**, enter the diameter of the desired circle, which is specified in the calibration chart supplied with the calibration standard
- Confirm your input with **RET**
- Tap **Start**
- > The teach sequence is started and the wizard is displayed in the **Measure** menu
- Follow the instructions of the wizard
- Tap **Confirm** to confirm that you have completed the wizard's instructions
- > The teach sequence is complete
- Tap **Undo** to repeat the teach sequence
- Tap **Close** to close the wizard
- Repeat the procedure to determine the pixel sizes for all available magnifications

Further information: "Pixel sizes", Page 480

Configuring parcentric and parfocal error compensation

Parcentric and parfocal error compensation compensate for deviations caused by the mechanical settings of magnification and video focus. The parcentric error compensation compensates for deviations on the X and Y axes. The parfocal error compensation compensates for deviations on the Z axis. The error compensation can be configured via a teach sequence.

> Before configuring and activating parcentric and parfocal error compensation, carry out the following configurations:
> - Camera orientation
> - Contrast settings
> - Pixel sizes
> - Error compensation of the axes (optional)

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Parcentric and parfocal error compensation**
- Tap **Reference magnification**
- Select the desired reference magnification
- Tap **Start**
- > The teach sequence is started and the wizard is displayed in the **Measure** menu
- Follow the instructions of the wizard
- Tap **Confirm** to confirm that you have completed the wizard's instructions
- > The teach sequence is complete
- Tap **Undo** to repeat the teach sequence
- Tap **Close** to close the wizard
- Tap **Back** twice to return to the previous display
- Use the **ON/OFF** slider to activate the **Compensation** function
- > The error compensation for the axis is applied

Further information: "Parcentric and parfocal error compensation", Page 480

Configuring the field of view compensation

The **Field of view compensation** compensates for deviations caused by the properties of the lens. Due to the curvature, rays of light are refracted more strongly at the edge of the lens—this may cause measuring errors. The error compensation can be configured via a teach sequence. In the teach sequence a grid is measured from a defined number of measuring points (supporting points). This step must be repeated for each available magnification. The compensation factor is determined from the deviations in the measurement results for each supporting point.

- ▶ Tap **Settings** in the main menu
- ▶ Tap **Sensors**
- ▶ Open in the sequence
  - **Video edge detection (VED)**
  - **Field of view compensation**
- ▶ Tap **Magnification**
- ▶ Select the desired magnification
- ▶ Tap **Start**
- > The teach sequence is started and the wizard is displayed in the **Measure** menu
- ▶ Follow the instructions of the wizard
- ▶ Tap **Confirm** to confirm that you have completed the wizard's instructions
- > The teach sequence is complete
- ▶ Tap **Undo** to repeat the teach sequence
- ▶ Tap **Close** to close the wizard
- ▶ Tap **Back** twice to return to the previous display
- ▶ Use the **ON/OFF** slider to activate the **Compensation** function
- > The error compensation for the axis is applied

Further information: "Field of view compensation", Page 479

7.3.4 Configuring an OED sensor

If the QUADRA-CHEK 3000 OED software option is enabled, the OED sensor needs to be configured. This section describes the configuration procedure.

Setting the magnification

For measuring machines with adjustable optical magnifications, each magnification must also be set in the device. This ensures the correct size ratio during a measurement.

The number of magnifications depends on the measuring machine connected to the product.

Adjusting the magnification

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in succession:
  - **Optical edge detection (OED)**
  - **Magnifications**
- Set a magnification in the measuring machine, e.g. 1.0
- Tap **OED Zoom 1**, for example
- Tap the **Description** input field
- Adapt the existing description
- Confirm the entry with **RET**
- Tap the **Acronym for quick access menu** input field
- Adapt the existing acronym
- Confirm the entry with **RET**
- > The magnification list shows the magnification together with the adapted information

Further information: "Magnifications", Page 482

Adding a magnification

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in succession:
  - **Optical edge detection (OED)**
  - **Magnifications**
- Set a magnification in the measuring machine, e.g. 2.0
- Tap **Add**
- Tap the **Description** input field
- Enter a description for the magnification you have set
- Confirm the entry with **RET**
- Tap the **Acronym for quick access menu** input field
- Enter a meaningful acronym
- Confirm the entry with **RET**
- > The acronym is needed for selecting the magnification in the quick access menu of the Inspector
- Tap **Add**
- > The new magnification appears in the magnification list

Further information: "Magnifications", Page 482

Removing magnifications

Magnifications that are no longer needed can be removed from the list.

> Only inactive magnifications can be removed.

- Tap **Measure** in the main menu
- Tap the **quick access menu** in the Inspector
- Select a magnification that is not to be deleted
- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in succession:
  - **Optical edge detection (OED)**
  - **Magnifications**
- > The active magnification is indicated by a check mark
- Tap the inactive magnification that you want to remove
- Tap **Remove**
- To confirm the removal, tap **Remove** in the dialog
- > The magnification is removed from the magnification list

Adjusting the contrast settings

Adjust the contrast settings to the current light conditions via a teach sequence. As part of this process, you need to acquire one point each from the light and dark areas of the screen with the OED sensor.

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- To determine the contrast settings in a teach sequence, go to **OED contrast teach sequence** and tap **Start**
- Follow the instructions of the wizard
- Tap **OK** to close the dialog
- > The contrast settings are saved for the selected magnification
- Repeat this procedure for all available magnifications

Further information: "Contrast settings", Page 483

Adjusting the threshold settings

The threshold settings define the contrast value starting from which a light-to-dark transition is recognized as an edge. Adjust the threshold settings to the current light conditions via a teach sequence. To do so, use the OED sensor to measure a distance for which you define a nominal value.

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Open the tool palette
- \> The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the threshold settings in a teach sequence, go to **OED threshold teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ Tap **OK** to close the dialog
- \> The threshold settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Threshold settings", Page 483

Configuring offset settings

The offset settings compensate for the position error between the crosshair for measuring point acquisition and the OED sensor for edge detection. You can configure the offset settings using a teach sequence in which you measure a circle with two different measuring tools. The offset of the OED sensor for the X and Y axes is calculated from the deviations of both circles and will then be compensated in subsequent measurements.

- ▶ Open the tool palette
- \> The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the offset settings in a teach sequence, go to **OED offset teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard:
  - Measure the points on the circle with the crosshair measuring tool
  - Confirm each measured point with **Enter point**
- ▶ Tap **OK** to close the dialog
- \> The offset settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

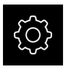
Further information: "Offset settings", Page 484

7.3.5 Configuring a TP sensor

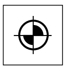
If the QUADRA-CHEK 3000 3D software option is enabled, a touch probe needs be configured. This section describes the configuration procedure.

Preparing the calibration

Before calibrating a touch probe, you need to enter some basic parameters for the calibration process.



- Tap **Settings** in the main menu

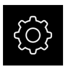


- Tap **Sensors**
- Tap **Touch probe (TP)**
- Tap **Calibration**
- Enter a value in **Diameter of calibration sphere**
- Confirm your input with **RET**
- Tap **Reset** to delete any touch probe calibration data, if required
- Confirm the prompt with **OK**

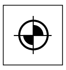
Further information: "Calibration", Page 485

Setting the Probe head

Depending on the design of your touch probe, you need to select the appropriate touch probe head design.



- Tap **Settings** in the main menu



- Tap **Sensors**
- Tap **Touch probe (TP)**
- Tap **Probe head**
- Select the desired option from the **Probe head** drop-down list
  - **Fixed**: Fixed touch probe that can only work in a certain angle
  - **Indexed swiveling**: The touch probe can be adjusted in predefined angles
  - **Non-indexed swiveling**: The touch probe can be adjusted freely
- If you selected **Indexed swiveling**, specify further parameters:
  - **Axis A Adjustment range (°)**
  - **Axis A Step size (°)**
  - **Axis B Adjustment range (°)**
  - **Axis B Step size**
- Confirm each input with **RET**

Further information: "Probe head", Page 486

Setting the Probe body

Depending on the design of your touch probe, you need to select the appropriate touch probe body design.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Tap **Touch probe (TP)**
- Tap **Probe body**
- Select the desired option from the **Type** drop-down list
  - **Triggered**: Automatic acquisition of a point when contact is made
  - **Hard**: No automatic acquisition of a point when contact is made; the point must be acquired with **Enter**
- If desired, use the **ON/OFF** slider to activate/deactivate the **Evaluation of the ready signal**

Further information: "Probe body", Page 487

Adding Styli

If you want to use different styli for probing, you can add the desired ones to the system.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Tap **Touch probe (TP)**
- Tap **Styli**
- Tap **Add**
- Enter the desired name in the **Name** input field
- Confirm your input with **RET**
- Select the desired option from the **Type** drop-down list:
  - **Straight**
  - **Star**
- Tap **Add**
- To add more styli, repeat these steps

Further information: "Styli", Page 487

7.4 OEM area

In the **OEM area**, commissioning engineers can customize the product in various ways:

- **Documentation**: Adding the OEM documentation, e.g. service information
- **Startup screen**: Defining a startup screen with the OEM's company logo
- **Screenshots**: Configuring the unit for screenshots with the program ScreenshotClient

7.4.1 Adding documentation

You can store and display the product's documentation right on the product.

> Only documents in the *.pdf file format can be added as a documentation. The product does not display documents provided in other file formats.

- Tap **Settings** in the main menu
- Tap **Service**
- Open in the sequence
  - **OEM area**
  - **Documentation**
  - **Add OEM service info**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- To navigate to the desired file, tap the location where the file is stored

> If you have accidentally tapped the wrong folder, you can return to the previous folder.
> - Tap the file name that is displayed above the list

- Navigate to the folder containing the file
- Tap the file name
- Tap **Select**
- > The file is copied to the product’s **Service info** area
  Further information: "Service info", Page 468
- Confirm the successful transfer with **OK**

Further information: "Documentation", Page 522

Safely removing a USB mass storage device

- Tap **File management** in the main menu
- Navigate to the list of storage locations
- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

7.4.2 Adding a startup screen

You can define an OEM-specific startup screen, e.g. the company name or logo, which will be displayed when the product is switched on. An image file with the following properties needs to be stored on the product for this purpose:

- File type: PNG or JPG
- Resolution: 96 ppi
- Image format: 16:10 (other formats will be scaled proportionally)
- Image size: Max. 1280 x 800 px

Adding a startup screen

- Tap **Settings** in the main menu
- Tap **Service**
- Open in the sequence
  - **OEM area**
  - **Startup screen**
  - **Add startup screen**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- To navigate to the desired file, tap the location where the file is stored

> If you have accidentally tapped the wrong folder, you can return to the previous folder.
> - Tap the file name that is displayed above the list

- Navigate to the folder containing the file
- Tap the file name
- Tap **Select**
- > The graphic file is copied to the product and displayed as the startup screen the next time the product is started
- Confirm the successful transfer with **OK**

Safely removing a USB mass storage device

- Tap **File management** in the main menu
- Navigate to the list of storage locations
- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

> When you save the user files, the OEM-specific opening screen is also saved and can be restored.
> **Further information:** "Back up user files", Page 199

7.4.3 Configuring the unit for screenshots

ScreenshotClient

With the ScreenshotClient PC software, you can use a computer to take screenshots of the active screen of the product.

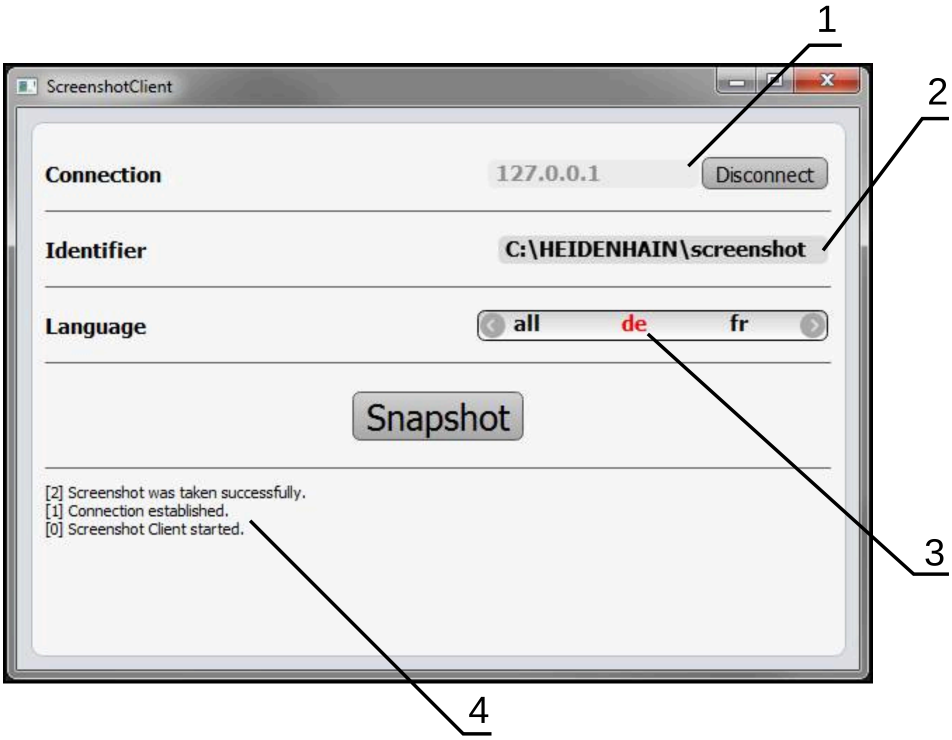


Figure 31: The ScreenshotClient user interface

1 Connection status
2 File path and file name
3 Language selection
4 Status messages

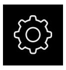
ScreenshotClient is included in the standard installation of **QUADRA-CHEK 3000 Demo**.

For a detailed description, please refer to the **QUADRA-CHEK 3000 Demo User's Manual**. This User's Manual is available in the "Documentation" folder of the product website.

Further information: "Demo software for the product", Page 20

Activating remote access for screenshots

To connect ScreenshotClient with the product via the computer you need to activate **Remote access for screenshots** on the product.



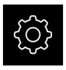
- Tap **Settings** in the main menu

- Tap **Service**
- Tap **OEM area**
- Use the **ON/OFF** slider to activate the **Remote access for screenshots** function

Further information: "OEM area", Page 522

7.5 Back up settings

The product’s settings can be backed up as a file so that they are available after a reset to the factory default settings has been performed or for installation on multiple units.



- Tap **Settings** in the main menu

- Tap **Service**
- Open in the sequence
  - **Back up and restore**
  - **Back up settings**

Performing a Complete backup

During a complete backup of the configuration, all settings of the product are backed up.

- Tap **Complete backup**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- Select the folder to which you want to copy the configuration data
- Specify a name for the configuration data, e.g. "<yyyy-mm-dd>_config"
- Confirm the entry with **RET**
- Tap **Save as**
- Tap **OK** to confirm the successful backup of the configuration
- > The configuration file was backed up

Further information: "Back up and restore", Page 521

Safely removing a USB mass storage device

- Tap **File management** in the main menu
- Navigate to the list of storage locations
- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

7.6 Back up user files

The user files of the product can be backed up as a file to make it available after a reset to the factory default settings. This, together with the backing up of the settings, enables you to back up the complete configuration of your product.

Further information: "Back up settings", Page 198

> All files from all user groups that are stored in the respective folders are backed up and can be restored as user files.
>
> The files in the **System** folder are not restored.

Performing back up

The user files can be backed up as a ZIP file on a USB mass storage device or connected network drive.

- Tap **Settings** in the main menu
- Tap **Service**
- Open in the sequence
  - **Back up and restore**
  - **Back up user files**
- Tap **Save as ZIP**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- Select the folder to which you want to copy the ZIP file
- Specify a name for the ZIP file, e.g. "<yyyy-mm-dd>_config"
- Confirm the entry with **RET**
- Tap **Save as**
- Tap **OK** to confirm successful backup of the user files
- > The user files were backed-up.

Further information: "Back up and restore", Page 521

Safely removing a USB mass storage device

- Tap **File management** in the main menu
- Navigate to the list of storage locations
- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

8

Setup

8.1 Overview

This chapter contains all the information necessary for setting up the product.

During setup, the (**Setup**) engineer configures the unit for use with the encoder in the respective applications. This includes, for example, setting up operators, creating measurement report templates, and generating measuring programs.

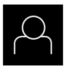
> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

> The following steps must be performed only by qualified personnel.
>
> **Further information:** "Personnel qualification", Page 31

8.2 Logging in for setup

8.2.1 User login

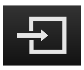
To set up the product, the **Setup** user must log in.



- Tap **User login** in the main menu
- If required, log out the user who is currently logged in
- Select the **Setup** user
- Tap the **Password** input field
- Enter the password "**setup**"

> If the password does not match the default password, ask a **Setup** user or **OEM** user for the assigned password.
>
> If the password is no longer known, contact a HEIDENHAIN service agency.

- Confirm the entry with **RET**



- Tap **Log in**

8.2.2 Performing the reference mark search after startup

> If the reference mark search after unit start is active, then all of the unit's functions will be disabled until the reference mark search has been successfully completed.
>
> **Further information:** "Reference marks (Encoder)", Page 515

> The reference mark search does not need to be performed for serial encoders with EnDat interface, because the axes are automatically homed.

If the reference mark search is active on the unit, then a wizard will ask you to traverse the reference marks of the axes.

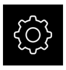
- ▶ After logging in, follow the instructions of the wizard
- > The Reference symbol stops blinking upon successful completion of the reference mark search

Further information: "Operating elements of the position display", Page 117

Further information: "Activating the reference mark search", Page 143

8.2.3 Setting the language

The user interface language is English. You can change to another language, if desired.



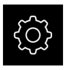
- ▶ Tap **Settings** in the main menu

- ▶ Tap **User**
- > The logged-in user is indicated by a check mark
- ▶ Select the logged-in user
- > The language selected for the user is indicated by a national flag in the **Language** drop-down list
- ▶ Select the flag for the desired language from the **Language** drop-down list
- > The user interface is displayed in the selected language

8.2.4 Changing the password

You must change the password to prevent unauthorized configuration.

The password is confidential and must not be disclosed to any other person.



- Tap **Settings** in the main menu

- Tap **User**
- > The logged-in user is indicated by a check mark
- Select the logged-in user
- Tap **Password**
- Enter the current password
- Confirm entry with **RET**
- Enter the new password and repeat it
- Confirm entry with **RET**
- Tap **OK**
- Close the message with **OK**
- > The new password is available the next time the user logs in

8.3 Single steps for setup

> The following setup steps build on each other.
>
> ▶ To correctly set up the product, make sure to perform the steps in the order described here

Prerequisite: You are logged on as a user of the **Setup** type (see "Logging in for setup", Page 202).

Basic settings

- Setting the date and time
- Setting the units of measure
- Entering and configuring users
- Adding the Operating Instructions
- Configuring the network
- Configuring the network drive
- Configuring the printer
- Configuring operation with a mouse or touchscreen
- Configuring the USB keyboard
- Configuring the barcode scanner

Configuring the sensor (software option)

For VED sensors:	For OED sensors:	For TP sensors:
■ Adjusting the contrast settings ■ Determining the pixel sizes	■ Adjusting the contrast settings ■ Configuring offset settings	■ Calibrating a stylus

Setting up the measuring application

- Configuring the measuring point acquisition
- Configuring the measurement result preview
- Creating a template for measurement reports
- Creating a measuring program
- Configuring the measured value output

Backing up data

- Back up settings
- Back up user files

NOTICE

Loss of or damage to configuration data!

If the product is disconnected from the power source while it is on, the configuration data can be lost or corrupted.

▶ Back up the configuration data and keep the backup for recovery purposes

8.3.1 Basic settings

> The commissioning engineer (**OEM**) may have already carried out several basic settings.

Setting the date and time

- Tap **Settings** in the main menu
- Tap **General**
- Tap **Date and time**
- > The set values are displayed in the following format: Year, month, day, hour, minute
- To set the date and time in the middle line, drag the columns up or down
- Tap **Set** to confirm
- Select the desired format from the **Date format** list:
  - MM-DD-YYYY: Display as month, day, year
  - DD-MM-YYYY: Display as day, month, year
  - YYYY-MM-DD: Display as year, month, day

Further information: "Date and time", Page 466

Setting the units of measure

You can set various parameters to define the units of measure, rounding methods and decimal places.

- Tap **Settings** in the main menu
- Tap **General**
- Tap **Units**
- To set a unit of measure, tap the corresponding drop-down list and select the unit
- To set the rounding method, tap the corresponding drop-down list and select the rounding method
- To set the number of decimal places displayed, tap **-** or **+**

Further information: "Units", Page 466

Entering and configuring users

The following user types, which have different rights, are defined in the product's factory default settings:

- **OEM**
- **Setup**
- **Operator**

Creating a user and password

You can create new **Operator** users. You can use any characters for the user ID and the password. These entries are case-sensitive.

Requirement: An **OEM** or **Setup** user is logged in.

> It is not possible to create new **OEM** or **Setup**-type users.

- Tap **Settings** in the main menu
- Tap **User**
- Tap **Add**
- Tap the **User ID** input field

> The **User ID** is displayed for user selection, e.g. at the login prompt.
>
> The **User ID** cannot be changed once it has been defined.

- Enter the user ID
- Confirm the entry with **RET**
- Tap the **Name** input field
- Enter the name of the new user
- Confirm the entry with **RET**
- Tap the **Password** input field
- Enter the new password and repeat it
- Confirm the entry with **RET**

> You can show the contents of the password fields in plain text and hide them again.
>
> - Use the **ON/OFF** sliding switch to show or hide the contents

- Tap **OK**
- > A message appears
- Close the message with **OK**
- > The user is created with the basic data. The user can then further edit the data himself later

Configuring the user

After creating a new **Operator**-type user, you can add or edit the following user data:

- Name
- First name
- Department
- Password
- Language
- Auto login

> If automatic user login is active for one or more users, the last user who logged in is automatically logged in when the product is switched on. Neither the user ID nor the password needs to be entered.

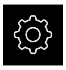
- ▶ Tap **Settings** in the main menu
- ▶ Tap **User**
- ▶ Select the user
- ▶ Tap the input field whose contents you want to edit: **Name**, **First name**, **Department**
- ▶ Edit the contents and confirm your changes with **RET**
- ▶ To change the password, tap **Password**
- > The **Change password** dialog appears
- ▶ When changing the password of the logged-in user, enter the current password
- ▶ Confirm the entry with **RET**
- ▶ Enter the new password and repeat it
- ▶ Confirm the entries with **RET**
- ▶ Tap **OK**
- > A message appears
- ▶ Close the message with **OK**
- ▶ To change the language, select the flag for the desired language in the **Language** drop-down list
- ▶ Use the **ON/OFF** slider to activate or deactivate the **Auto login** function

Deleting users

You can remove **Operator**-type users that are no longer needed.

> **OEM** and **Setup**-type users cannot be deleted.

Requirement: A user of **OEM** or **Setup**-type is logged in.



- Tap **Settings** in the main menu

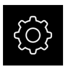
- Tap **User**
- Tap the user you want to delete
- Tap **Remove user account**
- Enter the password of the authorized user (**OEM** or **Setup**)
- Tap **OK**
- > The user is deleted

Adding the Operating Instructions

The product provides the possibility to upload the corresponding Operating Instructions in the desired language. You can copy the Operating Instructions from the supplied USB mass storage device to the product.

The most recent version of the Operating Instructions is also available at **www.heidenhain.de**.

Requirement: The Operating Instructions are available as a PDF file.



- Tap **Settings** in the main menu

- Tap **Service**
- Open in the sequence
  - **Documentation**
  - **Add Operating Instructions**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- Navigate to the folder containing the new Operating Instructions

> If you have accidentally tapped the wrong folder, you can return to the previous folder.
> - Tap the file name that is displayed above the list

- Select file
- Tap **Select**
- > The Operating Instructions are copied to the product
- > Any existing Operating Instructions will be overwritten
- Confirm the successful transfer with **OK**
- > The Operating Instructions can be opened and displayed on the product

Configuring the network

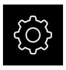
Network settings

The configuration of the network settings is identical for both network connections.

Contact your network administrator for the correct network settings for configuring the product.

Requirement: The unit is connected to a network.

Further information: "Connecting a network peripheral", Page 62



- ▶ Tap **Settings** in the main menu

- ▶ Tap **Interfaces**
- ▶ Tap **Network**
- ▶ Tap the desired interface (**X116** or **X117**)
- > The MAC address is detected automatically
- ▶ Depending on the network environment, use the **ON/OFF** slider to activate or deactivate the **DHCP** function
- > If DHCP is active, the network settings are obtained automatically as soon as the IP address is assigned
- ▶ If DHCP is not active, enter the **IPv4 address**, **IPv4 subnet mask** and **IPv4 standard gateway**
- ▶ Confirm the entries with **RET**
- ▶ Depending on the network environment, use the **ON/OFF** slider to activate or deactivate the **IPv6 SLAAC** function
- > If IPv6 SLAAC is active, the network settings are obtained automatically as soon as the IP address is assigned
- ▶ If IPv6 SLAAC is not active, enter the **IPv6 address**, **IPv6 subnet prefix length** and **IPv6 standard gateway**
- ▶ Confirm the entires with **RET**
- ▶ Enter the **Preferred DNS server** and, if required, the **Alternative DNS server**
- ▶ Confirm the entires with **RET**
- > The configuration of the network connection is applied

Further information: "Network", Page 497

Configuring the network drive

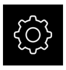
You will need the following data for configuring the network drive:

- **Name**
- **Server IP address or host name**
- **Shared folder**
- **User name**
- **Password**
- **Network drive options**

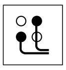
> Contact your network administrator for the correct network settings for configuring the product.

Requirement: The product is connected to a network and a network drive is available.

Further information: "Connecting a network peripheral", Page 62



- ▶ Tap **Settings** in the main menu



- ▶ Tap **Interfaces**
- ▶ Tap **Network drive**
- ▶ Enter the network drive details
- ▶ Confirm the entries with **RET**
- ▶ Use the **ON/OFF** slider to activate or deactivate the **Show password** function
- ▶ If required, select **Network drive options**
  - Select **Authentication** for encrypting the password in the network
  - Configure the **Mount options**
  - Tap **OK**
- ▶ Tap **Mount**
- ▶ The connection to the network drive is established

Further information: "Network drive", Page 498

Configuring the printer

The product can print measurement reports and stored PDF files with a printer connected via USB or the network. The product supports several printer models from various manufacturers. See the product area at **www.heidenhain.de** for a complete list of supported printers.

If this list contains the used printer, the appropriate driver is available on the product and you can directly configure the printer. If this is not the case, you will need a printer-specific PPD file.

Further information: "Finding PPD files", Page 215

Adding a USB printer

Requirement: A USB printer is connected to the product.

Further information: "Connecting a printer", Page 61

- Tap **Settings** in the main menu
- Tap **General**
- Tap **Printers**
- > If no default printer has been set up yet, a message appears
- Tap "Close" in the message
- Open in succession:
  - **Add printer**
  - **USB printer**
- > Connected USB printers are detected automatically
- Tap **Located printers**
- > The list of detected printers is displayed
- > If only one printer is connected, the printer is selected automatically
- Select the desired printer
- Tap **Located printers** once again
- > The available printer information, e.g. name and description, is displayed
- If required, enter a name for the printer into the **Name** input field

> The text must not contain slashes ("/"), hash characters ("#") or spaces.

- Confirm your input with **RET**
- If required, enter an optional description for the printer into the **Description** input field, e.g. "Color printer"
- Confirm your input with **RET**
- If required, enter an optional location into the **Location** input field, e.g. "Office"
- Confirm your input with **RET**
- If required, enter the connection parameters into the **Connection** input field, if they have not been entered automatically
- Confirm your input with **RET**
- Tap **Select the driver**
- Select the appropriate driver for the printer type

> If the appropriate driver is not listed, a suitable PPD file must be copied to the product.
>
> **Further information:** "Finding PPD files", Page 215

- > The driver is activated
- Tap **Close** in the message

- Tap **Set standard values**
- Tap **Resolution** to set the printer resolution
- Select the desired resolution
- Tap **Resolution** once again
- Tap **Paper size** to set the paper size
- Select the desired paper size
- Depending on the type of printer, select further values such as type of paper or duplex print
- Tap **Properties**
- > The entered values are saved as defaults
- > The printer is added and can be used

> Use the CUPS web interface to configure the enhanced settings of the connected printer. You can also use this web interface if the printer information fails over the product.
>
> **Further information:** "Using CUPS", Page 216

Further information: "Printers", Page 464

Adding a network printer

Requirement: A network printer or network is connected to the product.

Further information: "Connecting a printer", Page 61

Further information: "Connecting a network peripheral", Page 62

- Tap **Settings** in the main menu
- Tap **General**
- Tap **Printers**
- Open in the sequence
  - **Add printer**
  - **Network printer**
- > Printers available on the network are detected automatically
- Tap **Located printers**
- > The list of detected printers is displayed
- > If only one printer is connected, the printer is selected automatically
- Select the desired printer
- Tap **Located printers** once again
- > The available printer information, e.g. name and description, is displayed
- If required, enter a name for the printer into the **Name** input field

> The text must not contain slashes ("/"), hash characters ("#") or spaces.

- Confirm your input with **RET**
- If required, enter an optional description for the printer into the **Description** input field, e.g. "Color printer"
- Confirm your input with **RET**
- If required, enter an optional location into the **Location** input field, e.g. "Office"
- Confirm your input with **RET**
- If required, enter the connection parameters into the **Connection** input field, if they have not been entered automatically
- Confirm your input with **RET**
- Tap **Select the driver**
- Select the appropriate driver for the printer type

> If the appropriate driver is not listed, a suitable PPD file must be copied to the product.
>
> **Further information:** "Finding PPD files", Page 215

- > The driver is activated
- Tap **Close** in the message
- Tap **Set standard values**
- Tap **Resolution** to set the printer resolution

- ▶ Select the desired resolution
- ▶ Tap **Resolution** once again
- ▶ Tap **Paper size** to set the paper size
- ▶ Select the desired paper size
- ▶ Depending on the type of printer, select further values such as type of paper or duplex print
- ▶ Tap **Properties**
- > The entered values are saved as defaults
- > The printer is added and can be used

> Use the CUPS web interface to configure the enhanced settings of the connected printer. You can also use this web interface if the printer information fails over the product.
>
> **Further information:** "Using CUPS", Page 216

Further information: "Printers", Page 464

Unsupported printers

To set up an unsupported printer, the product needs a "PPD" file containing information about the printer properties and drivers

> This unit supports only drivers that are provided by Gutenprint (www.gutenprint.sourceforge.net).

Alternatively, you can select a similar printer from the list of supported printers. The scope of functionality may be limited but printing should generally be possible.

Finding PPD files

Locate the required PPD file as follows:

- ▶ Search for the printer manufacturer and printer model at www.openprinting.org/printers
- ▶ Download the appropriate PPD file

or

- ▶ Search for a Linux driver for the printer model on the website of the printer manufacturer
- ▶ Download the appropriate PPD file

Using PPD files

When configuring an unsupported printer, during the driver selection step you need to copy the located PPD file to the product:

- ▶ Tap **Select the driver**
- ▶ In the **Select the manufacturer** dialog tap **Select PPD file**
- ▶ Tap **Select file**
- ▶ To navigate to the desired PPD file, tap the **location** where the file is stored
- ▶ Navigate to the folder containing the downloaded PPD file
- ▶ Select the PPD file
- ▶ Tap **Select**
- > The PPD file is copied to the product
- ▶ Tap **Continue**
- > The PPD file is loaded and the driver is activated
- ▶ Tap **Close** in the message

Enhanced printer settings

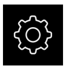
Using CUPS

For printer control the product uses the Common Unix Printing System (CUPS). In the network, CUPS enables connected printers to be set up and managed using a web interface. These functions depend on whether the product uses a USB printer or network printer.

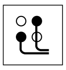
The CUPS web interface enables you to configure the enhanced settings of the printer connected to the product. You can also use this web interface if printer setup via the product fails.

Requirement: The product is connected to a network.

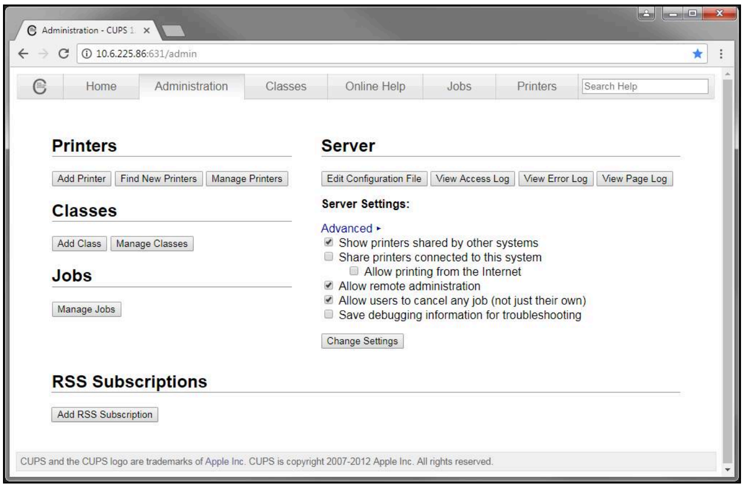
Further information: "Connecting a network peripheral", Page 62



- Tap **Settings** in the main menu



- Tap **Interfaces**
- Tap **Network**
- Tap the **X116** interface
- Determine the product's IP address from **IPv4 address** and write it down
- On a computer in the network, call the web interface of CUPS via the following URL:
  http://[IP address of the product]:631
  (e.g. http://10.6.225.86:631)
- In the web interface, click on the **Administration** tab and select the desired action



> See the **Online Help** tab for detailed information about the CUPS web interface.

Modifying the resolution and paper size for a printer

- ▶ Tap **Settings** in the main menu
- ▶ Tap **General**
- ▶ Tap **Printers**
- ▶ If multiple default printers have been set up for the product, select the desired printer in the **Default printer** drop-down list
- ▶ Tap **Properties**
- ▶ Tap **Resolution** to set the printer resolution
- > The resolutions provided by the driver are displayed
- ▶ Select the resolution
- ▶ Tap **Resolution** once again
- ▶ Tap **Paper size** to set the paper size
- > The paper sizes provided by the driver are displayed
- ▶ Select the paper size
- > The entered values are saved as defaults

> Depending on the type of printer, select further values such as type of paper or duplex print under **Properties**.

Further information: "Printers", Page 464

Removing a printer

- ▶ Tap **Settings** in the main menu
- ▶ Tap **General**
- ▶ Open in the sequence:
  - **Printers**
  - **Remove printer**
- ▶ In the **Printers** drop-down list, select the printer you no longer need
- > The model, location and connection of the printer are displayed
- ▶ Tap **Remove**
- ▶ Confirm with **OK**
- > The printer is removed from the list and can no longer be used

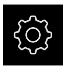
Configuring operation with a mouse or touchscreen

The product can be operated either via the touchscreen or a connected (USB) mouse. If the product is in its factory default setting, touching the touchscreen deactivates the mouse. Alternatively, you can set that the product is operated either only via the mouse or only via the touchscreen.

Requirement: A USB mouse is connected to the product.

Further information: "Connecting input devices", Page 62

You can modify the touch sensitivity of the touchscreen to allow operation under special conditions (e.g. for operation with gloves).



- Tap **Settings** in the main menu

- Tap **General**
- Tap **Input devices**
- Select the desired option from the **Touchscreen sensitivity** drop-down list
- Select the desired option from the **Mouse substitute for multitouch gestures** drop-down list

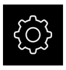
Further information: "Input devices", Page 463

Configuring the USB keyboard

The factory default language for the keyboard assignment is English. You can switch the keyboard assignment to the desired language.

Requirement: A USB keyboard is connected to the product.

Further information: "Connecting input devices", Page 62



- Tap **Settings** in the main menu

- Tap **General**
- Tap **Input devices**
- Select the flag for the desired language from the **USB keyboard layout** drop-down list
- > The keyboard assignment corresponds to the selected language

Further information: "Input devices", Page 463

Configuring the barcode scanner

You can transfer a defined number of characters from a barcode to a text field using a barcode scanner connected via USB. By this means, you can enter part numbers or order numbers into a measurement report, for example.

Prior to configuration on the unit, you must first configure the barcode scanner for USB operation.

Requirement: A barcode scanner is connected to the product.

Further information: "Connecting a barcode scanner ", Page 62

Configuring the barcode scanner for USB operation

For USB operation, you must first configure the barcode scanner with the following codes.

> For more information, please refer to the vendor’s documentation at **www.cognex.com/DataMan® Configuration Codes**

- ▶ Make sure that the barcode scanner is ready for operation (two beeping sounds)
- ▶ Scan the code “Reset Scanner to Factory Defaults.”

Figure 32: Barcode (source: COGNEX DataMan® Configuration Codes)

- > The barcode scanner is reset (two beeps)
- ▶ Scan code “USB-COM/RS-232"

Figure 33: Barcode (source: COGNEX DataMan® Configuration Codes)

- > The barcode scanner is configured for USB operation

Configuring the barcode scanner for QUADRA-CHEK 3000

- Tap **Settings** in the main menu
- Tap **Interfaces**
- Tap **Barcode scanner**
- Activate the barcode scanner with the **ON/OFF** sliding switch
- In the **Filter setting 1** field, define how many characters are truncated at the start of the barcode
- In the **Filter setting 2** field, define how many characters of the barcode are transferred to the text field
- > In the **User data of test code** panel, the sample display will be updated in accordance with the entries in the **Filter setting 1** and **Filter setting 2** fields
- Do the following to test the settings:
  - Tap the **Test area** text field
  - Scan the test code with the barcode scanner
- > All characters of the scanned test code appear in the **Raw data of test code** panel
- > The filtered test code appears in the **User data of test code** panel as defined in the **Filter setting 1** and **Filter setting 2** fields
- > The payload of the test code appears in the **Test area** input field

Further information: "Barcode scanner", Page 500

8.3.2 Configuring a VED sensor

If the QUADRA-CHEK 3000 VED software option is enabled, the VED sensor needs to be configured. This section describes the configuration procedure.

Adjusting the contrast settings

The contrast threshold defines the contrast value starting from which a light-to-dark transition is recognized as an edge. The higher the defined contrast threshold, the higher the contrast of the measured transition must be.

This section explains how to set the contrast threshold manually or how to adjust it to the current light conditions using a teach sequence.

Alternatively, you can also adjust the contrast threshold with the contrast bar in the **Measure** menu.
Further information: "Show contrast bar", Page 127 and Page 105

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- Tap **Settings** in the main menu

- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Contrast settings**
- Select the **Edge algorithm** for the edge detection
  - **Automatic**: The edge is defined automatically
  - **First edge**: The first transition ≥ the contrast threshold is defined as an edge
  - **Strongest edge**: The strongest transition ≥ the contrast threshold is defined as an edge
- In the **Contrast threshold value for edge detection** field, enter the desired contrast threshold value and do not superimpose the camera image (setting range: **0 ... 255**)

or

- To start the teach sequence, tap **Start**
- > The teach sequence is started and the **Measure** menu is displayed
- Select the **lighting palette**
- Adjust the sliders to achieve the highest possible contrast at the edge
- Tap **Confirm** in the wizard to confirm the positioning of the measuring tool and the lighting settings
- > The values in the **Contrast threshold value for edge detection** and **Contrast** fields will be adjusted automatically, based on the selected edge algorithm
- > The teach sequence is complete
- Tap **Undo** to repeat the teach sequence
- Tap **Close** to close the wizard

Further information: "Contrast settings", Page 478

Determining the pixel sizes

When measuring with a VED sensor, the measurement is performed in the live image obtained by the product. To ensure that the size of the live image matches that of the measured object, the pixel size must be determined for each magnification.

- Tap **Settings** in the main menu
- Tap **Sensors**
- Open in succession:
  - **Video edge detection (VED)**
  - **Pixel sizes**
- Tap **Magnification**
- Select the desired magnification
- In **Calibration standard diameter**, enter the diameter of the desired circle, which is specified in the calibration chart supplied with the calibration standard
- Confirm your input with **RET**
- Tap **Start**
- > The teach sequence is started and the wizard is displayed in the **Measure** menu
- Follow the instructions of the wizard
- Tap **Confirm** to confirm that you have completed the wizard's instructions
- > The teach sequence is complete
- Tap **Undo** to repeat the teach sequence
- Tap **Close** to close the wizard
- Repeat the procedure to determine the pixel sizes for all available magnifications

Further information: "Pixel sizes", Page 480

8.3.3 Configuring an OED sensor

If the QUADRA-CHEK 3000 OED software option is activated, then the OED sensor must be configured. This section describes the configuration procedure.

Adjusting the contrast settings

Adjust the contrast settings to the current light conditions via a teach sequence. As part of this process, you need to acquire one point each from the light and dark areas of the screen with the OED sensor.

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the contrast settings in a teach sequence, go to **OED contrast teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ Tap **OK** to close the dialog
- > The contrast settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Contrast settings", Page 483

Adjusting the threshold settings

The threshold settings define the contrast value starting from which a light-to-dark transition is recognized as an edge. Adjust the threshold settings to the current light conditions via a teach sequence. To do so, use the OED sensor to measure a distance for which you define a nominal value.

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the threshold settings in a teach sequence, go to **OED threshold teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ Tap **OK** to close the dialog
- > The threshold settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Threshold settings", Page 483

Configuring offset settings

The offset settings compensate for the position error between the crosshair for measuring point acquisition and the OED sensor for edge detection. You can configure the offset settings using a teach sequence in which you measure a circle with two different measuring tools. The offset of the OED sensor for the X and Y axes is calculated from the deviations of both circles and will then be compensated in subsequent measurements.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the offset settings in a teach sequence, go to **OED offset teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard:
  - Measure the points on the circle with the crosshair measuring tool
  - Confirm each measured point with **Enter point**
- ▶ Tap **OK** to close the dialog
- > The offset settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Offset settings", Page 484

8.3.4 Setting a TP sensor

Prerequisite: Touch probe (TP) is configured in the device settings

Further information: "Configuring a TP sensor", Page 193

Selecting the sensor

- ▶ Select **Manual measuring** in the function palette

- ▶ If multiple sensors are available, select **TP sensor** in the sensor palette
- > The position display is now shown in the workspace

Calibrating a stylus

Before you can use a stylus for measuring, it must be calibrated. For this purpose, measure the calibration sphere whose diameter you indicated in the device settings. Place at least three measuring points on the circumference and one on the top of the calibration sphere.

The first stylus you calibrate is defined as the main stylus. All other styli refer to the main stylus. If you re-calibrate the main stylus, you need to re-calibrate the other styli as well.

> If you are using a star-type stylus, each stylus tip must be calibrated.

> If you are using an indexed swiveling stylus, repeat the calibration procedure for each axis and each angular value required for measurement.

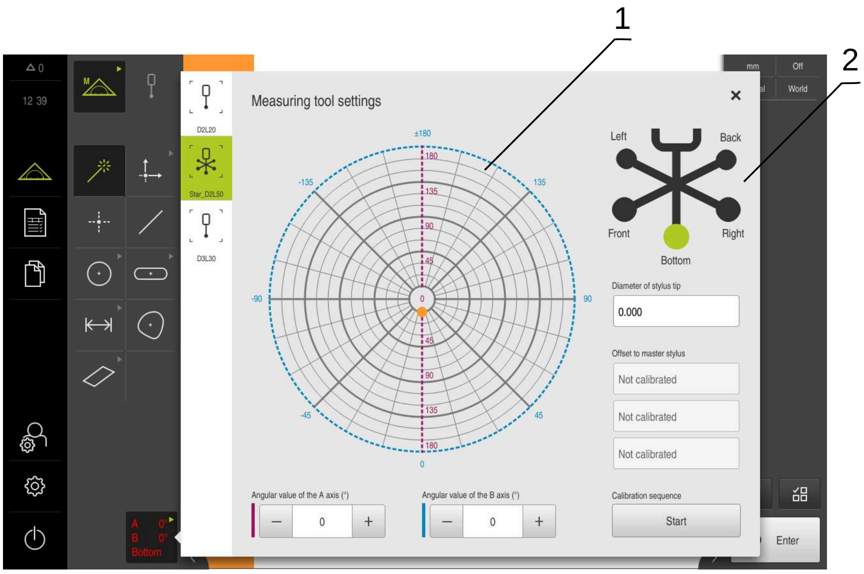


Figure 34: **Measuring tool settings** dialog for TP measuring tools

1 Graphical representation for selection of the angle values for indexed swiveling styli
2 Graphical representation for selection of the stylus tip for star-type styli

In the graphical representation of indexed swiveling styli, you can select a stylus position in order to calibrate it then. The scale corresponds to the range of adjustment of the touch probe head that is indicated in the settings.

Further information: "Probe head", Page 486

The calibrated positions and the selected position are marked by dots. The colors of the dots have the following meaning:

Color	Meaning
Orange	Position has been selected but not yet calibrated
Green	Position has been selected and calibrated
Dark gray	Position has not yet been selected and calibrated

- Select the desired stylus in the tool palette
- > The **Measuring tool settings** dialog shows the available parameters for the selected stylus
- If you are using a star-type stylus, tap the first stylus tip in the graphics
- > The selected stylus tip is displayed in green
- If you are using an indexed swiveling stylus, select the first angular value in the graphical representation or in the input fields
- Enter the diameter of the stylus tip
- To start the calibration, tap **Start**
- Follow the instructions of the wizard
- If you are using a star-type stylus, repeat this procedure for each stylus tip
- If you are using an indexed swiveling stylus, repeat the procedure for each axis and each angular value

> When the icon in the tool bar is displayed in green, the stylus is fully calibrated

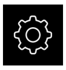
Further information: "Touch probe (TP)", Page 484

8.3.5 Setting the measuring application

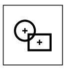
Configuring the measuring point acquisition

To measure the features, you can e.g. adjust the required minimum number of measuring points or the settings for the measuring point filter.

Adjusting the General settings



- Tap **Settings** in the main menu

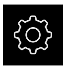


- Tap **Features**
- Tap **General settings**
- To set the measuring point acquisition to a fixed or free number of measuring points, select the desired option in the **Number of measuring points** drop-down list:
  - **Fixed**: Measuring point acquisition is concluded automatically as soon as the specified minimum number of measuring points for the geometry is reached
  - **Free**: After reaching the required minimum number of measuring points, you can acquire as many additional measuring points as desired. When the minimum number of points for the geometry has been reached, the measuring point acquisition can be concluded manually
- To display the distances between the measuring points as absolute or direction-dependent values, select the desired option in the **Distances** drop-down list:
  - **Signed**: The distance between the measuring points is displayed depending on the measuring direction
  - **Absolute**: The distance between the measuring points is displayed independently of the measuring direction

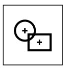
Further information: "General settings (Features)", Page 488

Measuring point filter

During a measurement, you can filter out measuring points that do not match certain criteria.



- Tap **Settings** in the main menu



- Tap **Features**
- Tap **Measuring point filter**
- To activate or deactivate the filter during measuring point acquisition, drag the **ON/OFF** slider to the desired setting
- In the **Error limit** input field, specify the tolerance of the measuring point filter
- In the **Confidence interval (±xσ)** input field, specify the number of measuring points that may lie beyond the error limit
- In the **Minimum % proportion of retained measuring points** input field, specify the minimum percentage of measuring points that must be used for the measurement

Further information: "Measuring point filter", Page 490

Measure Magic

Measure Magic automatically determines the geometry type during measurement.

> The geometry type assigned to a new feature depends on the Measure Magic settings. The measurement result must correspond to the defined criteria.

- Tap **Settings** in the main menu
- Tap **Features**
- Tap **Measure Magic**
- To define up to which form deviation a feature type is automatically detected, enter the desired value in the **Maximum form deviation ratio** input field

> Calculate the **Maximum form deviation ratio** with the following formula:
>
> $$Form\ deviation\ ratio_{max} = \frac{form\ error}{feature\ size}$$
>
> The feature size of a **Circle** or **Arc** is the diameter. For an **Ellipse**, **Slot**, **Rectangle**, or **Line**, it is the length.

- To define the minimum angle for the detection of a circular arc, enter the desired value into the **Minimum angle for an arc** input field
- To define the maximum angle for the detection of a circle segment, enter the desired value into the **Maximum angle for an arc** input field
- To define the minimum length for the detection of a line, enter the desired value into the **Minimum line length** input field
- To define the ratio of linear eccentricity to the semimajor axis of an ellipse, enter the desired value into the **Minimum numeric ellipse eccentricity** input field
- > The numerical eccentricity describes the deviation of an ellipse from the circular shape; the greater the value, the greater the deviation
- > A value of 0 represents a circle; a value of 1 results in an ellipse flattened into a line

Further information: "Measure Magic", Page 493

Features

- Tap **Settings** in the main menu
- Tap **Features**
- Tap the desired feature, e.g. **Circle**
- To reduce or increase the minimum number of measuring points required, tap **-** or **+**

> It is not possible to use fewer than the mathematically required minimum number of points for the geometries.

Further information: "Geometry types", Page 494

Configuring the measurement result preview

The measurement result preview is displayed in the workspace after a measurement process is concluded and shows information about the measured feature. For each geometry type it can be defined which parameters are displayed in the measurement result preview. Which parameters are available depends on the specific geometry type.

Figure 35: **Measurement result preview** for a circle

- Tap **Settings** in the main menu
- Tap **Features**
- Tap **General settings**
- If required, activate the measurement result preview with the **ON/OFF** sliding switch
- Tap **Return**
- Tap the desired **Geometry type**
- Tap **Measurement result preview**
- Activate the desired parameter with the **ON/OFF** sliding switch

> The **Number of measuring points**, **Coordinate system** and **Fitting algorithm** parameters are always displayed in the measurement result preview and cannot be deactivated.

Further information: "General settings (Features)", Page 488

Further information: "Geometry types", Page 494

Further information: "Overview of parameters in the measurement result preview", Page 495

Creating a template for measurement reports

In the **Measurement report** main menu, you can create detailed reports for your measuring tasks. You can document one or more measured features in a measurement report. The measurement reports can be printed, exported and saved. For the creation of measurement reports, you can choose between several standard templates.
Using the integrated editor, you can create custom report templates and adapt them as needed.

Creating a template with the editor

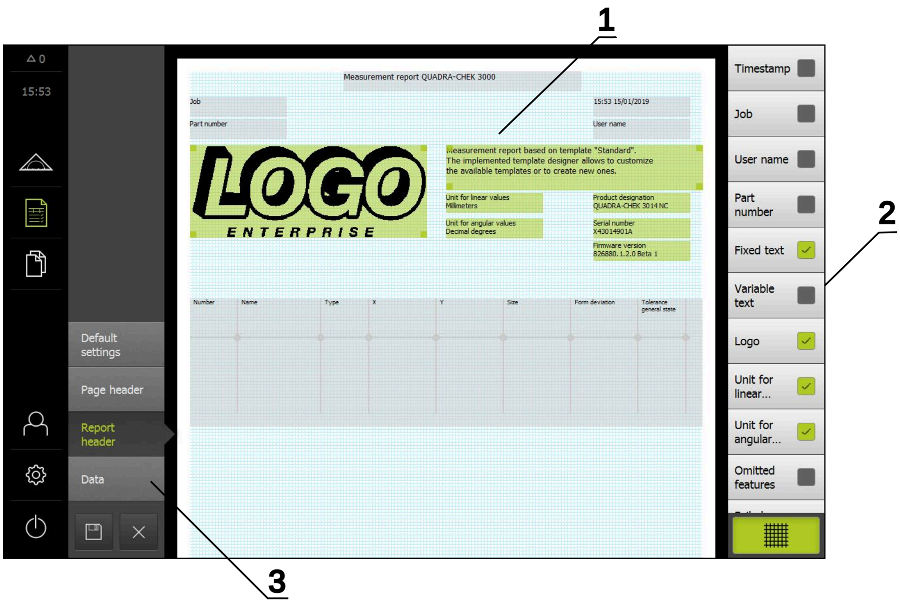


Figure 36: Template editor for measurement reports

1 The form fields of the selected area are highlighted in green and can be edited
2 List of form fields that can be added to the selected area
3 Areas in the measurement report template

A description of how to create the templates is provided in the Measurement Report chapter.

Further information: "Measurement reports", Page 433

Creating a measuring program

You can create measuring programs for the measurements with the measuring machine and store them on the product.

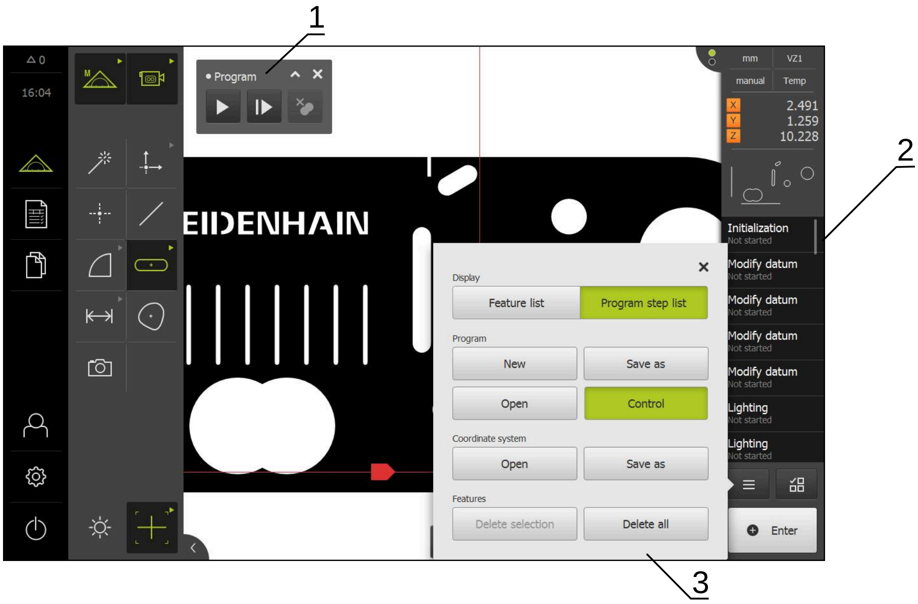


Figure 37: Displays and controls of measuring programs

1 Program control with operating elements
2 Program step list
3 Miscellaneous functions

A description of how to create the measuring programs is provided in the Programming chapter.

Further information: "Programming", Page 415

8.3.6 Configuring the measured value output

The product offers you various functions for manual or automatic transfer of the acquired measured values to a computer.

Prerequisites:

- The product must be connected to the computer via an RS-232 adapter
- Receiving software is installed on the computer, e. g.

The following steps are necessary in order to configure the measured value output:

- Configuring an interface
- Selecting a data format
- Selecting contents for the data transfer

> If you connect a USB-to-RS232 connecting cable from the manufacturer STEINWALD datentechnik GmbH to the product, the data interface is configured automatically and is ready immediately. The data format **Steinwald** is used for measured value output. The settings are not configurable.

Configuring an interface

In the product settings you configure the interface for data transfer to the computer.

- Tap **Settings** in the main menu
- Tap **Interfaces**
- Tap **RS-232**
- Select the connected interface
- The following settings are sent through the RS-232 adapter, and can be adapted as needed for the receiver software:
  - **Baud rate**
  - **Data bits**
  - **Parity**
  - **Stop bits**
  - **Flow control**

Further information: "RS-232", Page 499

Selecting a data format

By assigning a data format to the function for the measured value output, you specify the format in which the measured values will be sent to the computer. For this purpose, you can use the **Standard** and **Steinwald** data formats, or create your own data format (see "Creating your own data format", Page 233).

Selecting a data format

- Tap **Settings** in the main menu
- Tap **Interfaces**
- Tap **Data transfer**
- In the **RS-232** drop-down list, select the type of interface
- Select the data format in the **Data format for data transfer** drop-down list

Further information: "Data transfer", Page 500

Creating your own data format

In the file management you will find a file that you can copy to a storage medium and then adapt it individually on a computer. Then you can copy the new file to the file storage area of the product and assign it to .

Data formats are saved as XML files

- ▶ Tap **File management** in the main menu
- ▶ Open in the sequence
  - **Internal**
  - **User**
  - **DataTransfer**
- > The folder contains the file **MyFormat1.xml**
- ▶ Copy the file **MyFormat1.xml** to a transfer medium
- ▶ Rename file
- ▶ Edit the file in an XML editor or the computer's text editor
- ▶ Copy the file from the transfer medium to the following folder of the product: **Internal** ▶ **User** ▶ **DataTransfer**

- ▶ Use the **Switch-off** menu to shut down the product and then restart it
- > The data format can be selected through the following path: **Settings** ▶ **Interfaces** ▶ **Data transfer**

> In order to prevent your data formats from being removed when the firmware is updated, save each file under a separate name.
>
> When the firmware is updated, the **MyFormat1** file in the **DataTransfer** folder is reset to the status it had when shipped. The file is automatically recreated if it no longer exists. Other files in the **DataTransfer** folder are not affected by a firmware update.

Further information: "Copying a file", Page 455
Further information: "Data transfer", Page 500

XML schema of the MyFormat1.xml file


```xml
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <base id="Settings">
    <group id="General">
      <group id="Format">
        <group id="MyFormat1">
          <element id="General" prefix="" suffix="" previousValues="false" writeLabel="true" writeUnit="true" writeTimestamp="false" newlineAfterTimestamp="false"/>
          <element id="X" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="Y" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="Z" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="Q" unit="deg" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="R" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="D" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="L" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="W" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="A" unit="mm^2" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="C" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="f" unit="" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="&lt;" unit="deg" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="&lt;S" unit="deg" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="&lt;E" unit="deg" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="Lx" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="Ly" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
          <element id="Lz" unit="mm" base="10" factor="1" newline="false" prefix=" " suffix=" " decimalPlaces="3" digits="0" positiveSign="false"/>
        </group>
      </group>
    </group>
  </base>
  <base id="version" major="0" minor="0" build="0"/>
</configuration>
```

Figure 38: Data format **MyFormat1.xml**

1 Name of the file format that is displayed in the product settings
2 The line with the ID "General" defines parameters for the entire send block
3 The subsequent lines define parameters for each measured value

The following overview explains the parameters and values that you can define individually. All elements not listed here must be kept as they are.

Element and parameter	Default value	Explanation
group id	"MyFormat1"	Name of the data format that is displayed in the **Settings** menu
element prefix	" "	Character string that is output before the send block or measured value Numbering of send blocks: If in the line ID="General" the value is "%0x" then the send blocks are numbered sequentially; x defines the quantity of characters for the numbering (x = 0 ... 9) Example: ■ prefix="%04" ■ The first send block is assigned the number 0001
element suffix	" "	Character string that is output after the send block or measured value
element previousValues	"false"	■ "true": The previous send block is output in addition to the current send block ■ "false": Only the current send block is output
element writeLabel	"true"	■ "true": The axis name is output before the measured value ■ "false": The axis name is not output
element writeUnit	"true"	■ "true": The unit is output after the measured value Prerequisite: A value must be defined for the "element unit" parameter (see below) ■ "false": The unit is not output

Element and parameter	Default value	Explanation
element writeTimestamp	"true"	Time stamp for the send block in the format "yyyy-MM-ddThh:mm:ss.zzz" The value is inserted after the `prefix` attribute. In combination with the `previousValues="true"` attribute, the first (current) value receives the current time upon sending. The second (previous) value retains its original time stamp
element newlineAfterTimestamp	"true"	A page break is inserted after the time stamp Only if attribute `writeTimestamp="true"`
element id	"X"	Measured value to which the subsequent parameters apply; each value is defined in its own line Possible values: ■ "X": Current position of X axis ■ "Y": Current position of Y axis ■ "Z": Current position of Z axis ■ "Q": Current position of Q axis ■ "R": Current radius value ■ "D": Current diameter value ■ "L": Current length value ■ "W": Current width value ■ "A": Current value of area ■ "C": Current value of circumference ■ "F": Current value of form error ■ "<": Current angle value (<) ■ "<S": Current value of start angle (<S) ■ "<E": Current value of end angle (<E) ■ "Lx": Current value of distance in X ■ "Ly": Current value of distance in Y ■ "Lz": Current value of distance in Z
element unit	"mm"	The measured value is output in the unit millimeters. Possible values: "mm", "inch", "deg", "dms", "rad" If no value is defined, the units are not adapted
element base	"10"	■ "10": Measured value is output as a decimal value ■ "16": Measured value is output as a hexadecimal value
element factor	"1"	Factor by which the measured value is multiplied Example: ■ Measured value: 43.67 ■ factor="100" ■ Measured value output: 4367.00
element newline	"false"	■ "true": There is a line break after the measured value ■ "false": There is no line break after the measured value

Element and parameter	Default value	Explanation
element decimalPlaces	"3"	Number of decimal places to which the measured value is rounded
element digits	"0"	Number of digits before the decimal separator to which the measured value is rounded according to commercial practice Example: ■ Measured value: 43.67 ■ digits="4" ■ Measured value output: 0043.67
element positiveSign	"false"	■ "true": Output a plus sign before the measured value ■ "false": Do not output a plus sign before the measured value

Selecting contents for the data transfer

For each geometry type, you can define which parameters are to be sent to the computer. Which parameters are available depends on the specific geometry type. **Further information:** "Overview of parameters in the measurement result preview", Page 495

The contents for the data transmission can be selected in the following ways:

- Select contents in the **Measurement result preview**
- Select contents in the **Details** dialog

> **i** The product saves the selection for all features of the same geometry type.

Select contents in the Measurement result preview

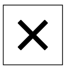
Requirement: The **Measurement result preview** is active

Further information: "General settings (Features)", Page 488

- Measure a feature, e. g., a **Circle**
- > The **Measurement result preview** opens

> All numerical values of the feature are available for selection.
> **Further information:** "Overview of parameters in the measurement result preview", Page 495

- To select or deselect contents, tap the corresponding **Symbol**
- > The selected contents are marked by the Send symbol



- Tap **Close**
- > The selection is saved for all elements of the same geometry type.

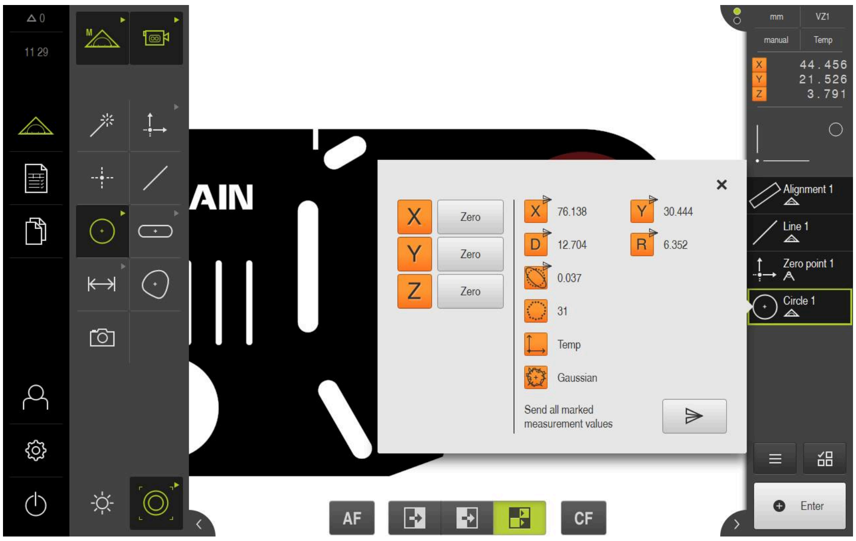


Figure 39: Content of the data transfer in the **Measurement result preview**

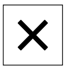
Select contents in the Details dialog

- Drag a feature (e.g., a **Circle**) from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected

- Tap **Content of the data transfer**
- > A dialog box for selecting the contents appears

> All numerical values of the feature are available for selection.
> **Further information:** "Overview of parameters in the measurement result preview", Page 495

- To select or deselect contents, tap the corresponding **Symbol**
- > The selected contents are marked by the Send symbol



- Tap **Close**
- > The selection is saved for all elements of the same geometry type.

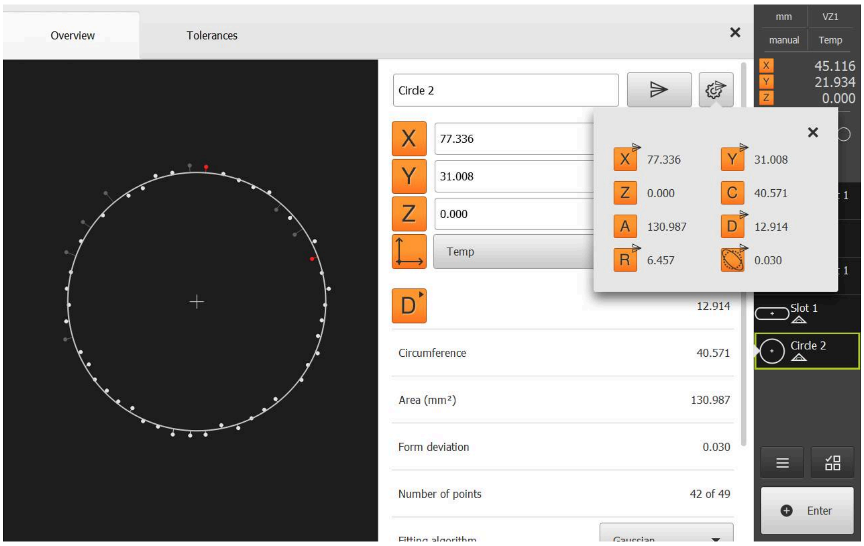


Figure 40: Content of the data transfer in the **Details** dialog

8.4 Back up settings

The product’s settings can be backed up as a file so that they are available after a reset to the factory default settings has been performed or for installation on multiple units.

- Tap **Settings** in the main menu
- Tap **Service**
- Open in the sequence
  - **Back up and restore**
  - **Back up settings**

Performing a Complete backup

During a complete backup of the configuration, all settings of the product are backed up.

- Tap **Complete backup**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- Select the folder to which you want to copy the configuration data
- Specify a name for the configuration data, e.g. "<yyyy-mm-dd>_config"
- Confirm the entry with **RET**
- Tap **Save as**
- Tap **OK** to confirm the successful backup of the configuration
- > The configuration file was backed up

Further information: "Back up and restore", Page 521

Safely removing a USB mass storage device

- Tap **File management** in the main menu
- Navigate to the list of storage locations
- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

8.5 Back up user files

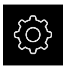
The user files of the product can be backed up as a file to make it available after a reset to the factory default settings. This, together with the backing up of the settings, enables you to back up the complete configuration of your product.

Further information: "Back up settings", Page 198

> All files from all user groups that are stored in the respective folders are backed up and can be restored as user files.
>
> The files in the **System** folder are not restored.

Performing back up

The user files can be backed up as a ZIP file on a USB mass storage device or connected network drive.

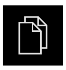


- Tap **Settings** in the main menu

- Tap **Service**
- Open in the sequence
  - **Back up and restore**
  - **Back up user files**
- Tap **Save as ZIP**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- Select the folder to which you want to copy the ZIP file
- Specify a name for the ZIP file, e.g. "<yyyy-mm-dd>_config"
- Confirm the entry with **RET**
- Tap **Save as**
- Tap **OK** to confirm successful backup of the user files
- > The user files were backed-up.

Further information: "Back up and restore", Page 521

Safely removing a USB mass storage device



- Tap **File management** in the main menu
- Navigate to the list of storage locations

- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

9

Quick Start

9.1 Overview

In this chapter an example is used to describe the steps of a typical measuring sequence. The steps range e.g. from aligning the measured object and measuring the features through to creating the measurement report.

> For a detailed description of the individual activities, please refer to the "Measuring" chapter and to the following chapters.

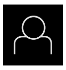
Depending on the configuration of the unit and the enabled software options, you can acquire measuring points with or without sensor. The product identifies the captured measuring points as features and displays them.

> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

9.2 Logging in for Quick Start

User login

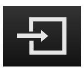
For Quick Start, the **Operator** user must log in.



- Tap **User login** in the main menu
- If required, log out the user who is currently logged in
- Select the **Operator** user
- Tap the **Password** input field
- Enter the password "operator”

> If the password does not match the default password, ask a **Setup** user or **OEM** user for the assigned password.
>
> If the password is no longer known, contact a HEIDENHAIN service agency.

- Confirm entry with **RET**



- Tap **Log in**

9.3 Conducting a measurement

This section describes the typical steps for conducting a measurement.

9.3.1 Preparing a measurement

Cleaning the measured object and the measuring machine

Contamination, e.g. from chips, dust and oil residues, leads to incorrect measurement results. The measured object, the holder for the measured object, and the sensor must be clean before you start measuring.

- Clean the measured object, the holder for the measured object, and the sensors with appropriate cleaning products

Stabilizing the temperature of the measured object

The objects to be measured should be stored at the measuring machine for an appropriate amount of time to allow the objects to adjust to the ambient temperature. Since the dimensions of the measured objects vary with temperature changes, the temperature of the measured objects must be stabilized.

This ensures the reproducibility of the measurement. The reference temperature is usually 20 °C.

- Stabilize the temperature of the measured objects for an appropriate amount time

Reducing environmental influences

Environmental influences, such as incident light, ground vibration or air humidity, can affect the measuring machine, the sensors or the measured objects, and thus falsify the measurement results. Certain influences, such as incident light, also have a negative effect on the measurement uncertainty.

- Eliminate or avoid environmental influences as far as possible

Fixing the measured object in place

The measured object must be fixed in place on the measuring plate or in an appropriate holder, depending on its size.

- Position the measured object in the center of the measuring range
- Use e.g. modeling clay to fix small measured objects in position
- Use fixtures to fix large measured objects in position
- Make sure that the measured object is fastened neither too loosely nor too tightly

Conducting the reference mark search

With the help of reference marks, the unit can assign axis positions of the encoder to the machine.

If no reference marks for the encoder are provided by a defined coordinate system, you need to perform a reference mark search before you start measuring.

> If the reference mark search after unit start is active, then all of the unit's functions will be disabled until the reference mark search has been successfully completed.
>
> **Further information:** "Reference marks (Encoder)", Page 515

> The reference mark search does not need to be performed for serial encoders with EnDat interface, because the axes are automatically homed.

If the reference mark search is active on the unit, then a wizard will ask you to traverse the reference marks of the axes.

- ▶ After logging in, follow the instructions of the wizard
- > The Reference symbol stops blinking upon successful completion of the reference mark search

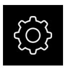
Further information: "Operating elements of the position display", Page 117

Further information: "Activating the reference mark search", Page 143

Starting the reference mark search manually

> A manual reference mark search can be performed only by the **Setup** and **OEM** user types.

If the reference mark search was not performed on startup, you can start it manually later.



- ▶ Tap **Settings** in the main menu
- ▶ Open in the sequence
  - **Axes**
  - **General settings**
  - **Reference marks**
- ▶ Tap **Start**
- > The Reference symbol blinks
- ▶ Follow the instructions of the wizard
- > The Reference symbol stops blinking upon successful completion of the reference mark search

Calibrating a VED sensor

Prerequisites

- The VED sensor has been configured in the device settings
  Further information: "Configuring a VED sensor", Page 175

Selecting the sensor

- ▶ Select **Manual measuring** in the function palette
- ▶ If multiple sensors are available, select **VED sensor** in the sensor palette
- > The image section from the VED sensor is displayed in the workspace
- ▶ Position the measuring tool over a high-contrast edge of the measured object
- ▶ Focus the optics of the measuring machine until the displayed edge is as sharp as possible

Adjusting the lighting

- ▶ Tap **Lighting palette**
- ▶ Use the sliders to adjust the lighting in the workspace so that the contrast at the object edge is as high as possible

Adjusting the contrast settings

The contrast threshold defines the contrast value starting from which a light-to-dark transition is recognized as an edge. The higher the defined contrast threshold, the higher the contrast of the measured transition must be.

This section explains how to set the contrast threshold manually or how to adjust it to the current light conditions using a teach sequence.

Alternatively, you can also adjust the contrast threshold with the contrast bar in the **Measure** menu.
Further information: "Show contrast bar", Page 127 and Page 105

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Tap **Settings** in the main menu
- ▶ Tap **Sensors**
- ▶ Open in the sequence
  - **Video edge detection (VED)**
  - **Contrast settings**
- ▶ Select the **Edge algorithm** for the edge detection
  - **Automatic**: The edge is defined automatically
  - **First edge**: The first transition ≥ the contrast threshold is defined as an edge
  - **Strongest edge**: The strongest transition ≥ the contrast threshold is defined as an edge
- ▶ In the **Contrast threshold value for edge detection** field, enter the desired contrast threshold value and do not superimpose the camera image (setting range: **0 ... 255**)

or

- ▶ To start the teach sequence, tap **Start**
- > The teach sequence is started and the **Measure** menu is displayed
- ▶ Select the **lighting palette**
- ▶ Adjust the sliders to achieve the highest possible contrast at the edge
- ▶ Tap **Confirm** in the wizard to confirm the positioning of the measuring tool and the lighting settings
- > The values in the **Contrast threshold value for edge detection** and **Contrast** fields will be adjusted automatically, based on the selected edge algorithm
- > The teach sequence is complete
- ▶ Tap **Undo** to repeat the teach sequence
- ▶ Tap **Close** to close the wizard

Further information: "Contrast settings", Page 478

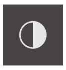
Calibrating an OED sensor

Prerequisites

- The OED sensor has been configured in the device settings
  Further information: "Configuring an OED sensor", Page 189

Selecting the sensor

- ▶ Select **Manual measuring** in the function palette



- ▶ If multiple sensors are available, select **OED sensor** in the sensor palette
- > The position display is now shown in the workspace
- ▶ Focus the optics of the measuring machine such that the sharpest edge possible is shown on the projection screen of the measuring machine
- ▶ Adjust the lighting of the measuring machine such that the highest amount of contrast possible is shown on the projection screen of the measuring machine

Adjusting the contrast settings

Adjust the contrast settings to the current light conditions via a teach sequence. As part of this process, you need to acquire one point each from the light and dark areas of the screen with the OED sensor.

> **i** The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the contrast settings in a teach sequence, go to **OED contrast teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ Tap **OK** to close the dialog
- > The contrast settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Contrast settings", Page 483

Adjusting the threshold settings

The threshold settings define the contrast value starting from which a light-to-dark transition is recognized as an edge. Adjust the threshold settings to the current light conditions via a teach sequence. To do so, use the OED sensor to measure a distance for which you define a nominal value.

ℹ	The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the threshold settings in a teach sequence, go to **OED threshold teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ Tap **OK** to close the dialog
- > The threshold settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Threshold settings", Page 483

Configuring offset settings

The offset settings compensate for the position error between the crosshair for measuring point acquisition and the OED sensor for edge detection. You can configure the offset settings using a teach sequence in which you measure a circle with two different measuring tools. The offset of the OED sensor for the X and Y axes is calculated from the deviations of both circles and will then be compensated in subsequent measurements.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the offset settings in a teach sequence, go to **OED offset teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard:
  - Measure the points on the circle with the crosshair measuring tool
  - Confirm each measured point with **Enter point**
- ▶ Tap **OK** to close the dialog
- > The offset settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Offset settings", Page 484

Setting a TP sensor

Prerequisite: Touch probe (TP) is configured in the device settings

Further information: "Configuring a TP sensor", Page 193

Selecting the sensor

- Select **Manual measuring** in the function palette

- If multiple sensors are available, select **TP sensor** in the sensor palette
- > The position display is now shown in the workspace

Calibrating a stylus

Before you can use a stylus for measuring, it must be calibrated. For this purpose, measure the calibration sphere whose diameter you indicated in the device settings. Place at least three measuring points on the circumference and one on the top of the calibration sphere.

The first stylus you calibrate is defined as the main stylus. All other styli refer to the main stylus. If you re-calibrate the main stylus, you need to re-calibrate the other styli as well.

i	If you are using a star-type stylus, each stylus tip must be calibrated.

i	If you are using an indexed swiveling stylus, repeat the calibration procedure for each axis and each angular value required for measurement.

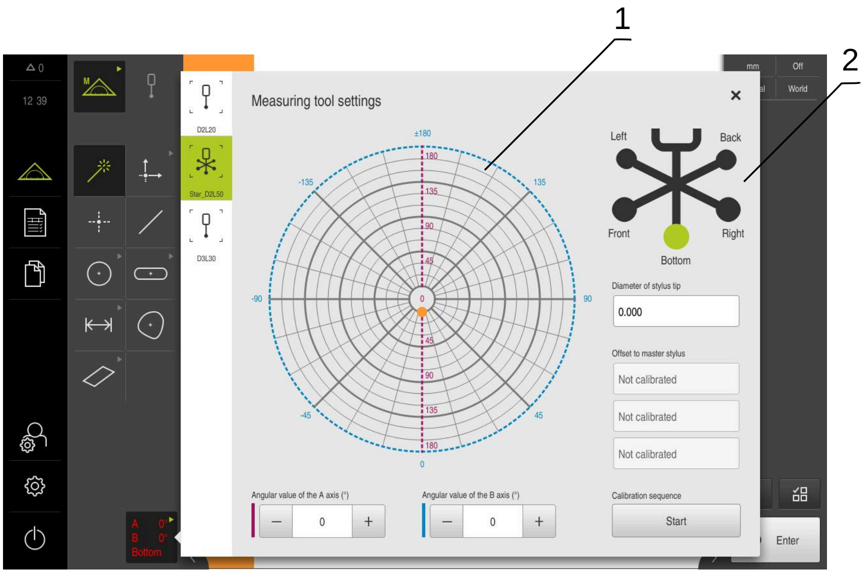


Figure 41: **Measuring tool settings** dialog for TP measuring tools

1. Graphical representation for selection of the angle values for indexed swiveling styli
2. Graphical representation for selection of the stylus tip for star-type styli

In the graphical representation of indexed swiveling styli, you can select a stylus position in order to calibrate it then. The scale corresponds to the range of adjustment of the touch probe head that is indicated in the settings.

Further information: "Probe head", Page 486

The calibrated positions and the selected position are marked by dots. The colors of the dots have the following meaning:

Color	Meaning
Orange	Position has been selected but not yet calibrated
Green	Position has been selected and calibrated
Dark gray	Position has not yet been selected and calibrated

- ▶ Select the desired stylus in the tool palette
- > The **Measuring tool settings** dialog shows the available parameters for the selected stylus
- ▶ If you are using a star-type stylus, tap the first stylus tip in the graphics
- > The selected stylus tip is displayed in green
- ▶ If you are using an indexed swiveling stylus, select the first angular value in the graphical representation or in the input fields
- ▶ Enter the diameter of the stylus tip
- ▶ To start the calibration, tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ If you are using a star-type stylus, repeat this procedure for each stylus tip
- ▶ If you are using an indexed swiveling stylus, repeat the procedure for each axis and each angular value

- > When the icon in the tool bar is displayed in green, the stylus is fully calibrated

Further information: "Touch probe (TP)", Page 484

9.3.2 Measuring without a sensor

On products without sensors, only geometries and no measuring tools are available. For alignment and measuring point acquisition, you can use an external screen with crosshairs, for example. The workspace of the user interface displays the position of the measuring plate.

> ℹ The measurements illustrated here are described in detail in the Measurement chapter.

Further information: "Measuring", Page 301

Aligning the measured object

Before you can evaluate the measuring points, you need to align the measured object. During this process, the coordinate system of the measured object (workpiece coordinate system) is determined, which is specified in the technical drawing.

This makes it possible to compare the measured values with the data in the technical drawing and assess them.

Further information: "2-D demo part", Page 545

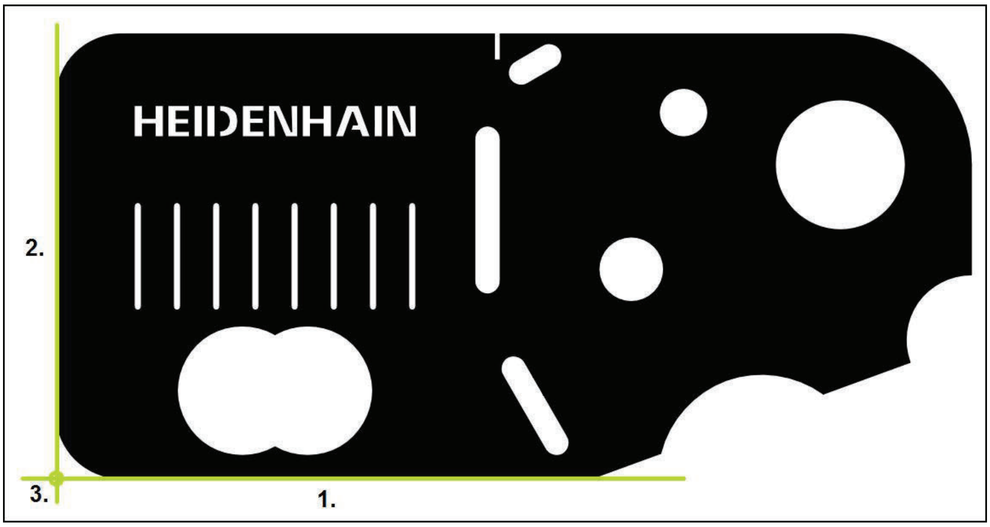


Figure 42: Example of aligning a 2-D demo part

Measured objects are usually aligned in the following steps:

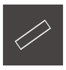
1 Measuring the alignment
2 Measuring a straight line
3 Constructing the zero point

Measuring the alignment

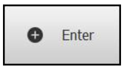
Define the reference edge for the alignment according to the technical drawing.

- ▶ Tap **Measure** in the main menu

- ▶ Select **Manual measuring** in the function palette
- > The workspace is displayed, showing the axis positions



- ▶ Select **Alignment** in the geometry palette
- ▶ Position the first measuring point on the reference edge



- ▶ Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

> **i** Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- ▶ Position the second measuring point on the reference edge
- ▶ Tap **Enter** in the Inspector

> **i** Depending on the configuration, you can also acquire additional measuring points for the feature. In this way you increase the accuracy.

- ▶ Tap **Finish** in the new feature
- > The alignment is displayed in the feature list
- > The measurement result preview appears

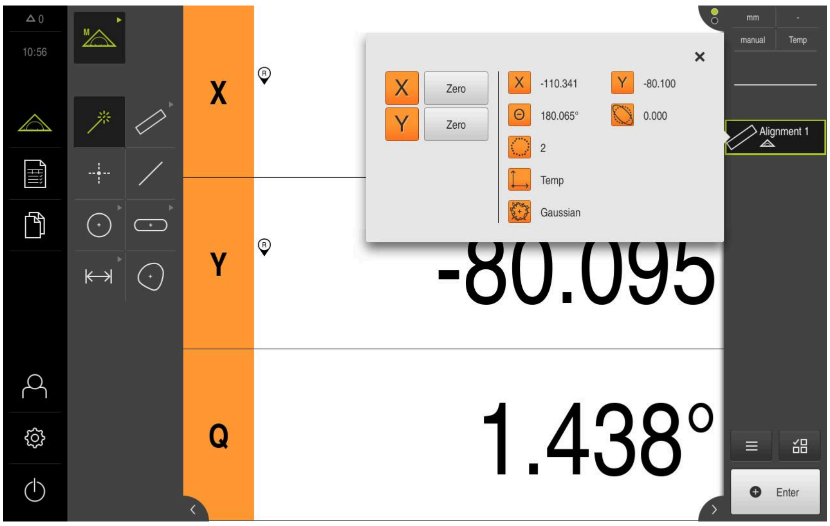
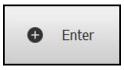


Figure 43: **Alignment** feature in the feature list with **Measurement result preview**

Measuring a straight line

A straight line is measured as the second reference edge.

- Select **Line** in the geometry palette
- Position the first measuring point on the reference edge



- Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

> Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- Position the second measuring point on the reference edge
- Tap **Enter** in the Inspector

> Depending on the configuration, you can also acquire additional measuring points for the feature. In this way you increase the accuracy.

- Tap **Finish** in the new feature
- > The straight line is displayed in the feature list
- > The measurement result preview is now displayed

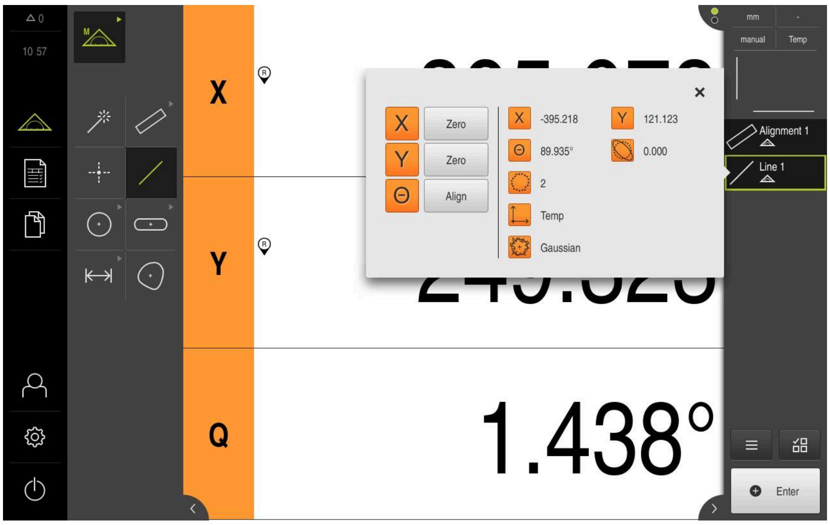
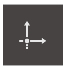


Figure 44: **Line** feature in the feature list with **Measurement result preview**

Constructing the zero point

Construct the zero point at the point of intersection between the alignment and the straight line.



- ▶ Select **Zero point** in the geometry palette
- ▶ Select the **Alignment** and **Line** features in the Inspector or in the features view
- > The selected features are displayed in green
- > A new feature is displayed in the feature list

- ▶ Tap **Finish** in the new feature
- > The zero point is displayed in the feature list
- > The workpiece coordinate system for the measured object has been determined
- ▶ Tap **Features preview**
- > The coordinate system is shown in the workspace

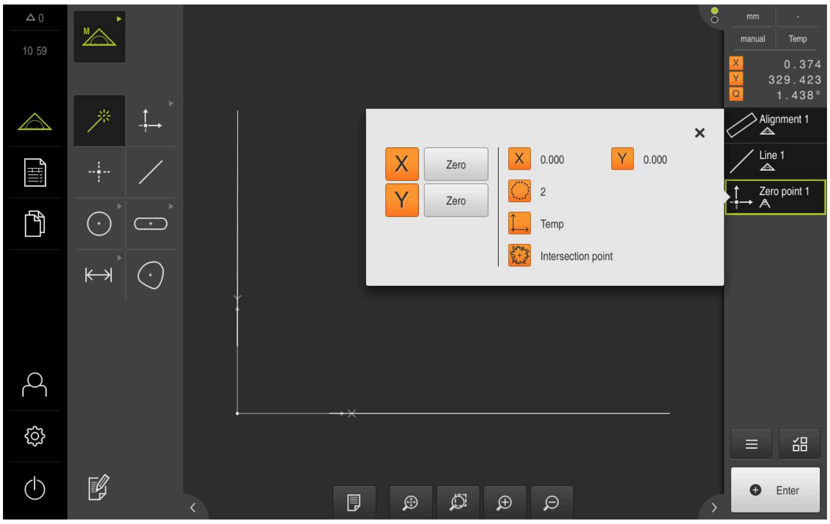


Figure 45: Workspace with zero point displayed in the coordinate system

Measuring features

To measure features, you can use the geometries of the geometry palette or Measure Magic.

> If you use Measure Magic, the type of geometry is automatically determined from the captured measuring points. The type of geometry can be changed after the measurement.

Further information: "Measuring with Measure Magic", Page 328

Further information: "Overview of geometry types", Page 302

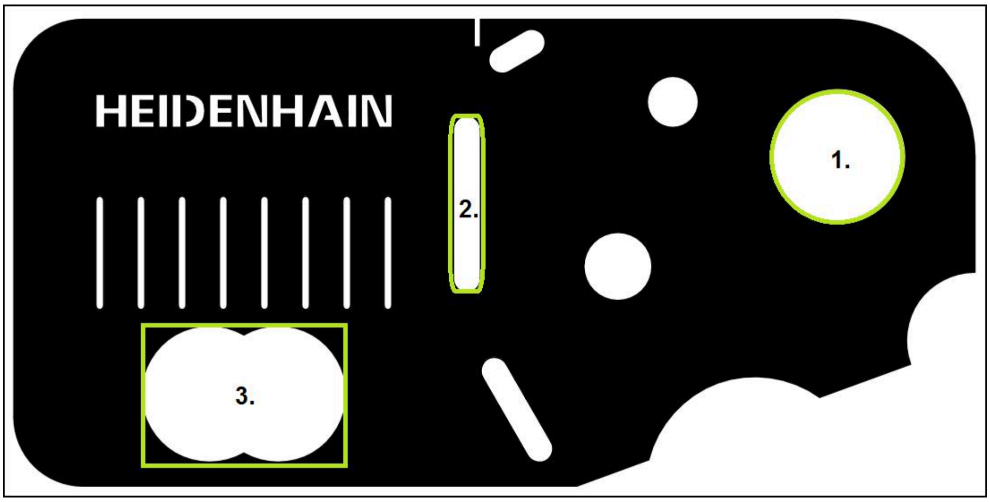


Figure 46: Examples of measuring a 2-D demo part

The section below describes measuring the following features:

1 Circle
2 Slot
3 Blob

Measuring a circle

A minimum of three measuring points is required to measure a circle.

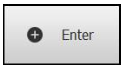
- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette
- > The workspace is displayed, showing the axis positions

- Select **Measure Magic** in the geometry palette

or

- Select **Circle** in the geometry palette
- Move to the first measuring point on the contour of the circle



- Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list
- Move to the next measuring point on the contour of the circle

> Distribute the measuring points as evenly as possible along the contour of the feature.

- Tap **Enter** in the Inspector
- To acquire more measuring points, repeat these steps

- Tap **Finish** in the new feature
- > The circle is displayed in the feature list
- > The measurement result preview appears

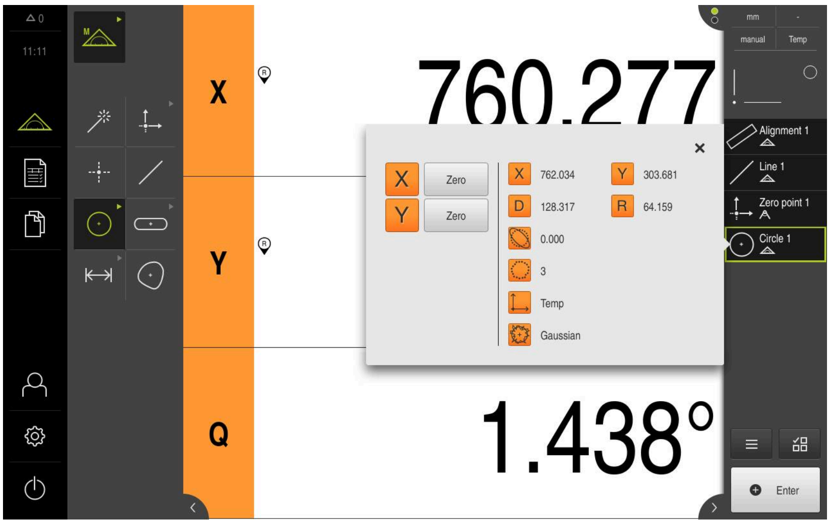


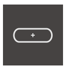
Figure 47: **Circle** feature in the feature list with **Measurement result preview**

Measuring a slot

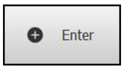
A minimum of five measuring points is required to measure a slot. Place at least two measuring points on the first long side, one measuring point on the second long side, and one measuring point on each arc of the slot.

- ▶ Select Measure Magic in the geometry palette

or



- ▶ Select **Slot** in the geometry palette
- ▶ Move to the first measuring point on the contour of the slot



- ▶ Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list
- ▶ Move to the next measuring point on the contour of the slot

> Distribute the measuring points along the entire length of the first long side, if possible.

- ▶ Tap **Enter** in the Inspector
- ▶ To acquire more measuring points, repeat these steps

- ▶ Tap **Finish** in the new feature
- > The slot is displayed in the feature list
- > The measurement result preview appears

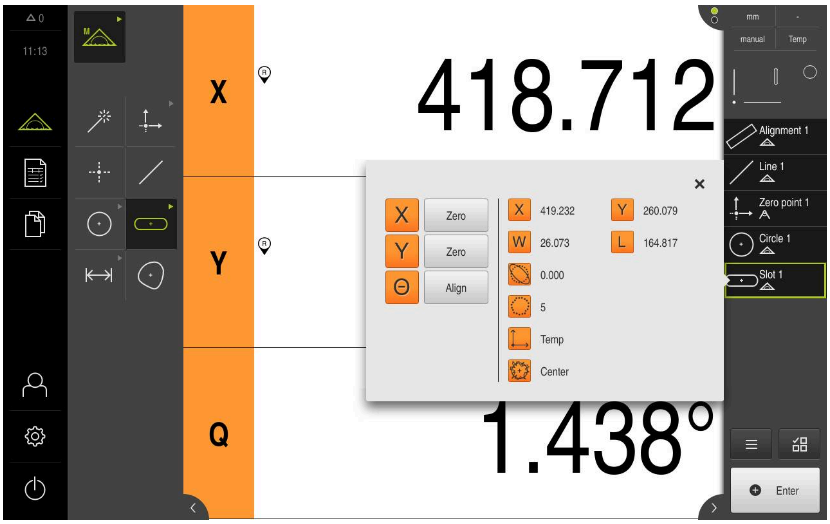
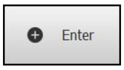


Figure 48: **Slot** feature in the feature list with **Measurement result preview**

Measuring a blob

A minimum of three measuring points is required to measure a blob.

- Select **Blob** in the geometry palette
- Move to the first measuring point on the contour of the blob



- Tap **Enter** in the Inspector
- \> A new feature is displayed in the feature list
- Move to the next measuring point on the contour of the blob

> **i** Distribute the measuring points as evenly as possible along the contour of the feature.

- Tap **Enter** in the Inspector
- To acquire more measuring points, repeat these steps

- Tap **Finish** in the new feature
- \> The blob is displayed in the feature list
- \> The measurement result preview is now displayed

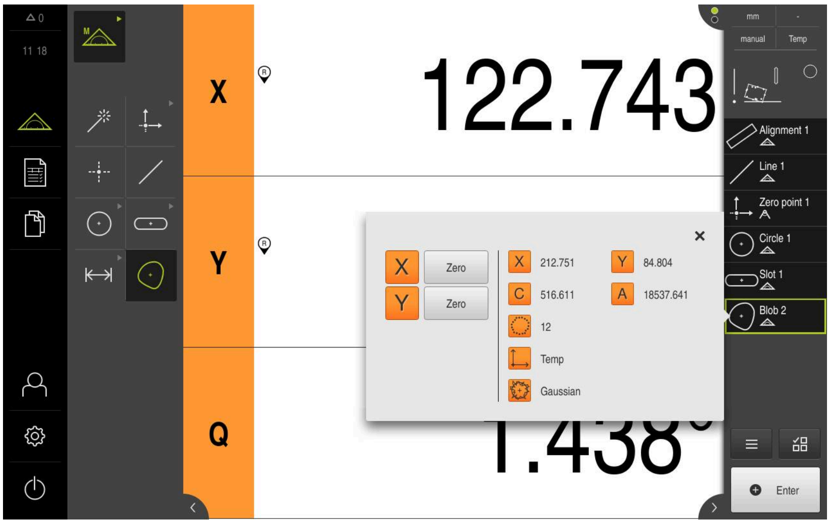


Figure 49: **Blob** feature in the feature list with **Measurement result preview**

9.3.3 Measuring with a VED sensor

For the measurement of edges and contours with a VED sensor, various measuring tools are available to you for the acquisition of measuring points in the live image.

Further information: "Overview of the VED measuring tools", Page 90

The measurements illustrated here are described in detail in the Measurement chapter.

For the measurements described in this section, a virtual camera (Virtual Camera (GigE)) will be used with the depiction of the supplied 2-D demo part.

Application-specific adjustments during commissioning or setup can lead to deviating depictions.

It is possible for the OEM user or the Setup user to switch to the virtual camera at any time. By this means, the depicted examples can be reproduced.

Further information: "Measuring", Page 301

Aligning the measured object

Before you can evaluate the measuring points, you need to align the measured object. During this process, the coordinate system of the measured object (workpiece coordinate system) is determined, which is specified in the technical drawing.

This makes it possible to compare the measured values with the data in the technical drawing and assess them.

Further information: "2-D demo part", Page 545

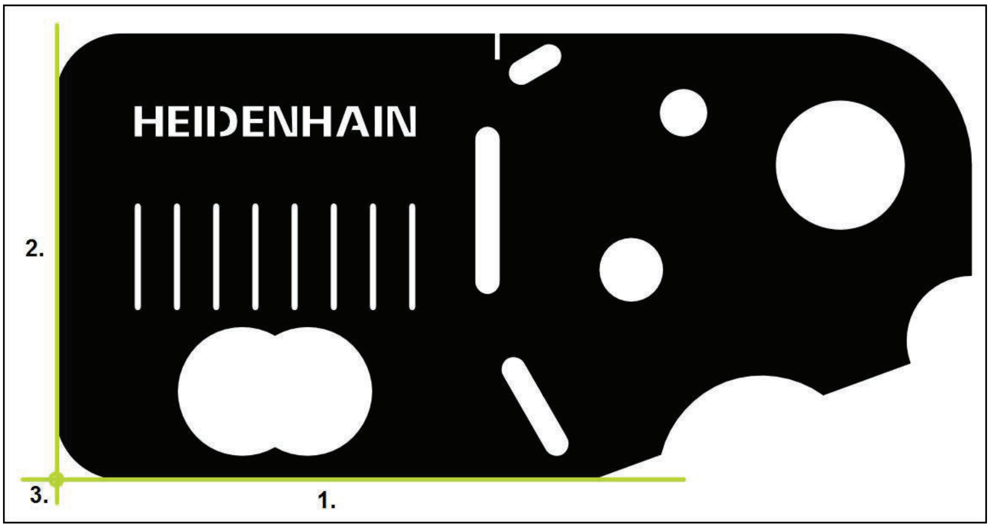


Figure 50: Example of aligning a 2-D demo part

Measured objects are usually aligned in the following steps:

1 Measuring the alignment
2 Measuring a straight line
3 Constructing the zero point

When using the **Manual measuring** function, you can move the image section.

Further information: "Moving an image section", Page 92

Determining the focal plane with the Autofocus function (software option)

The **Autofocus (AF)** function helps you determine the focal plane. A wizard guides you through this procedure. While you move the measurement tool on the z axis, the product determines the position in which the contours of the measured object are best in focus.

- Tap **Measure** in the main menu
- Select **Manual measuring** in the function palette
- If multiple sensors are available, select **VED sensor** in the sensor palette
- > The geometry palette and the VED measuring tools are displayed
- > The workspace shows the camera's live image
- In the quick access menu, select the magnification that is set on the measuring machine
- Select one of the following measuring tools
  - Crosshair
  - Single edge
  - Circle
  - Buffer
  - Contour

AF

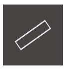
- Tap **Autofocus**
- Follow the instructions of the wizard
- > The wizard determines the optimum position on the Z axis
- Tap **Close** to close the wizard
- Move to the determined Z axis position

Measuring the alignment

Define the reference edge for the alignment according to the technical drawing.

- If required, select the **XY** projection plane in the quick access menu

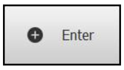
Further information: "Selecting the projection plane", Page 128



- Select **Alignment** in the geometry palette

- Select **Buffer** in the tool palette
- Position the measuring tool above the reference edge
- To adjust the scanning direction, rotate the measuring tool
- Expand the measuring tool so that the edge region enclosed in the search area is as large as possible

- Select the edge detection mode at the bottom of the workspace



- Tap **Enter** in the Inspector
- > Multiple measuring points are captured along the edge
- > A new feature is displayed in the feature list

> Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- If the edge is interrupted or not fully displayed in the workspace, reposition the measuring tool and capture more measuring points

- Tap **Finish** in the new feature
- > The alignment is displayed in the feature list
- > The measurement result preview is now displayed

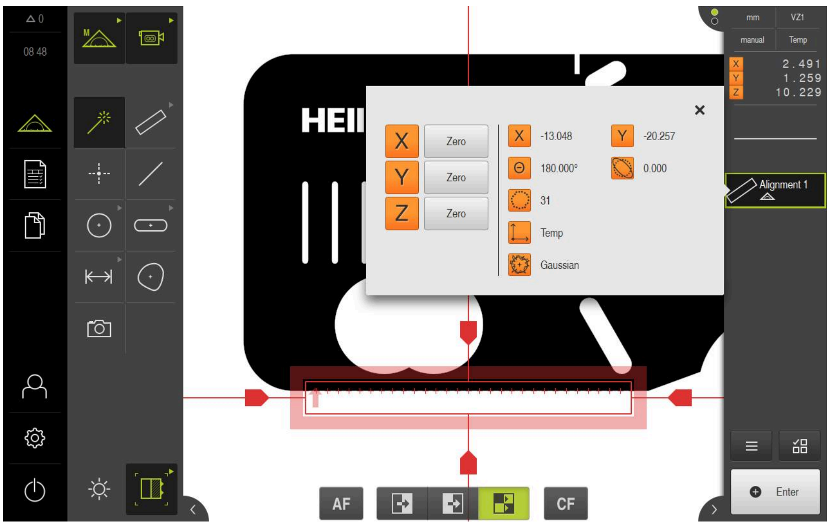


Figure 51: **Alignment** feature in the feature list with **Measurement result preview**

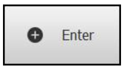
Measuring a straight line

For the second reference edge, you can measure a straight line with the **Buffer** measuring tool, for example.

- Select **Line** in the geometry palette

- Select **Buffer** in the tool palette
- Position the measuring tool above the reference edge
- To adjust the scanning direction, rotate the measuring tool
- Expand the measuring tool so that the edge area enclosed in the search range is as large as possible

- Select the edge detection mode at the bottom of the workspace



- Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

> **i** Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- If the edge is interrupted or not fully displayed in the workspace, reposition the measuring tool and capture more measuring points

- Tap **Finish** in the new feature
- > The straight line is displayed in the feature list
- > The measurement result preview appears

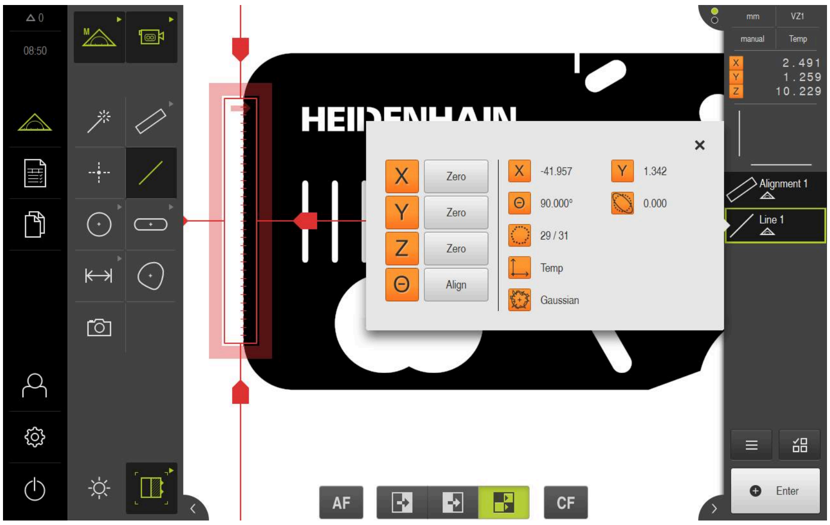
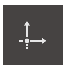


Figure 52: **Line** feature in the feature list with **Measurement result preview**

Constructing the zero point

Construct the zero point at the point of intersection between the alignment and the straight line.



- ▶ Select **Zero point** in the geometry palette
- ▶ Select the **Alignment** and **Line** features in the Inspector or in the features view
- > The selected features are displayed in green
- > A new feature is displayed in the feature list

- ▶ Tap **Finish** in the new feature
- > The zero point is displayed in the feature list
- > The workpiece coordinate system for the measured object has been determined
- ▶ Tap **Features preview**
- > The coordinate system is shown in the workspace

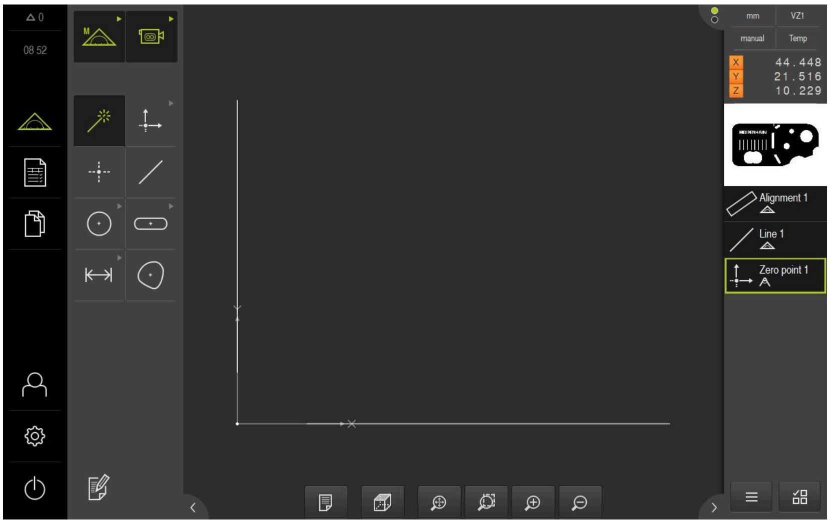


Figure 53: Workspace with zero point displayed in the coordinate system

Measuring features

To measure features, you can use the geometries of the geometry palette or Measure Magic.

> If you use Measure Magic, the type of geometry is automatically determined from the captured measuring points. The type of geometry can be changed after the measurement.

Further information: "Measuring with Measure Magic", Page 328

Further information: "Overview of geometry types", Page 302

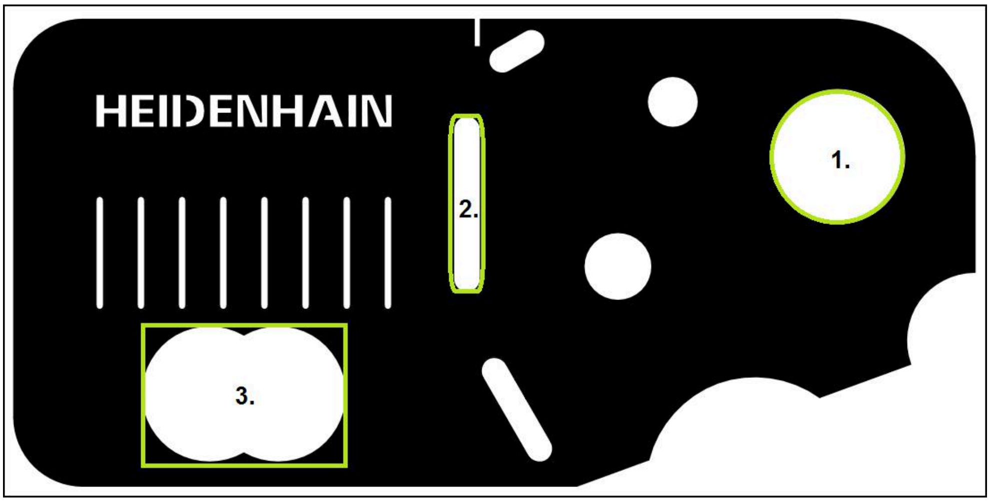


Figure 54: Examples of measuring a 2-D demo part

The section below describes measuring the following features:

1 Circle
2 Slot
3 Blob

> When using the **Manual measuring** function, you can move the image section.
>
> **Further information:** "Moving an image section", Page 92

Measuring a circle

A minimum of three measuring points is required to measure a circle. To acquire the measuring points, you can use the **Circle** measuring tool, for example. Multiple measuring points are automatically distributed along the entire contour according to the specified settings.

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette

- If multiple sensors are available, select **VED sensor** in the sensor palette
- > The geometry palette and the VED measuring tools are displayed
- Tap **Live image preview** in the Inspector
- > The workspace shows the camera's live image
- In the quick access menu, select the magnification that is set on the measuring machine
- Position the measured object within the live image

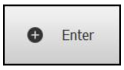
- Select **Measure Magic** in the geometry palette

or

- Select **Circle** in the geometry palette

- Select **Circle** in the tool palette
- Position the measuring tool on the contour
- Resize the two rings of the measuring tool so that the contour is fully enclosed within the search area between the inner and outer rings

- Select the edge detection mode at the bottom of the workspace



- Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

- Tap **Finish** in the new feature
- > The circle is displayed in the feature list
- > The measurement result preview appears

Figure 55: The circle is displayed in the features preview

Measuring a slot

A minimum of five measuring points is required in order to measure a slot. For measuring point acquisition, you can for example use the **Single edge** measuring tool. Place at least two measuring points on the first long side and at least one measuring point on the second long side, and on each arc of the slot.

- ▶ Select **Slot** in the geometry palette
- ▶ Select **Single edge** in the tool palette
- ▶ Position the search range of the measuring tool on the contour of the slot
- ▶ Resize the search range
- ▶ Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list
- ▶ Position the measuring tool on the contour of the slot to capture the second measuring point
- ▶ Tap **Enter**
- ▶ To acquire more measuring points, repeat these steps

> Distribute the measuring points along the entire length of the first long side, if possible.

- ▶ Tap **Finish** in the new feature
- > The slot is displayed in the feature list
- > The measurement result preview is now displayed

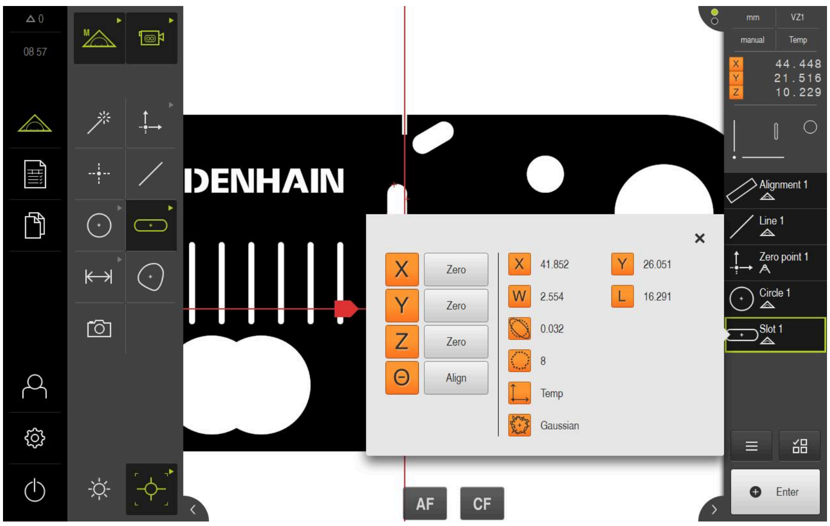


Figure 56: The slot is displayed in the features preview

Measuring a blob

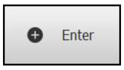
A minimum of three measuring points is required to measure a blob. To capture the measuring points, you can use e.g. the **Contour** measuring tool. Multiple measuring points are automatically distributed along the entire contour according to the specified settings.

- Select **Blob** in the geometry palette

- Select **Contour** in the tool palette
- Position the measuring tool at any desired location on the contour
- Resize the search range to enclose only one edge

> Make sure that there are no other edges or contours within the search range of the measuring tool.

- Select the edge detection mode at the bottom of the workspace



- Tap **Enter** in the Inspector
- > The measuring points are acquired along the edge until the start point is reached again
- > A new feature is displayed in the feature list

- Tap **Finish** in the new feature
- > The blob is displayed in the feature list
- > The measurement result preview is now displayed

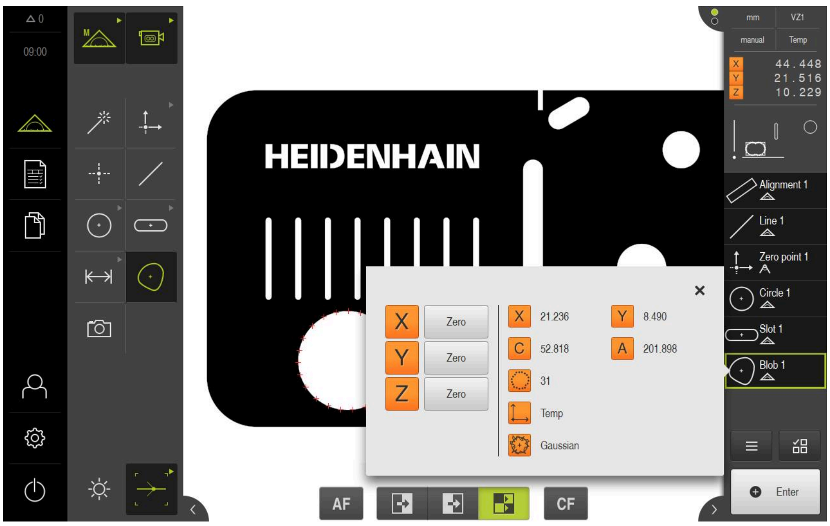


Figure 57: The blob is displayed in the features preview

9.3.4 Measuring with an OED sensor

For the measurement of edges and contours with an OED sensor, various measuring tools are available to you for the acquisition of measuring points.

Further information: "Overview of the OED measuring tools", Page 111

> The measurements illustrated here are described in detail in the Measurement chapter.

Further information: "Measuring", Page 301

Aligning the measured object

Before you can evaluate the measuring points, you need to align the measured object. During this process, the coordinate system of the measured object (workpiece coordinate system) is determined, which is specified in the technical drawing.

This makes it possible to compare the measured values with the data in the technical drawing and assess them.

Further information: "2-D demo part", Page 545

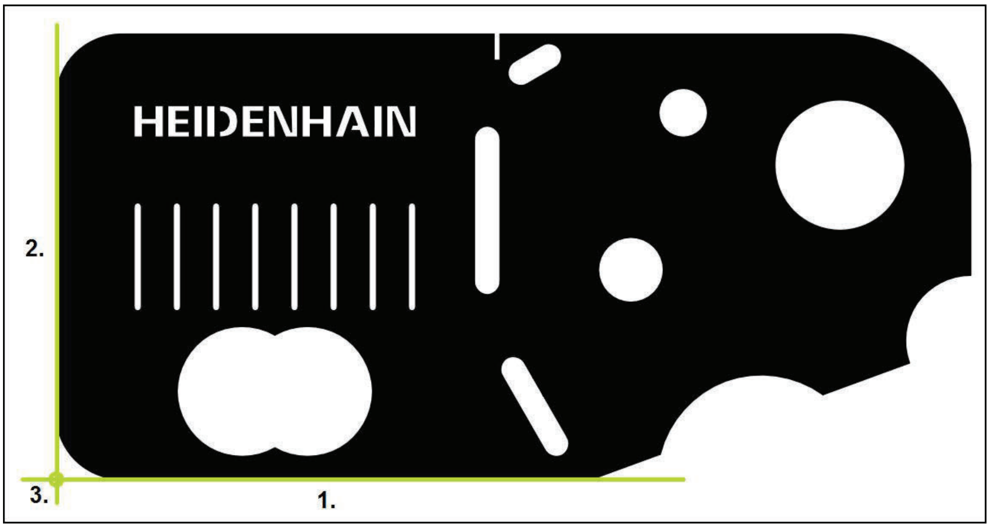


Figure 58: Example of aligning a 2-D demo part

Measured objects are usually aligned in the following steps:

1 Measuring the alignment
2 Measuring a straight line
3 Constructing the zero point

Measuring the alignment

Define the reference edge for the alignment according to the technical drawing.

- ▶ Tap **Measure** in the main menu
- ▶ Select **Manual measuring** in the function palette
- ▶ If multiple sensors are available, select **OED sensor** in the sensor palette
- > The geometry palette and the OED measuring tools are now displayed
- > The workspace now shows the position display
- ▶ In the quick access menu, select the magnification that is set on the measuring machine
- ▶ If required, select the **XY** projection plane in the quick access menu

Further information: "Selecting the projection plane", Page 128

- ▶ Select **Alignment** in the geometry palette
- ▶ Select **Auto OED** in the tool palette
- ▶ Cross over the reference edge multiple times with the OED sensor
- > A new feature is displayed in the feature list
- > A new measuring point is added for each pass over the reference edge

> Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- ▶ Tap **Finish** in the new feature
- > The alignment is displayed in the feature list
- > The measurement result preview is now displayed

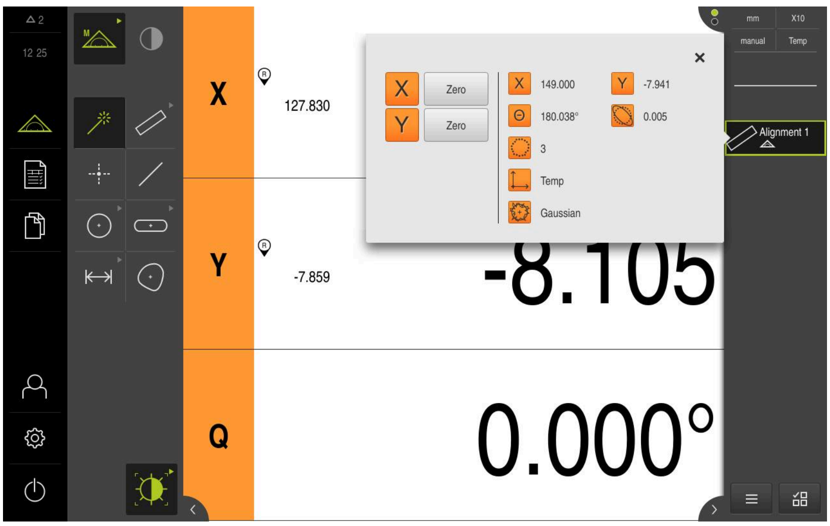


Figure 59: **Alignment** feature in the feature list with **Measurement result preview**

Measuring a straight line

Measure a straight line as the second reference edge.

- ▶ Select **Line** in the geometry palette

- ▶ Select **Auto OED** in the tool palette
- ▶ Cross over the reference edge multiple times with the OED sensor
- > A new feature is displayed in the feature list
- > A new measuring point is added for each pass over the reference edge

> ℹ Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- ▶ Tap **Finish** in the new feature
- > The straight line is displayed in the feature list
- > The measurement result preview appears

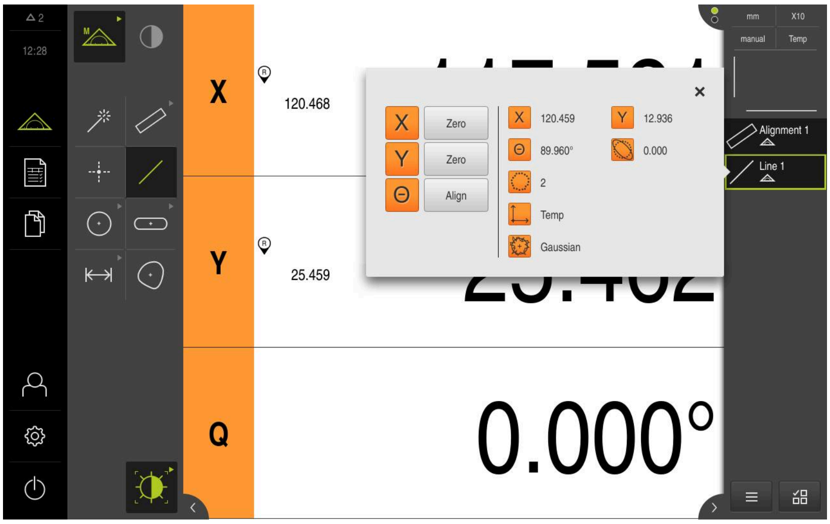
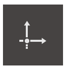


Figure 60: **Line** feature in the feature list with **Measurement result preview**

Constructing the zero point

Construct the zero point at the point of intersection between the alignment and the straight line.



- ▶ Select **Zero point** in the geometry palette
- ▶ Select the **Alignment** and **Line** features in the Inspector or in the features view
- > The selected features are displayed in green
- > A new feature is displayed in the feature list

- ▶ Tap **Finish** in the new feature
- > The zero point is displayed in the feature list
- > The workpiece coordinate system for the measured object has been determined
- ▶ Tap **Features preview**
- > The coordinate system is shown in the workspace

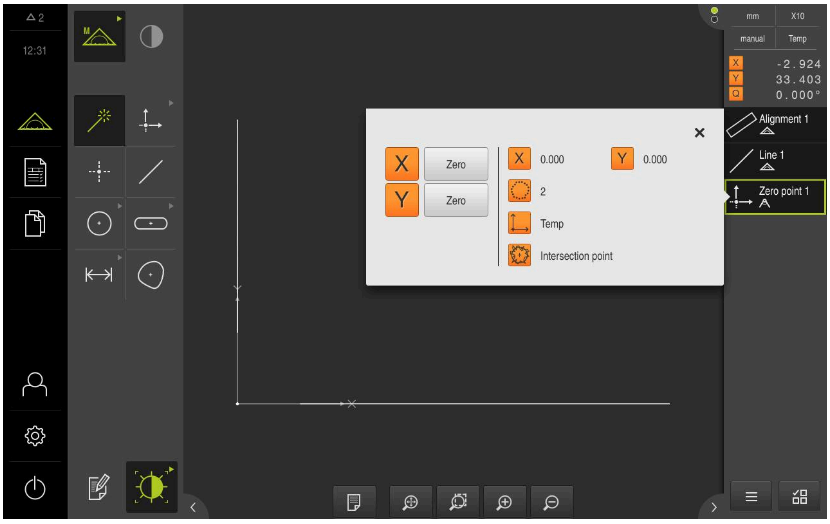


Figure 61: Workspace with zero point displayed in the coordinate system

Measuring features

To measure features, you can use the geometries of the geometry palette or Measure Magic.

> **i** If you use Measure Magic, the type of geometry is automatically determined from the captured measuring points. The type of geometry can be changed after the measurement.

Further information: "Measuring with Measure Magic", Page 328

Further information: "Overview of geometry types", Page 302

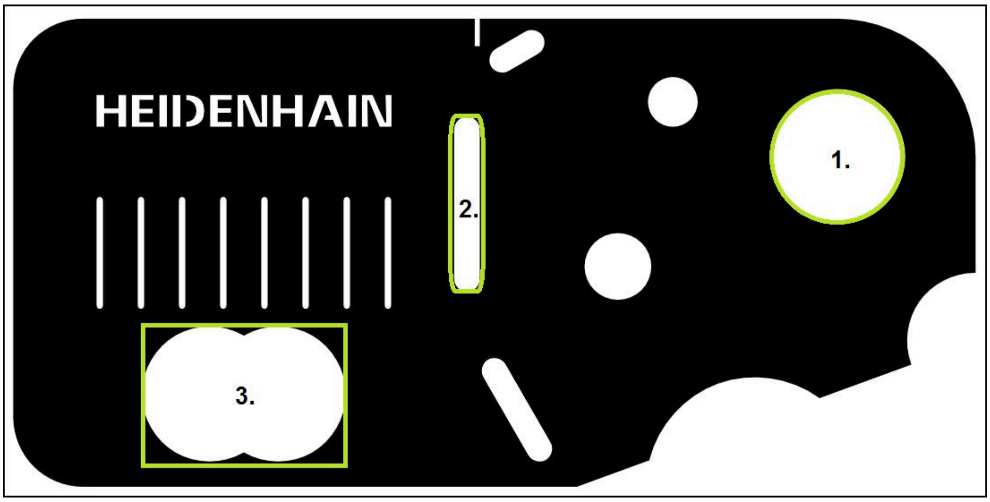


Figure 62: Examples of measuring a 2-D demo part

The section below describes measuring the following features:

1 Circle

2 Slot

3 Blob

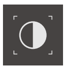
Measuring a circle

A minimum of three measuring points is required to measure a circle. For measuring point acquisition, you can use the **OED** measuring tool, for example.

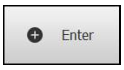
- ▶ Tap **Measure** in the main menu
- ▶ Select **Manual measuring** in the function palette
- ▶ If multiple sensors are available, select **OED sensor** in the sensor palette
- > The geometry palette and the OED measuring tools are displayed
- > The workspace now shows the position display
- ▶ In the quick access menu, select the magnification that is set on the measuring machine
- ▶ Select **Measure Magic** in the geometry palette

or

- ▶ Select **Circle** in the geometry palette



- ▶ Select **OED** in the tool palette
- ▶ With the OED sensor, traverse the edge of the circle
- > The product records the measuring point and saves it to the clipboard



- ▶ To confirm the measuring point acquisition, tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

> If the OED sensor traverses an edge, a measuring point is recorded in the clipboard.
>
> To add the measuring point to the point cloud of the feature, tap **Enter** in the Inspector.

- ▶ To acquire more measuring points, repeat these steps

- ▶ Tap **Finish** in the new feature
- > The circle is displayed in the feature list
- > The measurement result preview appears

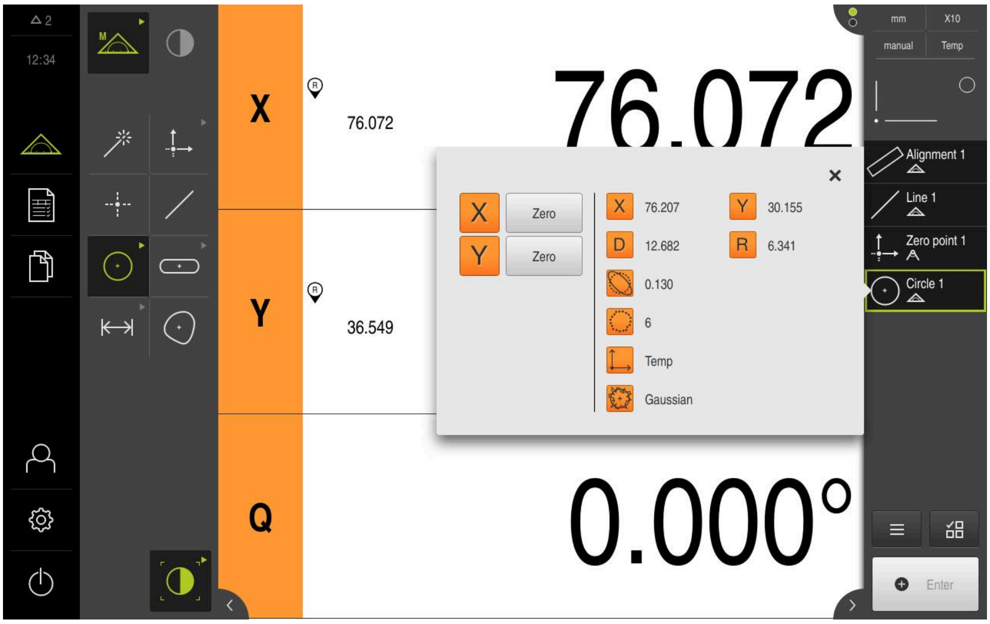


Figure 63: **Circle** feature in the feature list with **Measurement result preview**

Measuring a slot

A minimum of five measuring points is required in order to measure a slot. To measure point acquisition, you can use the **Auto OED** measuring tool, for example. Place at least two measuring points on the first long side and at least one measuring point on the second long side, and on each arc of the slot.

- Select **Slot** in the geometry palette

- Select **Auto OED** in the tool palette
- Cross over the edge of the slot multiple times with the OED sensor
- > A new feature is displayed in the feature list
- > A new measuring point is added each time the edge is traversed

> Distribute the measuring points along the entire length of the first long side, if possible.

- Tap **Finish** in the new feature
- > The slot is displayed in the feature list
- > The measurement result preview is now displayed

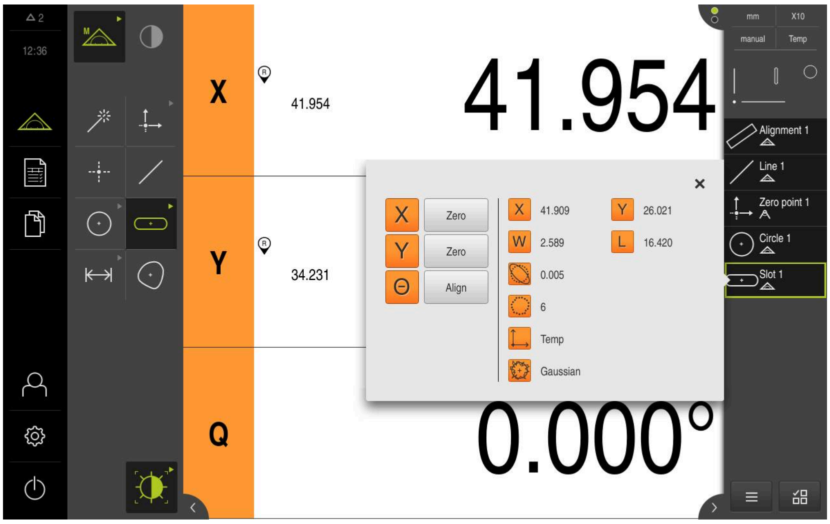


Figure 64: **Slot** feature in the feature list with **Measurement result preview**

Measuring a blob

A minimum of three measuring points is required to measure a blob. For measuring point acquisition, you can use the **Auto OED** measuring tool, for example. Multiple measuring points are automatically distributed along the entire contour according to the specified settings.

- Select **Blob** in the geometry palette

- Select **Auto OED** in the tool palette
- Cross over the edge of the blob multiple times with the OED sensor
- > A new feature is displayed in the feature list
- > A new measuring point is added each time the edge is traversed

> **i** Distribute the measuring points as evenly as possible along the contour of the feature.

- Tap **Finish** in the new feature
- > The blob is displayed in the feature list
- > The measurement result preview is now displayed

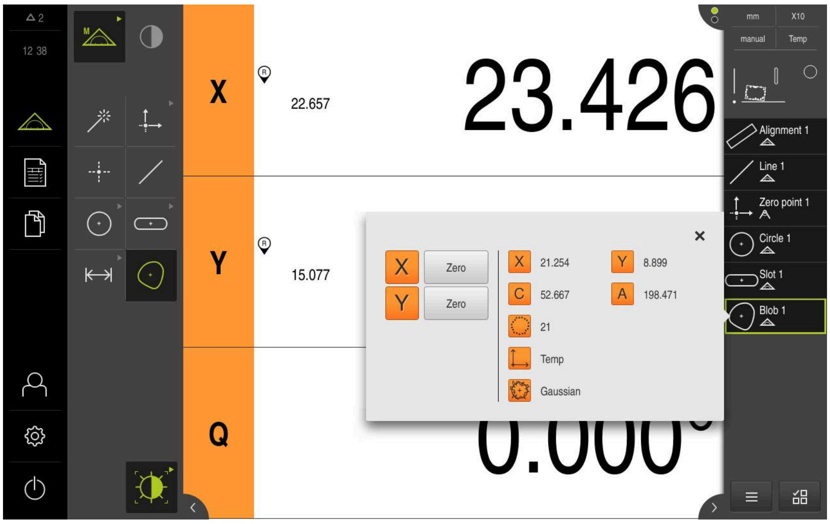


Figure 65: **Blob** feature in the feature list with **Measurement result preview**

9.3.5 Measuring with a TP sensor

For measuring edges and contours with a TP sensor, go to the tool palette and select the stylus used on the measuring machine.

Further information: "Controls for measuring with a TP sensor", Page 113

> The measurements illustrated here are described in detail in the Measurement chapter.

Further information: "Measuring", Page 301

Aligning the measured object

Measuring points can only be evaluated properly if the measured object has been aligned beforehand. During this process, the coordinate system of the measured object (workpiece coordinate system) is determined. This coordinate system is specified in the technical drawing.

This makes it possible to compare the measured values with the data in the technical drawing and to assess them.

Further information: "3-D demo part", Page 546

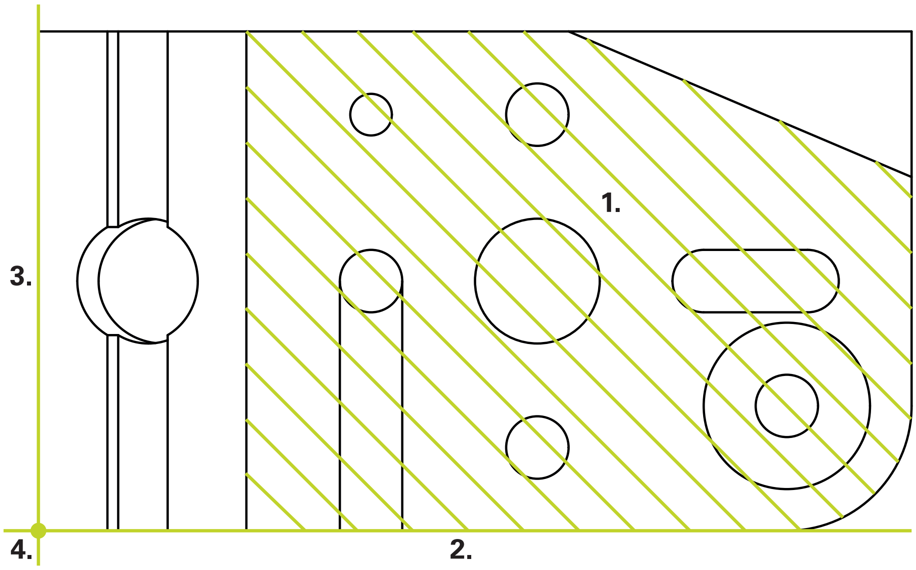


Figure 66: Sample alignment of the 3-D demo part

Measured objects are usually aligned in the following steps:

1 Measure **Reference plane**
2 Measure **Alignment**
3 Measure **Line**
4 Construct **Zero point**

Measuring the Reference plane

Define the reference surface through the **Reference plane** according to the technical drawing. A minimum of three measuring points is required to measure a **Reference plane**.

- ▶ Tap **Measure** in the main menu
- ▶ Select **Manual measuring** in the function palette
- ▶ If multiple sensors are available, select **TP sensor** in the sensor palette
- > The geometry palette and the TP tool palette are displayed
- ▶ If needed, tap **Position preview** in the Inspector
- > The workspace now shows the position display
- ▶ Select **Ref. plane** in the geometry palette
- ▶ In the tool palette, select the stylus used on the measuring machine
- ▶ If you are using a swiveling touch probe head, set its position, if required
- ▶ Move to the first measuring point on the surface
- > If the touch probe is equipped with a triggered probe body, the measuring point will be acquired automatically upon deflection of the stylus
- ▶ If the touch probe is equipped with a rigid (hard) probe body, tap **Enter** in the Inspector
- > A new feature is displayed in the feature list
- ▶ Move to the next measuring points

> Distribute the measuring points over the entire surface, if possible. This minimizes position errors.

- ▶ If required, tap **Enter** in the Inspector
- > The measuring point is acquired
- ▶ To acquire more measuring points, repeat these steps
- ▶ To conclude the measuring point acquisition, tap **Finish** in the new feature
- > The **Reference plane** is displayed in the feature list
- > The measurement result preview appears

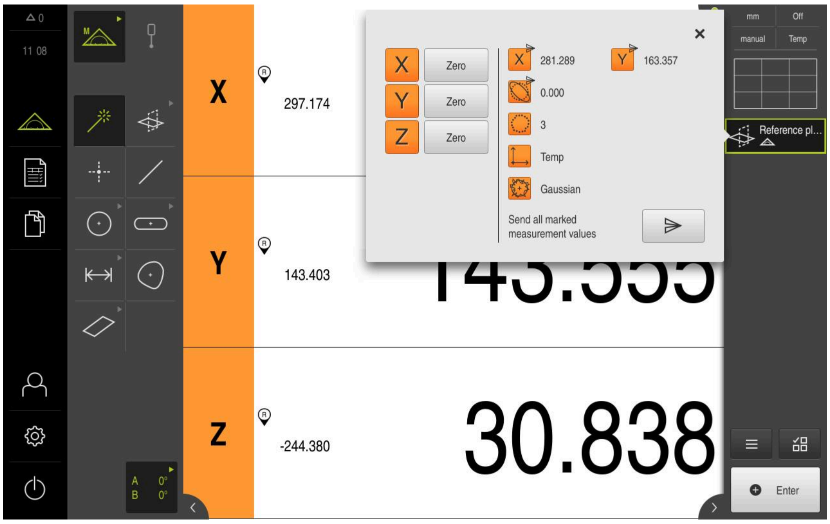


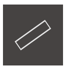
Figure 67: **Reference plane** feature in the feature list with **Measurement result preview**

Measuring the Alignment

Define the reference edge for the **Alignment** according to the technical drawing.

- If required, select the **XY** projection plane in the quick access menu

Further information: "Selecting the projection plane", Page 128



- Select **Alignment** in the geometry palette
- Move to the first measuring point on the contour of the alignment
- > If the touch probe is equipped with a triggered probe body, the measuring point will be acquired automatically upon deflection of the stylus
- If the touch probe is equipped with a rigid (hard) probe body, tap **Enter** in the Inspector
- > A new feature is displayed in the feature list
- Move to next measuring point

> Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- If required, tap **Enter** in the Inspector
- > The measuring point is acquired
- To acquire more measuring points, repeat these steps

- To conclude the measuring point acquisition, tap **Finish** in the new feature
- > The **Alignment** is displayed in the feature list
- > The measurement result preview appears

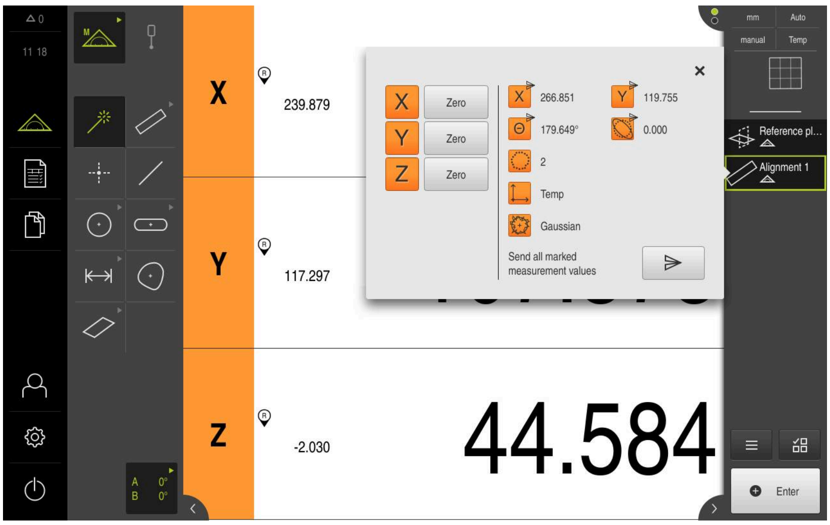


Figure 68: **Alignment** feature in the feature list with **Measurement result preview**

Measuring the Line

Measure a **Line** as the second reference edge.

- Select **Line** in the geometry palette
- Move to the first measuring point on the contour of the straight line
- If required, tap **Enter** in the Inspector
- > The measuring point is acquired
- > A new feature is displayed in the feature list
- Move to next measuring point

> **i** Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- If required, tap **Enter** in the Inspector
- > The measuring point is acquired
- To acquire more measuring points, repeat these steps

- To conclude the measuring point acquisition, tap **Finish** in the new feature
- > The **Line** is displayed in the feature list
- > The measurement result preview appears

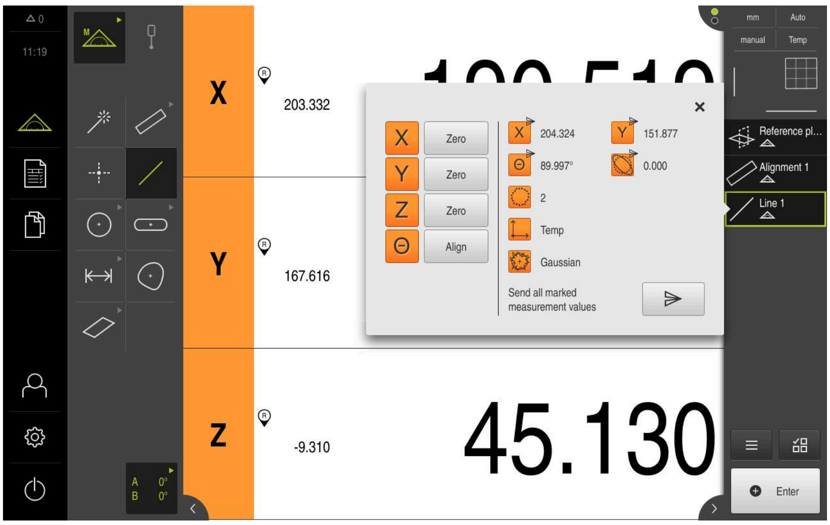
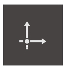


Figure 69: **Line** feature in the feature list with **Measurement result preview**

Constructing the zero point

First, construct the point of intersection (X and Y axis values) between the straight line and the alignment. Then, construct the zero point from the previously constructed point of intersection and the reference plane.

Constructing the point of intersection



- Select **Zero point** in the geometry palette
- Select the **Orientation** and **Line** features in the Inspector or in the features view
- > The selected features are displayed in green
- > A new feature is displayed in the feature list

- Tap **Finish** in the new feature
- > The point of intersection is displayed in the feature list
- Tap **Features preview**
- > The point of intersection is now shown in the workspace

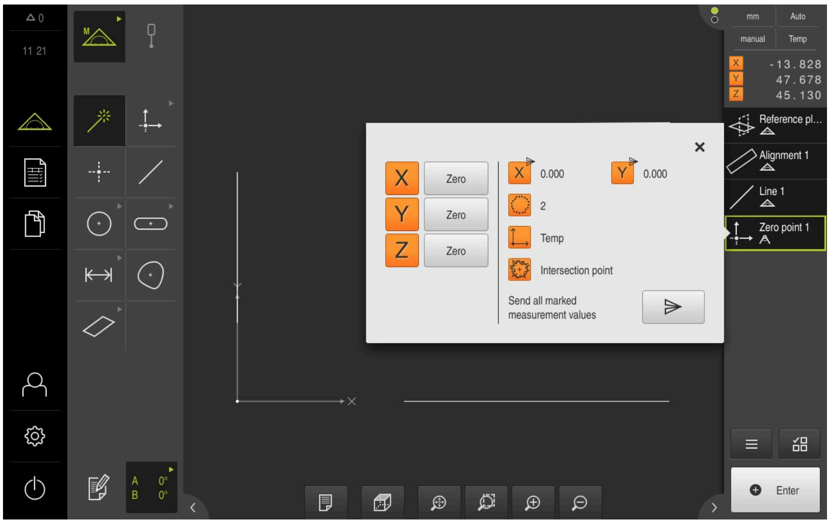
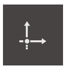


Figure 70: Workspace with point of intersection displayed in the coordinate system

Constructing the zero point



- ▶ Select **Zero point** in the geometry palette
- ▶ Select the **Reference plane** and **Zero point** features in the Inspector or in the features view
- > The selected features are displayed in green
- > A new feature is displayed in the feature list

- ▶ Tap **Finish** in the new feature
- > The zero point is displayed in the feature list
- > The workpiece coordinate system for the measured object has been determined
- ▶ Tap **Features preview**
- > The coordinate system is shown in the workspace

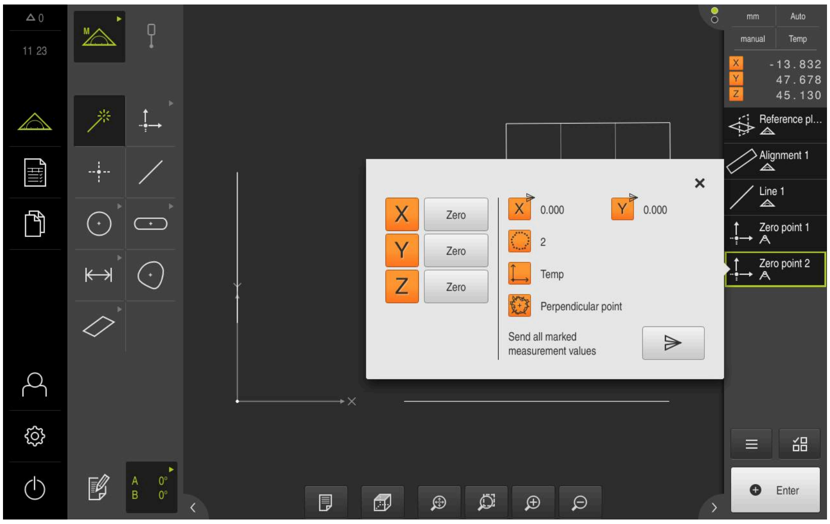


Figure 71: Workspace with zero point displayed in the coordinate system

Measuring features

To measure features, you can use the geometries of the geometry palette.

Further information: "Overview of geometry types", Page 302

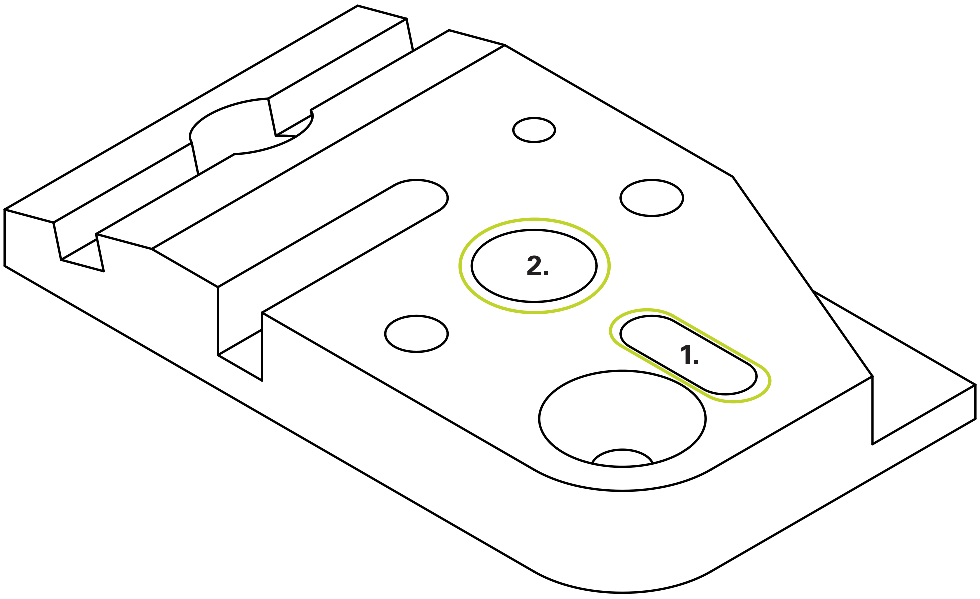


Figure 72: Sample measurements on the 3-D demo part

The section below describes how to measure the following features:

1 **Slot**

2 **Cylinder**

> For TP sensor measurements, the **Measure Magic** function is currently not supported.

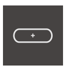
Measuring the Slot

A minimum of five measuring points is required to measure a **Slot**. Place at least two measuring points on the first long side and at least one measuring point on the second long side, and on each arc of the slot.

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette

- If multiple sensors are available, select **TP sensor** in the sensor palette
- > The geometry palette and the TP tool palette are displayed
- If needed, tap **Position preview** in the Inspector
- > The workspace now shows the position display



- Select **Slot** in the geometry palette

- In the tool palette, select the stylus used on the measuring machine
- If you are using a swiveling touch probe head, set its position, if required
- Move to the first measuring point on the contour of the slot
- > If the touch probe is equipped with a triggered probe body, the measuring point will be acquired automatically upon deflection of the stylus
- If the touch probe is equipped with a rigid (hard) probe body, tap **Enter** in the Inspector
- > A new feature is displayed in the feature list
- Move to next measuring point
- If required, tap **Enter** in the Inspector
- > The measuring point is acquired
- To acquire more measuring points, repeat these steps

- To conclude the measuring point acquisition, tap **Finish** in the new feature
- > The **Slot** is displayed in the feature list
- > The measurement result preview appears

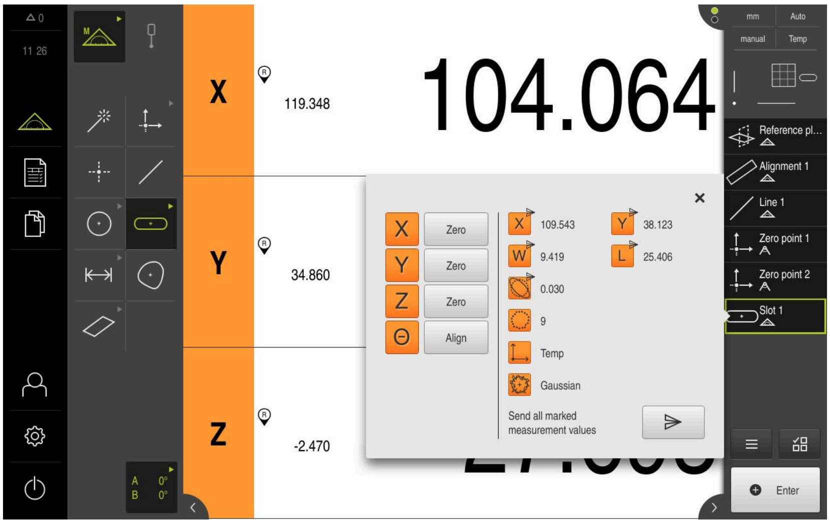


Figure 73: **Slot** feature in the feature list with **Measurement result preview**

Measuring the Cylinder

At least six measuring points are required to measure a **Cylinder**. Measure a circle near the base surface and another circle near the top surface of the cylinder. Acquire a minimum of three measuring points per circle.

- ▶ Select **Cylinder** in the geometry palette
- ▶ Move to the first measuring point on the contour of the cylinder
- ▶ If required, tap **Enter** in the Inspector
- > The measuring point is acquired
- > A new feature is displayed in the feature list
- ▶ Move to next measuring point

> Distribute the measuring points as evenly as possible along the contour of the feature.

- ▶ If required, tap **Enter** in the Inspector
- > The measuring point is acquired
- ▶ To acquire more measuring points, repeat these steps

- ▶ To conclude the measuring point acquisition, tap **Finish** in the new feature
- > The **Cylinder** is displayed in the feature list
- > The measurement result preview appears

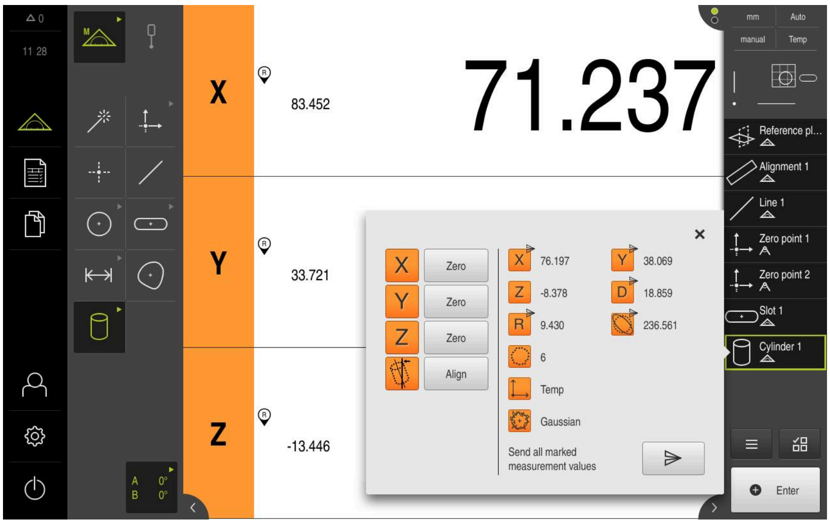


Figure 74: **Cylinder** feature in the feature list with **Measurement result preview**

9.3.6 Deleting features

If the measurement fails, one or more features can be deleted from the feature list.

> Reference features, such as a zero point, alignment, or reference plane, cannot be deleted as long as other features are referenced to them.

- Select the desired features from the feature list
- > The selected features are displayed in green
- Tap **Auxiliary functions** in the Inspector
- Tap **Delete selection**
- To delete all features, tap **Delete all**
- Tap **Close** to close the miscellaneous functions

9.4 Displaying and editing the measurement results

Each measured feature can be evaluated and edited in the **Details** dialog.

- To open the **Details** dialog, drag the corresponding feature from the feature list into the workspace

Short description

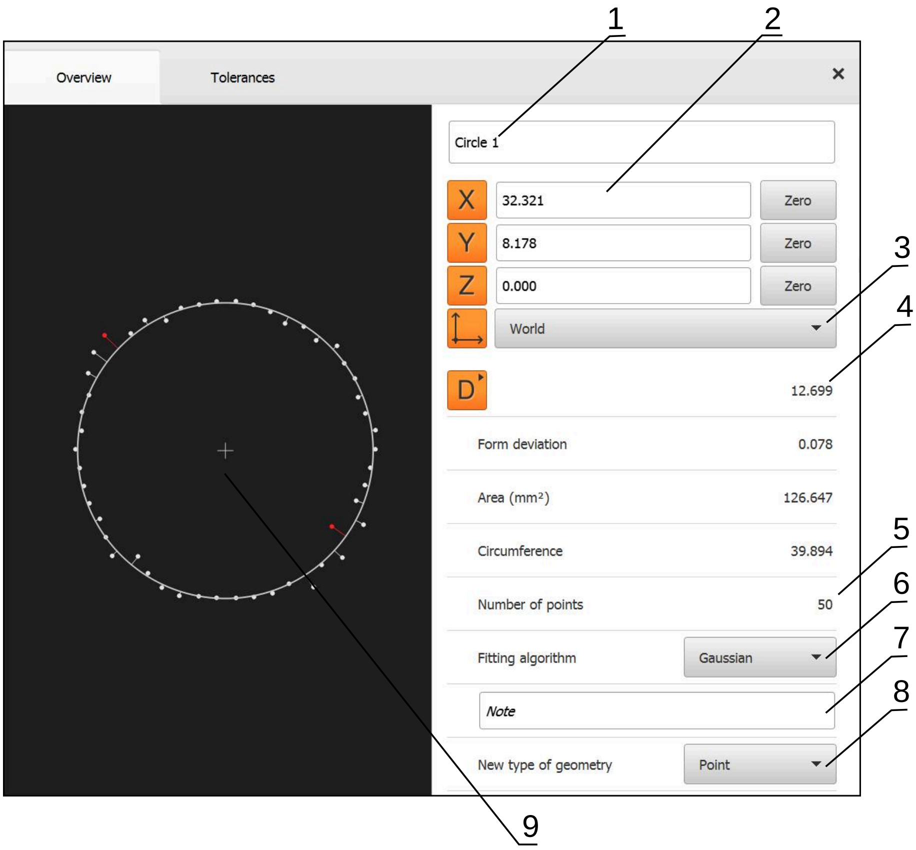
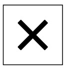


Figure 75: **Overview** tab in the **Details** dialog

1 Name of the feature
2 Axis positions of the center point
3 Coordinate system referenced by the coordinate values of the feature
4 Feature parameter, depending on the geometry type: For the circle geometry type, it is possible to toggle between radius and diameter
5 Number of measuring points used for calculating the feature
6 Fitting algorithm used for calculating the feature; depends on the geometry and the number of measuring points
7 2-D plane into which the feature is projected; there is not projection for the "3D" display
8 **Note** text field; if annotations are active, its contents will be shown in the features view
9 List of geometry types to which the feature can be converted
10 View of the measuring points and the shape

9.4.1 Renaming a feature

- Drag the feature from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- Tap the input field containing the current name
- Enter a new name for the feature
- Confirm entry with **RET**
- > The new name is displayed in the feature list



- Tap **Close** to close the dialog

9.4.2 Selecting the Fitting algorithm

You can adjust the fitting algorithm depending on the measured feature. The Gaussian fitting algorithm is used by default.

Further information: "Fitting algorithm", Page 382

- Drag a feature, e.g.a **Circle**, from the features list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- > The fitting algorithm used is shown in the **Fitting algorithm** drop-down list
- In the **Fitting algorithm** drop-down list, select the desired fitting algorithm (e.g., **Minimum circumscribed**)
- > The feature is displayed according to the selected fitting algorithm

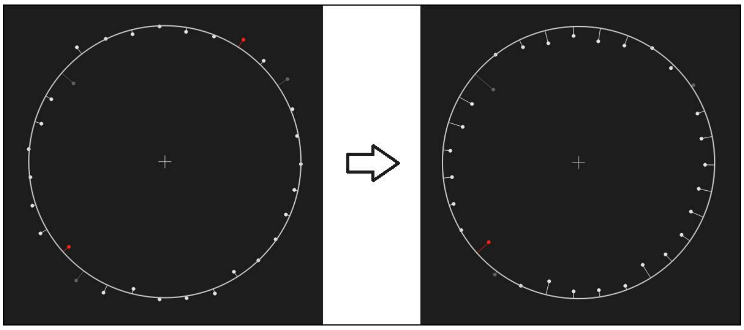
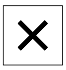


Figure 76: **Circle** feature with new fitting algorithm



- Tap **Close** to close the dialog

9.4.3 Converting a feature

The feature can be converted to a different type of geometry. The list of possible geometry types is provided as a drop-down list in the **Details** dialog.

- Drag a feature (e.g., a **Slot**) from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- > The geometry type of the feature is displayed
- In the **New type of geometry** drop-down list, select the type of geometry, for example **Point**

The **2-D profile** geometry type is currently not yet supported.

- > The feature is displayed in the new form

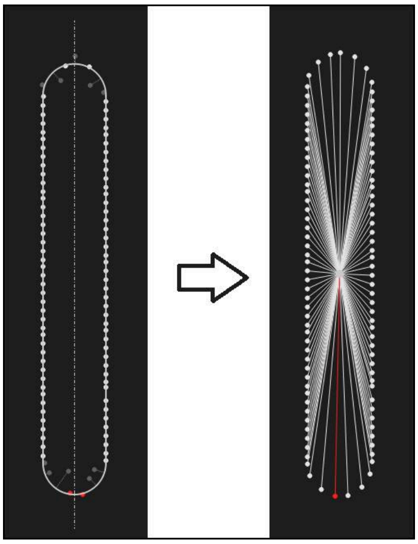
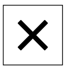


Figure 77: Type of geometry changed from **Slot** to **Point**



- Tap **Close** to close the dialog

9.4.4 Changing Tolerances

On the **Tolerances** tab, you can adjust the tolerances for a measured feature. The tolerances are grouped.

Figure 78: **Details** dialog with **Tolerances** tab

1 Display of general tolerance
2 List of tolerances, depending on feature
3 Status of the tolerance: active and within the tolerance or active and outside the tolerance

In the **Tolerances** tab, you can define the geometrical tolerancing of a feature. The tolerances are grouped.

- ▶ Drag a feature (e.g., a **Circle**) from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- ▶ Tap the **Tolerances** tab
- > The tab for tolerancing the selected feature is displayed

- ▶ Tap the size tolerance **X**
- > An overview of the selected size tolerance appears

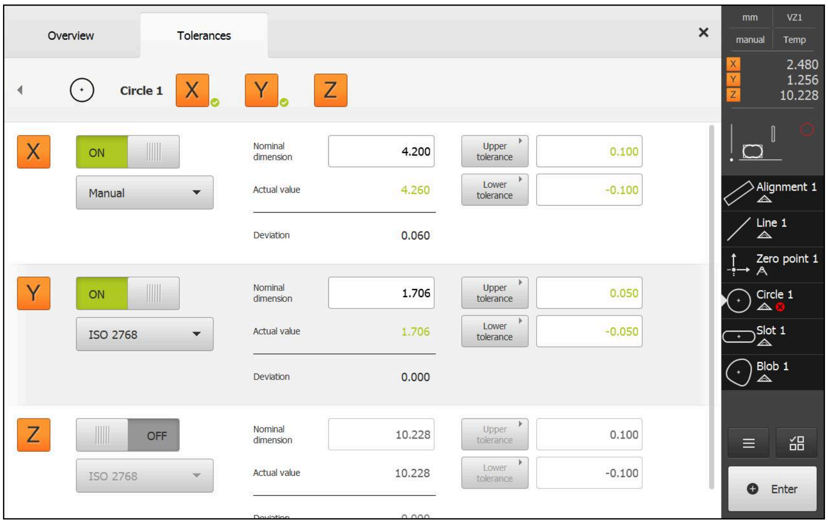


Figure 79: **Size tolerance** overview with activated **X**

- Activate tolerancing of the measured value with the **ON/OFF** slider
- > The selection and input fields become active
- Tap the **Nominal dimension** input field and enter the desired value
- Confirm entry with **RET**
- Tap the **Upper tolerance** input field and enter the desired value
- Confirm entry with **RET**
- Tap the **Lower tolerance** input field and enter the desired value
- Confirm entry with **RET**
- > The nominal value is shown in red if it is out of tolerance
- > The nominal value is shown in green if it is within tolerance

- Tap **Back**
- > The **Tolerances** tab is displayed
- > The results of the tolerance check are shown in the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list, using the following symbols:

	Activated tolerances are maintained
	One or more activated tolerances are exceeded

Further information: "Defining tolerances", Page 385

9.4.5 Adding annotations

You can add an annotation to every feature in the features view (e.g., measurement information or informational texts).

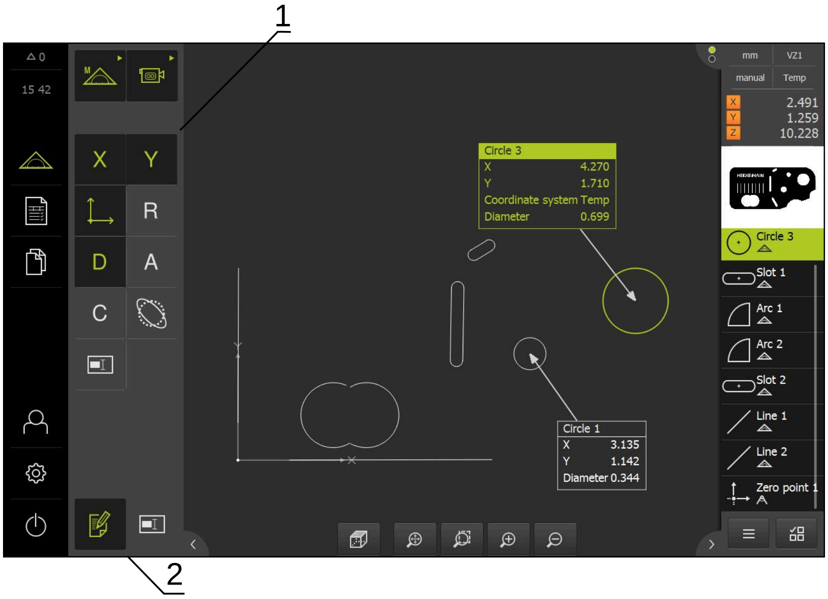


Figure 80: Operating elements for annotations and feature with annotations

1 Operating elements for adding annotations to one or more features
2 The **Edit annotations** operating element

9.5 Creating a measurement report

The measurement results can be displayed, saved, and printed as a measurement report.

The following steps are necessary to create a measurement report:

- "Selecting the features and the template"
- "Entering information on the measuring task"
- "Selecting document settings"
- "Saving a measurement report"
- "Exporting or printing a measurement report"

9.5.1 Selecting the features and the template

- Tap **Measurement report** in the main menu
- > The list of measured features is displayed, based on the measurement report template that was selected last
- > All features in the list are activated and the boxes are displayed in green
- To remove a feature from the measurement report, tap its box

> The feature list can be filtered by various criteria.
> **Further information:** "Filtering features", Page 293

- To change the measurement report template, tap **Templates**
- Select the desired measurement report template
- Tap **OK**
- > The list of measured features is adapted to the selected measurement report template

Filtering features

You can filter the feature list in the **Features** menu by various criteria. This means that only features meeting the filter criteria are displayed, e.g., only circles with a specific minimum diameter. You can use any combination of filters.

> The filter function controls how the feature list is displayed. It does not affect the contents of the measurement report.

- Tap **Filter**
- Select the desired filter criterion in the dialog
- Select the operator
- Select the function
- Tap **Close** to activate the filter criteria

Filtercriterion	Operator	Function
Type	**Is**	Only features of the selected geometry type are shown.
	Is not	Only features of geometry types that are not selected are shown.
Size	**Equal**	Only features of the specified size are shown.
	Greater than	Only features that are larger than the specified size are shown.
	Less than	Only features that are smaller than the speci-fied size are shown.
Tolerance	**Is**	Only features that fulfill the selected character-istic are shown.
	Is not	Only features that do not fulfill the selected characteristic are shown.
Creation type	**Is**	Only features that fulfill the selected character-istic are shown.
	Is not	Only features that do not fulfill the selected characteristic are shown.

9.5.2 Entering information on the measuring task

The available information depends on the configuration of the template.

- Tap **Information**
- To customize the date and time in the measurement report, select the desired option from the **Timestamp** drop-down list
  - **Set manually**: When creating the report, the system uses the date and time you entered manually
  - **Set automatically**: When creating the report, the system enters the current date and time
- Select an existing user from the **User name** drop-down list
- If you want another user to be displayed in the measurement report, select **Other user**
- Enter the name of the user into the input field
- Confirm your input with **RET**
- Enter the number of the measurement job into the **Job** input field
- Confirm your input with **RET**
- Enter the part number of the measured object into the **Part number** input field
- Confirm your input with **RET**
- Tap **Close** to close the dialog

9.5.3 Selecting document settings

- Tap **Information**
- Tap the **Document** tab
- To adjust the unit of measurement for linear measurement values, select the desired unit of measurement in the **Unit for linear values** drop-down list
  - **Millimeters**: Display in millimeters
  - **Inch**: Display in inches
- To reduce or increase the number of displayed **Decimal places for linear values**, tap **-** or **+**
- To adjust the unit of measurement for angular values, select the desired unit of measurement in the **Unit for angular values** drop-down list
  - **Decimal degrees**: Display in degrees
  - **Radian**: Display in radians
  - **Deg-Min-Sec**: Display in degrees, minutes, and seconds
- To adjust the format for the date and time, select the desired format in the **Date and time format** drop-down list
  - **hh:mm DD-MM-YYYY**: Time and date
  - **hh:mm YYYY-MM-DD**: Time and date
  - **YYYY-MM-DD hh:mm**: Date and time
- To customize the print format, select the corresponding settings in the drop-down lists of the following parameters:
  - **Duplex printing**: Duplex printing, flipped along the long or short edge of the page
  - **Page header**: The page header will appear on the title page or on every page
  - **Header of data chart**: The header will appear on the title page or on every page
  - **Display feature view** (with annotations): ON/OFF
- Tap **Close** to close the dialog

9.5.4 Opening previews

You can display both the features and the measurement report in a preview.

Opening the features preview

- ▶ Tap the **tab**
- > The features preview opens
- > The arrow changes direction

- ▶ To close the features preview, tap the **tab**

If you added annotations to your features, they will also be shown in the features preview.

Further information: "Adding annotations", Page 292

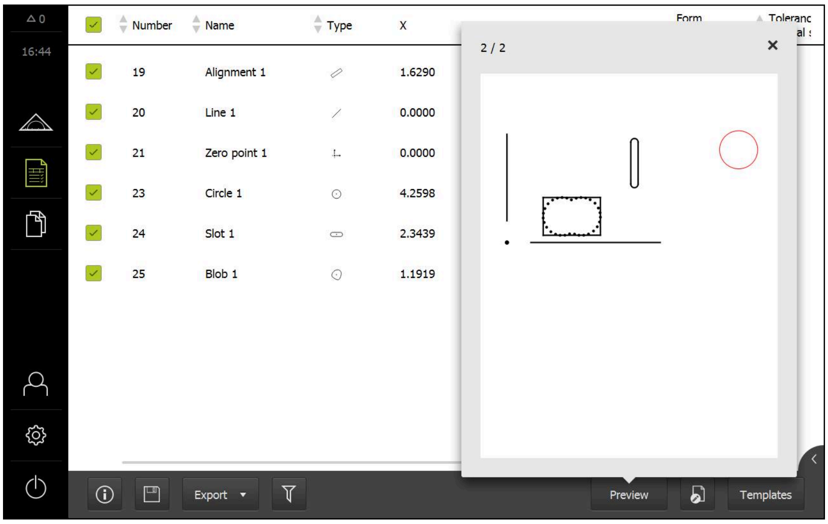
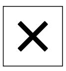


Figure 81: **Measurement report** menu with feature list and features preview

Opening the measurement report preview

- ▶ Tap **Preview**
- > The measurement report preview opens
- ▶ To browse the pages, tap the left or right edge of the preview pane



- ▶ Tap **Close** to close the preview

9.5.5 Saving a measurement report

Measurement reports are saved in the XMR data format.

- Tap **Save as**
- In the dialog, select the storage location, e.g. **Internal**/**Reports**
- Enter a name for the measurement report
- Confirm your input with **RET**
- Tap **Save as**
- \> The measurement report is saved

> In the **File management** main menu, you can open and edit saved reports.
> **Further information:** "Managing folders and files", Page 453

> The XMR data format has been changed for the current firmware version. You can no longer open or edit files saved in the XMR data format of the previous version.

9.5.6 Exporting or printing a measurement report

You have various possibilities for exporting measurement reports or printing them on the installed printer. You can export a PDF or CSV file or send the measurement report to a computer via the available RS-232 interface.

Exporting the measurement report

- Select the desired export format from the **Export** drop-down list:
  - **Export as PDF**: The measurement report is saved as a printable PDF file. The values are no longer editable
  - **Export as CSV**: The values in the measurement report are exported to a text file, separated by semicolons. The values can be edited in spreadsheet software
  - **Export via RS-232**: The values in the measurement report are sent in table view to a computer
    Prerequisite: The measured-value output has been configured
- Select the storage location for the PDF and CSV files in the dialog, e. g. **Internal**/**Reports**
- Enter a name for the measurement report
- Confirm the entry with **RET**
- Tap **Save as**
- \> The measurement report is exported in the selected format and stored in the storage location

Printing the measurement report

- Tap the **Export** drop-down list
- Tap **Print** in the drop-down list
- \> The measurement report is output to the specified printer
  Further information: "Configuring the printer", Page 211

9.6 Creating and managing measuring programs

The product can record and save the steps of a measuring process, and run them sequentially as a batch process. This batch processing is referred to as the measuring program.

In a measuring program, you can thus combine multiple work steps, such as measuring point acquisition and tolerancing, into a single process. This simplifies and standardizes the measuring process. The work steps of a measuring program are referred to as program steps.

Measuring programs can include the following program steps:

- Adapting the settings of the measuring program: Initialization, Auto enter, units
- Changing the reference system
- Adjusting the magnification
- Controlling the lighting
- Determining the focal plane with the Autofocus function
- Adjusting the contrast threshold
- Measuring point acquisition: Start the measuring tool
- Creating and evaluating a feature: Calculation, construction, definition
- Deleting features and program steps

The program steps are displayed in the program step list in the Inspector.

> The unit records every measuring process and work step as a program step regardless of the current view in the Inspector, the features list, or the program step list. The operator can switch the view between the feature list and the program step list at any time.

9.6.1 Saving a measuring program

In order to be able to execute a measuring process repeatedly, you need to save the executed work steps as a measuring program.

- ▶ Tap **Miscellaneous functions** in the Inspector
- ▶ In the Auxiliary functions dialog, tap **Save as**
- ▶ Select the storage location in the dialog, e.g. **Internal/Programs**
- ▶ Tap within the input field and enter the name for the measuring program
- ▶ Confirm entry with **RET**
- ▶ Tap **Save as**
- > The measuring program is saved
- > The name of the measuring program is displayed on the program control

9.6.2 Starting a measuring program

A measuring program that has been recorded or executed recently can be started from the program control. Program steps requiring user intervention are supported by a wizard. User intervention may be required under the following conditions, for example:

- The measuring points are outside the live image (only if the VED sensor is active)
- The settings of the camera optics must be adjusted (e.g., magnification of the camera)
- The measured object must be positioned manually using the axes of the measuring plate

> The user interface is locked while a program is running. Only the program control buttons and/or sliders and **Enter** are enabled.

- ▶ Tap **Run** on the program control
- > The program steps are executed
- > Program steps that are currently being executed or that require user intervention are highlighted
- > When user intervention is required, the measuring program stops
- ▶ Perform the required user intervention
- > The execution of the program steps is resumed until the next user intervention is required or the end of the program is reached
- > The successful completion of the measuring program is displayed
- ▶ Tap **Close** in the message
- > The features are displayed in the features preview

9.6.3 Opening a measuring program

If you open a measuring program, then the current measuring program will be closed. All unsaved changes in the current measuring program will be lost.

- Save any changes made to the current measuring program before opening another measuring program

Further information: "Saving a measuring program", Page 298

- Tap **Auxiliary functions** in the Inspector
- In the Auxiliary functions dialog, tap **Open**
- Confirm the message with **OK**
- > The **Internal**/**Programs** folder is now displayed
- Navigate to storage location of the measuring program
- Tap the name of the measuring program
- Tap **Select**
- > The user interface for measuring, constructing and defining appears
- > The program step list containing the program steps of the measuring program is displayed
- > The selected measuring program is displayed on the program control

10

Measuring

10.1 Overview

This chapter contains an overview of the predefined geometry types and describes how to prepare a measurement, acquire measuring points, and conduct the actual measurement. You will also learn how you can construct new features out of measured, constructed, or defined features.

> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

Short description

In the **Measure** menu you measure, construct or define all the features needed for the acquisition of a measured object. This section discusses the different possibilities of measuring point acquisition and describes the basic steps for conducting a measurement. Features are measured by manually capturing measuring points and using predefined geometries.

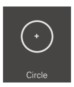
You can optionally use sensors and various measuring tools to acquire measuring points.

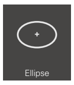
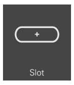
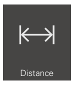
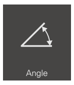
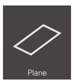
10.2 Overview of geometry types

The geometry palette contains predefined geometries that you can use for measuring, constructing, or defining. The selected geometry specifies the type of geometry that will be determined from the acquired measuring points or the specified parameters.

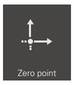
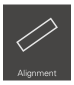
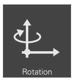
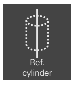
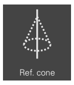
> For each geometry, the mathematically required minimum number of measuring points is defined in the device settings. Only after the corresponding number of measuring points has been acquired, the product is able to calculate the geometry. You can increase the minimum number of measuring points in the device settings.

Further information: "Geometry types", Page 494

Geometry	Name	Properties	Number of measuring points
	**Measure Magic**	Automatically determines the geometry type	≥ 1
	**Point**	Acquires a measuring point	≥ 1
	**Line**	Determines a line	≥ 2
	**Circle**	Determines a circle	≥ 3
	**Arc**	Determines a circle segment The opening angle is defined by the outermost measuring points	≥ 3

Geometry	Name	Properties	Number of measuring points
	**Ellipse**	Determines an ellipse The position and length of the reference axis are defined by the measuring points that are farthest apart	≥ 5
	**Slot**	Determines a slot The position and length of the reference axis are defined by the measuring points that are farthest apart	≥ 5
	**Rectangle**	Determines a rectangular feature with straight sides The position and length of the reference axis are defined by the measuring points that are farthest apart	≥ 5
	**Distance**	Determines the distance between two measuring points or the maximum distance in the case of multiple measuring points	≥ 2
	**Angle**	Determines two straight lines that intersect at any angle The angle is determined from the point of intersection of the two sides, and the position of each side The measuring points need to be captured for the first side and then for the second side	≥ 4
	**Blob**	Determines the center of mass of the area formed by all measuring points	≥ 3
	**Plane**	Determines a plane	≥ 3
	**Sphere**	Determines a sphere	≥ 4
	**Cone**	Determines a cone	≥ 6
	**Cylinder**	Determines a cylinder	≥ 6

Geometries for determining the coordinate system

Geometry	Name	Property	Number of measuring points
	**Zero point**	Sets the zero point of the coordinate system for a measured object	≥ 1
	**Alignment**	Determines the alignment of the X axis of the coordinate system for a measured object	≥ 2
	**Rotation**	Defines the rotation about an axis	–
	**Reference plane**	Determines the inclination of the reference plane for a measured object	≥ 3
	**Reference cylinder**	Determines the inclination of the reference plane for a measured object; the reference plane is aligned perpendicularly to the principal axis of the reference cylinder	≥ 6
	**Reference cone**	Determines the inclination of the reference plane for a measured object; the reference plane is aligned perpendicularly to the principal axis of the reference cone	≥ 6

10.3 Acquiring measuring points

When you measure an object, the existing geometries are determined based on features. To determine a feature, you need to capture measuring points for the feature.

A measuring point is a point in the coordinate system whose position is defined by the coordinates. Based on the positions of the acquired measuring points (point cloud) in the coordinate system, the product can determine and evaluate the feature. Depending on the measuring task, you can change the coordinate system in use by specifying a new zero point.

Further information: "Working with coordinate systems", Page 370

The product supports various types of measuring point acquisition:

- Without a sensor, e.g. by using crosshairs on the measuring microscope or profile projector
- With a sensor, e.g. in the form of a camera on the measuring machine or a touch probe at the measuring machine

10.3.1 Acquiring measuring points without using a sensor

If measuring points are acquired without using a sensor, then it is necessary that the operator on the connected measuring machine (e.g., measuring microscope, profile projector) be able to move to the desired position on the measured object (e.g., by using crosshairs). If this position has been reached, then measuring point acquisition is triggered either manually by the operator or automatically by the unit, depending on the configuration.

For the measuring point, the product captures the current axis positions that are displayed in the workspace or position preview. The coordinates of this measuring point thus result from the current position of the measuring plate. Based on the captured measuring points, the product determines the feature according to the selected geometry and displays it in the feature list in the Inspector.

The number of measuring points that need to be captured for a feature depends on the configuration of the selected geometry.

Further information: "Overview of geometry types", Page 302

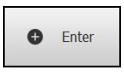
> The measuring point acquisition procedure without a sensor is identical for all geometries and is explained below using the **Circle** geometry

Measuring point acquisition without a sensor

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette
- > The workspace is displayed, showing the axis positions

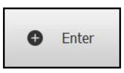
- Select **Circle** in the geometry palette
- On the measuring machine, move to the desired position on the measured object
- > If automatic measuring point acquisition is active, the measuring point will be acquired once the set dead time is reached
  Further information: "Setting automatic measuring point acquisition", Page 126



- If automatic measuring point acquisition is not active, tap **Enter** in the Inspector

- > A new feature is added to the feature list. The symbol of the feature corresponds to the selected geometry
- > The number of acquired measuring points is shown next to the symbol
- Move to next measuring point

> Distribute the measuring points as evenly as possible along the contour of the feature.



- Tap **Enter** in the Inspector
- To acquire more measuring points, repeat these steps
- > If **Number of measuring points Fixed** is set in the features settings, then measuring point acquisition is completed automatically

> If **Number of measuring points Free** is set in the features settings, then a check mark is displayed next to the feature in the feature list that can be tapped to complete the measurement

▶ Tap **Finish** to complete the measuring point acquisition

> The measurement result preview appears

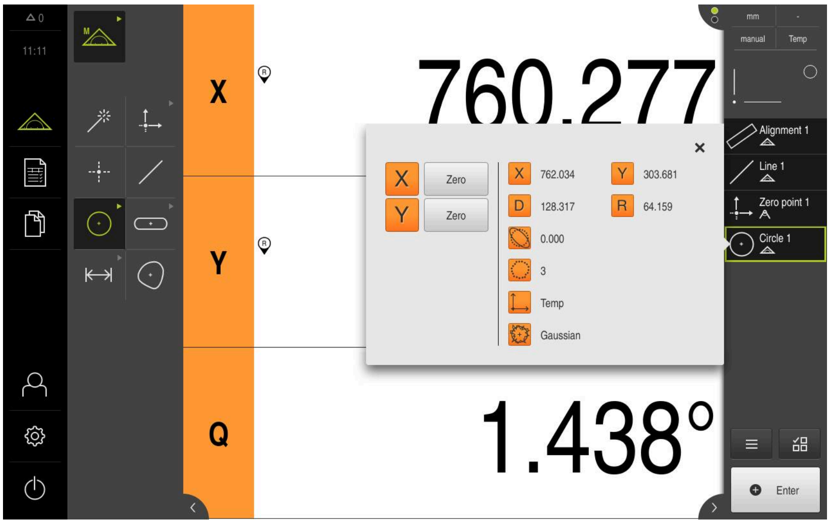


Figure 82: **Circle** feature with **Measurement result preview** for measuring point acquisition without a sensor

10.3.2 Acquiring measuring points using a sensor

In metrology, various optical and tactile sensors are available for measuring point acquisition. Selecting the appropriate sensor depends on the measuring task.

Supported sensors (software option)

Optical sensors:

- VED sensor (Video Edge Detection): automatic measured-value acquisition via video edge detection
- OED sensor (Optical Edge Detection): automatic measuring point acquisition via optical edge detection

Tactile sensors:

- TP sensor (Touch Probe): measuring point acquisition via a touch probe

> Changing sensors during a measuring task (multi-sensor function) is currently not supported.
>
> ▶ To avoid measuring errors, always use the same sensor for all steps of a measuring task

Sensor selection criteria

- Properties of the measured object (e.g. surface structure, compliance)
- Size and arrangement of the features to be measured (e.g. accessibility, shape)
- Required measuring accuracy
- Available measuring time
- Cost-effectiveness

Advantages of optical sensors

- Measurement of small geometries
- Measurement of compliant workpieces possible (measurement without contact)
- Short measuring times
- Large number of measuring points when measuring with active VED measuring tools

Advantages of tactile sensors

- Measurement of 3-D geometries possible
- High precision over a long measuring path
- Mechanically stable design
- Suitable for measured objects that are difficult to clean or whose surface reflects the light

Acquiring measuring points with a VED sensor (software option)

If the QUADRA-CHEK 3000 VED software option is activated, then the product supports the use of a VED sensor (optical sensor). A VED sensor is a USB camera or network camera connected to the product.

When capturing measuring points with a VED sensor, the live image from the connected camera is displayed in the workspace. The measuring points are captured in the live image by using VED measuring tools.

For this purpose, the measuring plate is traversed in order to position the measured object in such a way that the live image shows the feature to be measured on the object. The operator positions a VED measuring tool above the measured object in the live image.

In addition to the **Crosshair** VED measuring tool, the unit also offers active VED measuring tools such as **Active Crosshair** or **Circle**.

When acquiring measuring points with the **Crosshair** tool, the operator specifies the measuring point by manually positioning the measuring tool in the live image.

Active VED measuring tools allow an objective acquisition of measuring points because the product detects a light-to-dark transition within a defined search range of the measuring tools by evaluating the contrast. Measuring point acquisition is initiated by the operator or automatically by the unit, depending on the configuration.

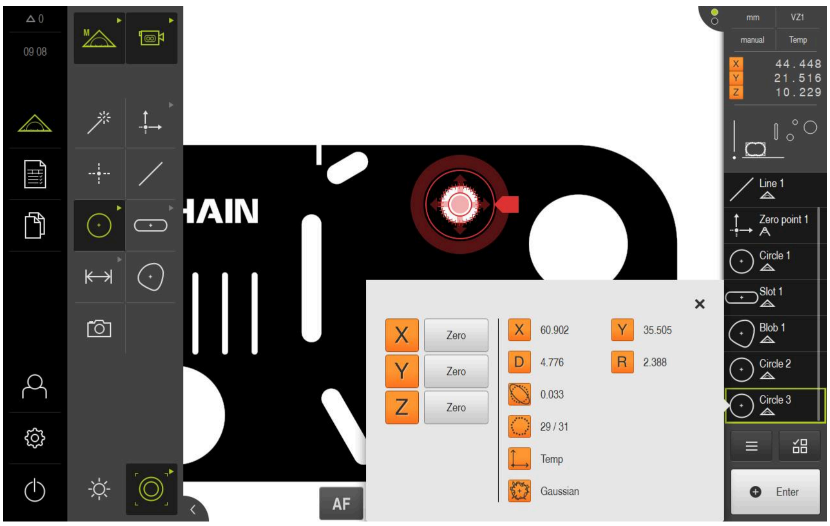


Figure 83: **Circle** VED measuring tool with acquired measuring points

Based on the position of the VED measuring tool in the live image and the axis positions, the product acquires the coordinates for the measuring point. The product determines the feature from the captured measuring points according to the selected geometry. The new feature is shown in the feature list of the Inspector. The number of measuring points that need to be captured for a feature depend on the configuration of the selected geometry.

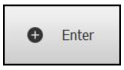
Further information: "Overview of geometry types", Page 302

> The procedure for acquiring measuring points using a VED sensor is identical for all geometries and is described below using the example of a **Circle** geometry.

Acquiring measuring points with the “Crosshair” VED measuring tool

- Tap **Measure** in the main menu
- Select **Manual measuring** in the function palette
- If multiple sensors are available, select **VED sensor** in the sensor palette
- \> The geometry palette and the VED measuring tools are displayed
- Tap **Live image preview** in the Inspector
- \> The workspace shows the camera's live image
- In the quick access menu, select the magnification that is set on the measuring machine
- Select **Circle** in the geometry palette
- Position the measured object in the live image by moving the measuring plate
- Select **Crosshair** in the tool palette
- Position the measuring tool in the live image by tapping or dragging
- \> If automatic measuring point acquisition is active, the measuring point will be acquired once the set dead time is reached
  Further information: "Setting automatic measuring point acquisition", Page 126
- If automatic measuring point acquisition is not active, tap **Enter** in the Inspector
- \> A new feature is added to the feature list. The symbol of the feature corresponds to the selected geometry
- \> The number of acquired measuring points is shown next to the symbol
- Move to next measuring point

> Distribute the measuring points as evenly as possible along the contour of the feature.



- Tap **Enter** in the Inspector
- To acquire more measuring points, repeat these steps
- > If **Number of measuring points Fixed** is set in the features settings, then measuring point acquisition is completed automatically

- > If **Number of measuring points Free** is set in the features settings, then a check mark is displayed next to the feature in the feature list that can be tapped to complete the measurement

- Tap **Finish** to complete the measuring point acquisition
- > The measurement result preview appears

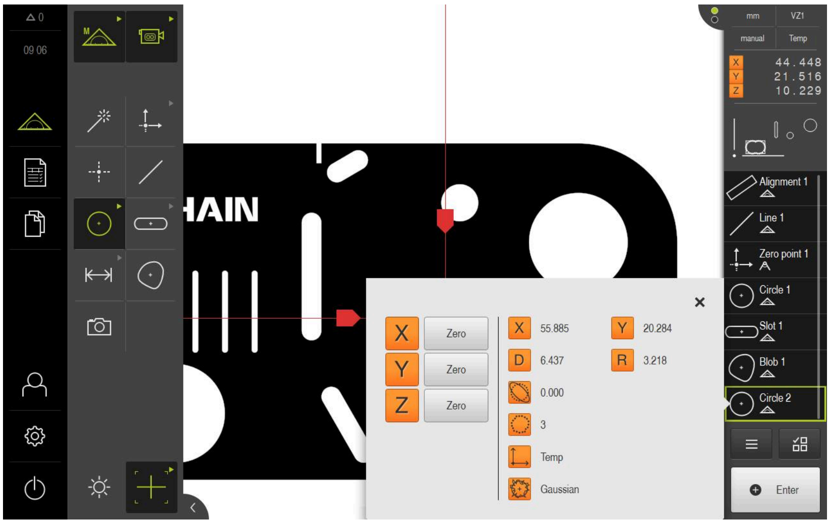


Figure 84: **Circle** feature with **Measurement result preview** for measuring point acquisition with the **Crosshair** VED measuring tool

Measuring point acquisition with an active VED measuring tool

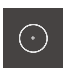
The active VED measuring tools vary in terms of their use and area of application.

Further information: "Controls for measuring with a VED sensor", Page 89

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette

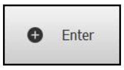
- If multiple sensors are available, select **VED sensor** in the sensor palette
- > The geometry palette and the VED measuring tools are displayed
- Tap **Live image preview** in the Inspector
- > The workspace shows the camera's live image
- In the quick access menu, select the magnification that is set on the measuring machine



- Select **Circle** in the geometry palette

- Select the appropriate measuring tool in the tool palette, e.g. **Circle**)
- Position the measuring tool on the contour
- Resize the two rings of the measuring tool so that the contour is fully enclosed within the search range between the inner and outer rings

- Select the edge detection mode at the bottom of the workspace



- Tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

- Tap **Finish** to complete the measuring point acquisition
- > The measurement result preview appears

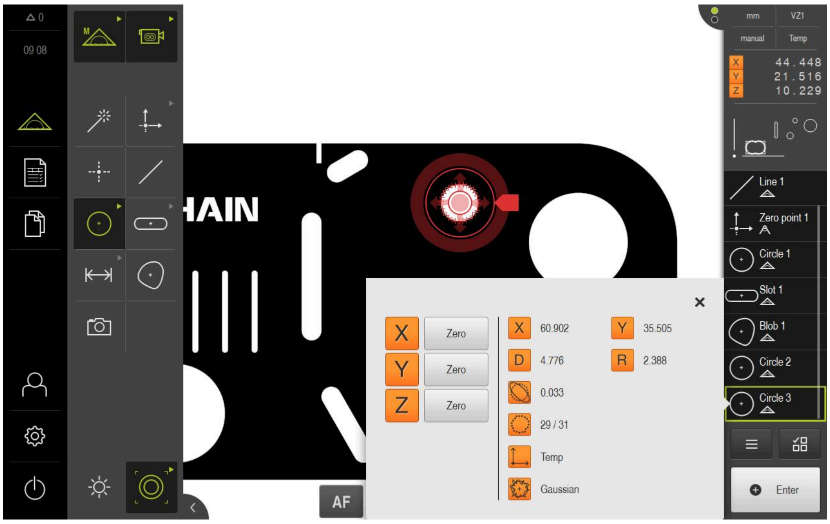


Figure 85: Acquiring measuring points with an active VED measuring tool

Acquiring measuring points with an OED sensor (software option)

If the QUADRA-CHEK 3000 OED software option is activated, the product supports the use of an OED sensor (optical edge detector). An OED sensor is an optical waveguide that is connected to the product and that transfers information about light intensity from the screen of the measuring machine to the product.

When measuring points are acquired with an OED sensor, the position display or features view is shown in the workspace. Measuring point acquisition is performed with OED measuring tools.

The operator positions the OED sensor at the desired edge by moving the measuring plate.

In addition to the **Crosshair** OED measuring tool, the product also provides the active **OED** or **Auto OED** measuring tools.

When using the **crosshairs** for acquiring measuring points, position them at the desired position on the projection screen of the measuring machine and then trigger measuring point acquisition manually.

Active OED measuring tools enable the objective acquisition of measuring points. This is because, based on a contrast analysis, the unit recognizes a light-to-dark transition as an edge. Depending on the configuration and the selected OED measuring tool, measuring point acquisition is triggered by the operator or automatically by the unit.

The unit acquires the coordinates for the measuring point based on the axis positions and the position of the OED sensor in relation to the crosshairs (offset between crosshairs and OED sensor). The unit determines the feature from the captured measuring points according to the selected geometry. The new feature is shown in the feature list of the Inspector. The number of measuring points that need to be captured for a feature depend on the configuration of the selected geometry.

Further information: "Overview of geometry types", Page 302

> The measuring point acquisition procedure with an OED sensor is identical for all geometries and is described below using the example of a **Circle** geometry.

Measuring point acquisition using the crosshair OED measuring tool

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette

- If multiple sensors are available, select **OED sensor** in the sensor palette
- > The geometry palette and the OED measuring tools are now displayed
- If needed, tap **Position preview** in the Inspector
- > The workspace now shows the position display
- In the quick access menu, select the magnification that is set on the measuring machine

- Select **Circle** in the geometry palette

- Select **Crosshair** in the tool palette
- Position the crosshairs on the projection screen to the edge of the circle
- > If automatic measuring point acquisition is active, the measuring point will be acquired once the set dead time is reached
  Further information: "Setting automatic measuring point acquisition", Page 126
- If automatic measuring point acquisition is not active, tap **Enter** in the Inspector
- > A new feature is added to the feature list. The symbol of the feature corresponds to the selected geometry
- > The number of acquired measuring points is shown next to the symbol
- Move to next measuring point

> Distribute the measuring points as evenly as possible along the contour of the feature.

- Tap **Enter** in the Inspector
- To acquire more measuring points, repeat these steps
- > If **Number of measuring points Fixed** is set in the features settings, then measuring point acquisition is completed automatically
- > If **Number of measuring points Free** is set in the features settings, then a check mark is displayed next to the feature in the feature list that can be tapped to complete the measurement
- Tap **Finish** to complete the measuring point acquisition
- > The measurement result preview appears

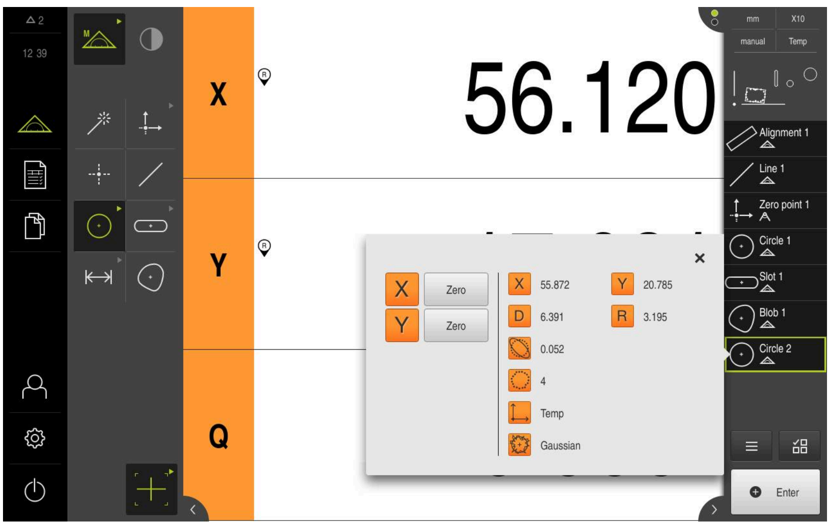


Figure 86: **Circle** feature with **Measurement result preview** for measuring point acquisition with the **Crosshair** OED measuring tool

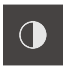
Measuring point acquisition using an active OED measuring tool

The active OED measuring tools vary in terms of their use and area of application.

Further information: "Controls for measuring with an OED sensor", Page 110

- ▶ Tap **Measure** in the main menu

- ▶ Select **Manual measuring** in the function palette



- ▶ If multiple sensors are available, select **OED sensor** in the sensor palette
- > The geometry palette and the OED measuring tools are now displayed
- ▶ If needed, tap **Position preview** in the Inspector
- > The workspace now shows the position display
- ▶ In the quick access menu, select the magnification that is set on the measuring machine

- ▶ Select **Circle** in the geometry palette

- ▶ Select the appropriate measuring tool in the tool palette, e.g. **Auto OED**
- ▶ With the OED sensor, cross over the edge of the circle
- > The measuring point is acquired automatically

- > A new feature is added to the feature list. The symbol of the feature corresponds to the selected geometry
- > The number of acquired measuring points is shown next to the symbol
- ▶ Cross over the edge of the circle multiple times until a sufficient number of measuring points have been acquired
- ▶ A new measuring point is added to the feature every time the edge is crossed over

> Distribute the measuring points as evenly as possible along the contour of the feature.

- > If **Number of measuring points Fixed** is set in the features settings, then measuring point acquisition is completed automatically

- > If **Number of measuring points Free** is set in the features settings, then a check mark is displayed next to the feature in the feature list that can be tapped to complete the measurement

- ▶ Tap **Finish** to complete the measuring point acquisition
- > The measurement result preview appears

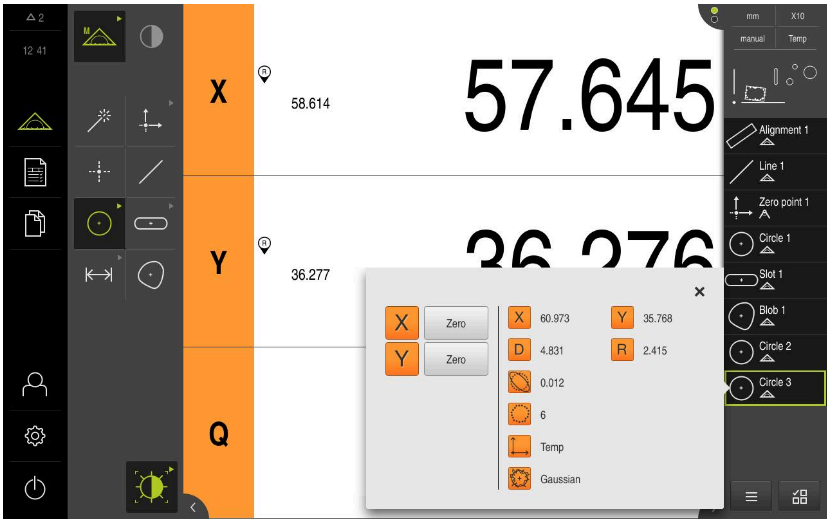


Figure 87: **Circle** feature with **Measurement result preview** for measuring point acquisition with active OED measuring tool

Acquiring measuring points with a TP sensor (software option)

If the QUADRA-CHEK 3000 3D software option is activated, the product supports the use of a TP sensor. A TP sensor is a touch probe connected to the product. When the stylus makes contact with an object, it is deflected and sends a signal that triggers measuring point acquisition.

While measuring points are acquired with a TP sensor, the position display is shown in the workspace.

The operator moves the TP sensor to position it at the desired edge or surface. Each time the stylus is deflected, the product acquires a measuring point.

Further information: "Overview of geometry types", Page 302

> Measuring point acquisition works in the same way for all geometries. The process is described below, using the **Circle** as an example.

Measuring point acquisition with a TP measuring tool

Prerequisites

- A stylus has been created in the device settings
  Further information: "Probe head", Page 486
- The stylus is calibrated
  Further information: "Calibrating a stylus", Page 113

▶ Tap **Measure** in the main menu

▶ Select **Manual measuring** in the function palette

▶ If multiple sensors are available, select **TP sensor** in the sensor palette
> The geometry palette and the TP tool palette are displayed
▶ If needed, tap **Position preview** in the Inspector
> The workspace now shows the position display
▶ Select **Circle** in the geometry palette

▶ If multiple styli are available, go to the tool palette and select the stylus used on the measuring machine
▶ If you are using a swiveling touch probe head, set its position, if required
▶ Move to the first measuring point on the contour of the circle
> If the touch probe is equipped with a triggered probe body, the measuring point will be acquired automatically upon deflection of the stylus
▶ If the touch probe is equipped with a rigid (hard) probe body, tap **Enter** in the Inspector

New
1

> A new feature is added to the feature list. The symbol of the feature corresponds to the selected geometry
> The number of acquired measuring points is shown next to the symbol
▶ Move to next measuring point

> Distribute the measuring points as evenly as possible along the contour of the feature.

▶ If required, tap **Enter** in the Inspector
> The measuring point is acquired
▶ To acquire more measuring points, repeat these steps
> If **Number of measuring points Fixed** is set in the features settings, then measuring point acquisition is completed automatically

New
3

> If **Number of measuring points Free** is set in the features settings, then a check mark is displayed next to the feature in the feature list that can be tapped to complete the measurement

▶ Tap **Finish** to complete the measuring point acquisition
> The measurement result preview appears

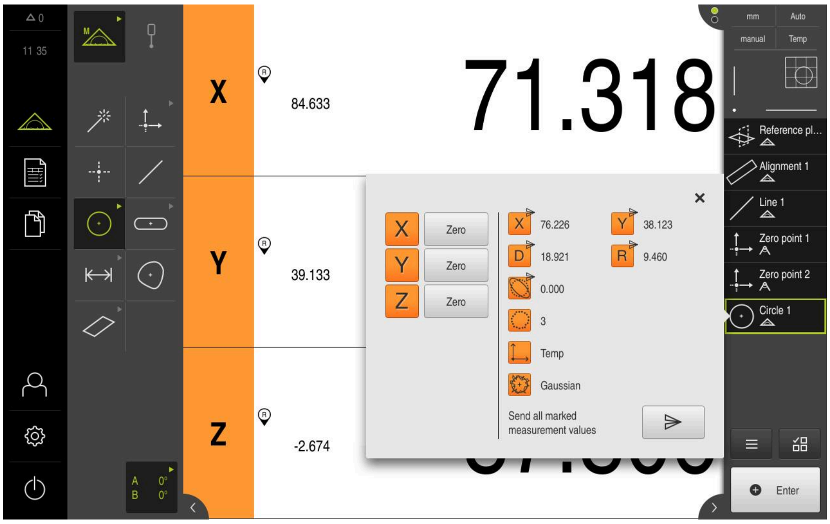


Figure 88: **Circle** feature with **Measurement result preview** for measuring point acquisition with a TP sensor

10.4 Conducting a measurement

10.4.1 Preparing a measurement

Cleaning the measured object and the measuring machine

Contamination, e.g. from chips, dust and oil residues, leads to incorrect measurement results. The measured object, the holder for the measured object, and the sensor must be clean before you start measuring.

- ▶ Clean the measured object, the holder for the measured object, and the sensors with appropriate cleaning products

Stabilizing the temperature of the measured object

The objects to be measured should be stored at the measuring machine for an appropriate amount of time to allow the objects to adjust to the ambient temperature. Since the dimensions of the measured objects vary with temperature changes, the temperature of the measured objects must be stabilized.

This ensures the reproducibility of the measurement. The reference temperature is usually 20 °C.

- ▶ Stabilize the temperature of the measured objects for an appropriate amount time

Reducing environmental influences

Environmental influences, such as incident light, ground vibration or air humidity, can affect the measuring machine, the sensors or the measured objects, and thus falsify the measurement results. Certain influences, such as incident light, also have a negative effect on the measurement uncertainty.

- ▶ Eliminate or avoid environmental influences as far as possible

Fixing the measured object in place

The measured object must be fixed in place on the measuring plate or in an appropriate holder, depending on its size.

- Position the measured object in the center of the measuring range
- Use e.g. modeling clay to fix small measured objects in position
- Use fixtures to fix large measured objects in position
- Make sure that the measured object is fastened neither too loosely nor too tightly

Conducting the reference mark search

With the help of reference marks, the unit can assign axis positions of the encoder to the machine.

If no reference marks for the encoder are provided by a defined coordinate system, you need to perform a reference mark search before you start measuring.

> If the reference mark search after unit start is active, then all of the unit's functions will be disabled until the reference mark search has been successfully completed.
>
> **Further information:** "Reference marks (Encoder)", Page 515

> The reference mark search does not need to be performed for serial encoders with EnDat interface, because the axes are automatically homed.

If the reference mark search is active on the unit, then a wizard will ask you to traverse the reference marks of the axes.

- After logging in, follow the instructions of the wizard
- > The Reference symbol stops blinking upon successful completion of the reference mark search

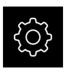
Further information: "Operating elements of the position display", Page 117

Further information: "Activating the reference mark search", Page 143

Starting the reference mark search manually

> A manual reference mark search can be performed only by the **Setup** and **OEM** user types.

If the reference mark search was not performed on startup, you can start it manually later.




- Tap **Settings** in the main menu
- Open in the sequence
  - **Axes**
  - **General settings**
  - **Reference marks**
- Tap **Start**
- > The Reference symbol blinks
- Follow the instructions of the wizard
- > The Reference symbol stops blinking upon successful completion of the reference mark search

Calibrating a VED sensor

Prerequisites

- The VED sensor has been configured in the device settings
  Further information: "Configuring a VED sensor", Page 175

Selecting the sensor

- ▶ Select **Manual measuring** in the function palette
- ▶ If multiple sensors are available, select **VED sensor** in the sensor palette
- > The image section from the VED sensor is displayed in the workspace
- ▶ Position the measuring tool over a high-contrast edge of the measured object
- ▶ Focus the optics of the measuring machine until the displayed edge is as sharp as possible

Adjusting the lighting

- ▶ Tap **Lighting palette**
- ▶ Use the sliders to adjust the lighting in the workspace so that the contrast at the object edge is as high as possible

Adjusting the contrast settings

The contrast threshold defines the contrast value starting from which a light-to-dark transition is recognized as an edge. The higher the defined contrast threshold, the higher the contrast of the measured transition must be.

This section explains how to set the contrast threshold manually or how to adjust it to the current light conditions using a teach sequence.

Alternatively, you can also adjust the contrast threshold with the contrast bar in the **Measure** menu.
Further information: "Show contrast bar", Page 127 and Page 105

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Tap **Settings** in the main menu

- Tap **Sensors**
- Open in the sequence
  - **Video edge detection (VED)**
  - **Contrast settings**
- Select the **Edge algorithm** for the edge detection
  - **Automatic**: The edge is defined automatically
  - **First edge**: The first transition ≥ the contrast threshold is defined as an edge
  - **Strongest edge**: The strongest transition ≥ the contrast threshold is defined as an edge
- In the **Contrast threshold value for edge detection** field, enter the desired contrast threshold value and do not superimpose the camera image (setting range: **0 ... 255**)

or

- To start the teach sequence, tap **Start**
- > The teach sequence is started and the **Measure** menu is displayed

- Select the **lighting palette**
- Adjust the sliders to achieve the highest possible contrast at the edge
- Tap **Confirm** in the wizard to confirm the positioning of the measuring tool and the lighting settings
- > The values in the **Contrast threshold value for edge detection** and **Contrast** fields will be adjusted automatically, based on the selected edge algorithm
- > The teach sequence is complete
- Tap **Undo** to repeat the teach sequence
- Tap **Close** to close the wizard

Further information: "Contrast settings", Page 478

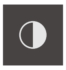
Calibrating an OED sensor

Prerequisites

- The OED sensor has been configured in the device settings
  Further information: "Configuring an OED sensor", Page 189

Selecting the sensor

- ▶ Select **Manual measuring** in the function palette



- ▶ If multiple sensors are available, select **OED sensor** in the sensor palette
- > The position display is now shown in the workspace
- ▶ Focus the optics of the measuring machine such that the sharpest edge possible is shown on the projection screen of the measuring machine
- ▶ Adjust the lighting of the measuring machine such that the highest amount of contrast possible is shown on the projection screen of the measuring machine

Adjusting the contrast settings

Adjust the contrast settings to the current light conditions via a teach sequence. As part of this process, you need to acquire one point each from the light and dark areas of the screen with the OED sensor.

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the contrast settings in a teach sequence, go to **OED contrast teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ Tap **OK** to close the dialog
- > The contrast settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Contrast settings", Page 483

Adjusting the threshold settings

The threshold settings define the contrast value starting from which a light-to-dark transition is recognized as an edge. Adjust the threshold settings to the current light conditions via a teach sequence. To do so, use the OED sensor to measure a distance for which you define a nominal value.

> The light conditions in the room affect the measurement result. Re-adjust the settings if there is a change in the light conditions.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the threshold settings in a teach sequence, go to **OED threshold teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ Tap **OK** to close the dialog
- > The threshold settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Threshold settings", Page 483

Configuring offset settings

The offset settings compensate for the position error between the crosshair for measuring point acquisition and the OED sensor for edge detection. You can configure the offset settings using a teach sequence in which you measure a circle with two different measuring tools. The offset of the OED sensor for the X and Y axes is calculated from the deviations of both circles and will then be compensated in subsequent measurements.

- ▶ Open the tool palette
- > The tool palette shows the **Measuring tool settings** dialog
- ▶ To determine the offset settings in a teach sequence, go to **OED offset teach sequence** and tap **Start**
- ▶ Follow the instructions of the wizard:
  - Measure the points on the circle with the crosshair measuring tool
  - Confirm each measured point with **Enter point**
- ▶ Tap **OK** to close the dialog
- > The offset settings are saved for the selected magnification
- ▶ Repeat this procedure for all available magnifications

Further information: "Offset settings", Page 484

Setting a TP sensor

Prerequisite: Touch probe (TP) is configured in the device settings

Further information: "Configuring a TP sensor", Page 193

Selecting the sensor

- Select **Manual measuring** in the function palette

- If multiple sensors are available, select **TP sensor** in the sensor palette
- > The position display is now shown in the workspace

Calibrating a stylus

Before you can use a stylus for measuring, it must be calibrated. For this purpose, measure the calibration sphere whose diameter you indicated in the device settings. Place at least three measuring points on the circumference and one on the top of the calibration sphere.

The first stylus you calibrate is defined as the main stylus. All other styli refer to the main stylus. If you re-calibrate the main stylus, you need to re-calibrate the other styli as well.

> **i** If you are using a star-type stylus, each stylus tip must be calibrated.

> **i** If you are using an indexed swiveling stylus, repeat the calibration procedure for each axis and each angular value required for measurement.

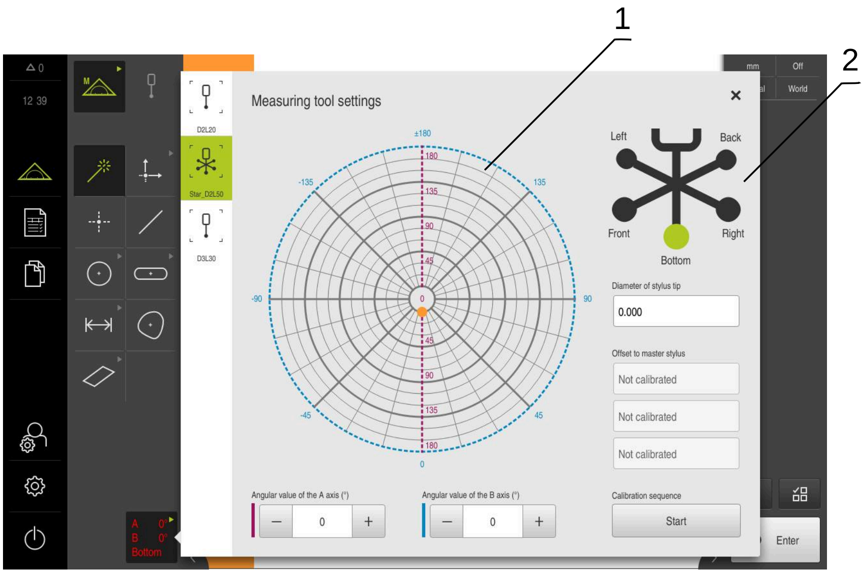


Figure 89: **Measuring tool settings** dialog for TP measuring tools

1 Graphical representation for selection of the angle values for indexed swiveling styli
2 Graphical representation for selection of the stylus tip for star-type styli

In the graphical representation of indexed swiveling styli, you can select a stylus position in order to calibrate it then. The scale corresponds to the range of adjustment of the touch probe head that is indicated in the settings.

Further information: "Probe head", Page 486

The calibrated positions and the selected position are marked by dots. The colors of the dots have the following meaning:

Color	Meaning
Orange	Position has been selected but not yet calibrated
Green	Position has been selected and calibrated
Dark gray	Position has not yet been selected and calibrated

- ▶ Select the desired stylus in the tool palette
- > The **Measuring tool settings** dialog shows the available parameters for the selected stylus
- ▶ If you are using a star-type stylus, tap the first stylus tip in the graphics
- > The selected stylus tip is displayed in green
- ▶ If you are using an indexed swiveling stylus, select the first angular value in the graphical representation or in the input fields
- ▶ Enter the diameter of the stylus tip
- ▶ To start the calibration, tap **Start**
- ▶ Follow the instructions of the wizard
- ▶ If you are using a star-type stylus, repeat this procedure for each stylus tip
- ▶ If you are using an indexed swiveling stylus, repeat the procedure for each axis and each angular value

- > When the icon in the tool bar is displayed in green, the stylus is fully calibrated

Further information: "Touch probe (TP)", Page 484

10.4.2 Aligning the measured object

Before you can evaluate the measuring points, you need to align the measured object. During this process, the coordinate system of the measured object (workpiece coordinate system) is determined, which is specified in the technical drawing.

This makes it possible to compare the measured values with the data in the technical drawing and assess them.

Further information: "2-D demo part", Page 545

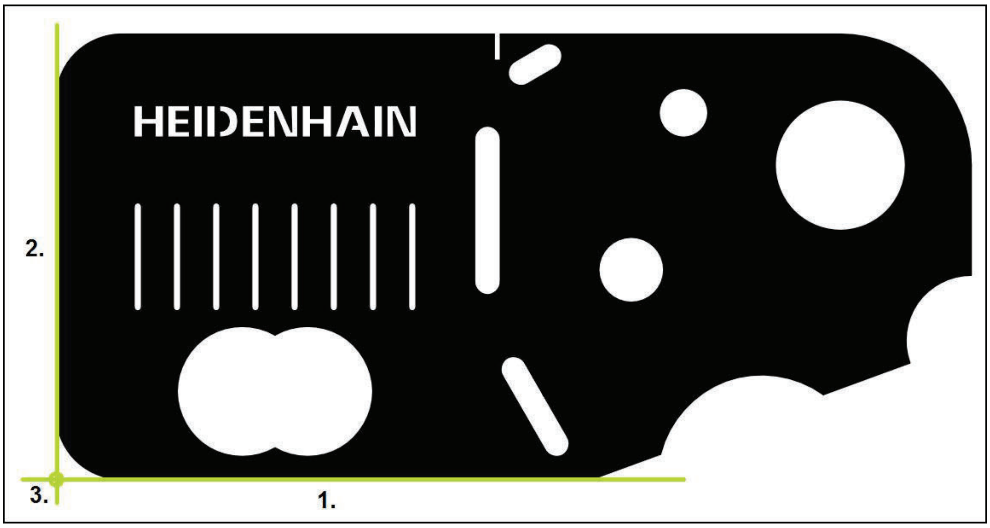


Figure 90: Example of aligning a 2-D demo part

Measured objects are usually aligned in the following steps:

1 Measuring the alignment
2 Measuring a straight line
3 Constructing the zero point

> The procedure for measuring features is basically the same for all geometries and is independent of the type of measuring point acquisition. The measurements below are shown using an example with the activated QUADRA-CHEK 3000 VED software option.

Measuring the alignment

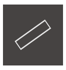
Define the reference edge for the alignment according to the technical drawing.

- Tap **Measure** in the main menu

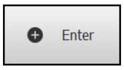
- Select **Manual measuring** in the function palette
- If necessary, select the desired sensor from the sensor palette
- > The geometry palette and corresponding measuring tool are shown
- In the quick access menu, select the magnification that is set on the measuring machine

- If required, select the **XY** projection plane in the quick access menu

Further information: "Selecting the projection plane", Page 128



- Select **Alignment** in the geometry palette
- Select the appropriate measuring tool in the tool palette
- Position the measuring tool



- To acquire measuring points, tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

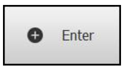
> Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- Tap **Finish** in the new feature
- > The alignment is displayed in the feature list
- > The measurement result preview is now displayed

Measuring a straight line

A straight line is measured as the second reference edge.

- Select **Line** in the geometry palette
- Select the appropriate measuring tool in the tool palette
- Position the measuring tool



- To acquire measuring points, tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

> Distribute the measuring points along the entire length of the edge. This minimizes the angular error.

- Tap **Finish** in the new feature
- > The straight line is displayed in the feature list
- > The measurement result preview is now displayed

Constructing the zero point

Construct the zero point at the point of intersection between the alignment and the straight line.

- ▶ Select **Zero point** in the geometry palette
- ▶ Select the **Alignment** and **Line** features in the Inspector or in the features view
- > The selected features are displayed in green
- > A new feature is displayed in the feature list
- ▶ Tap **Finish** in the new feature
- > The zero point is displayed in the feature list
- > The workpiece coordinate system for the measured object has been determined
- ▶ Tap **Features preview**
- > The coordinate system is shown in the workspace

10.4.3 Measuring features

This section lays out the typical steps required for conducting a measurement. This description provides an overview. Additional steps may be necessary depending on the measuring machine or the respective measuring application.

A measurement consists of the following steps:

- Selection of the appropriate geometry for the feature to be measured
- Measuring point acquisition using the selected geometry
  Further information: "Acquiring measuring points", Page 304

> The steps described in this section are the same for each measuring process. These steps are described using the **Circle** geometry as an example.

- ▶ Tap **Measure** in the main menu
- ▶ Select **Manual measuring** in the function palette
- ▶ If needed, enlarge the workspace by hiding the main menu, the submenu, or the Inspector
- ▶ Position the measured object such that it is located in the workspace
- ▶ Activate or deactivate automatic measuring point acquisition
  Further information: "Setting automatic measuring point acquisition", Page 126
- ▶ Select the **Circle** geometry in the geometry palette
- ▶ Choose an appropriate tool
- ▶ Position the measuring tool on the contour of the circle
- ▶ Acquiring measuring points

- ▶ To conclude measuring point acquisition, tap **Finish** in the new feature
- \> The measured feature is displayed in the feature list
- \> The measurement result preview appears
- \> The feature can be evaluated
  Further information: "Measurement evaluation", Page 379

Figure 91: Measured features in the feature list of the Inspector

10.4.4 Measuring with Measure Magic

If you work with Measure Magic, then the geometry type is automatically determined based on the acquired measuring points. You can later change this geometry type by converting the feature.

> **i** The geometry type assigned to a new feature depends on the Measure Magic settings. The measurement result must correspond to the defined criteria.

> **i** The steps described in this section are the same for each measuring process. These steps are described using the **Arc** geometry as an example.

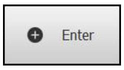
Measuring an arc

To measure an arc, at least three measuring points are needed. The central angle is determined by the two measuring points at the furthest ends.

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette

- Select **Measure Magic** in the geometry palette
- The measuring object is positioned such that the measured object is located in the workspace
- Select the appropriate measuring tool in the tool palette
- Position the measuring tool on the contour



- Acquire the measuring point and tap **Enter** in the Inspector
- > A new feature is displayed in the feature list

- Tap **Finish** in the new feature
- > The **Arc** is displayed in the feature list
- > The measurement result preview is now displayed
- Convert the feature if the automatically determined geometry does not match
  Further information: "Converting a feature", Page 289

> **i** If the geometry is not automatically recognized, then check the Measure Magic settings and the mathematically required minimum number of measuring points for the geometry type in question.

> **i** For TP sensor measurements, the **Measure Magic** function is currently not supported.

Further information: "Features", Page 228

Further information: "Overview of geometry types", Page 302

10.4.5 Measuring with Auto contour

When using the **Auto contour** measuring tool, the contours shown in the live image of the camera are detected automatically. You can acquire individual contours or all detected contours as features.

Prerequisites:

- The VED sensor has been activated (software option)

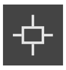
Measuring features

- Tap **Measure** in the main menu

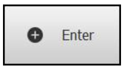
- Select **Manual measuring** in the function palette

- Select **Measure Magic** in the geometry palette

- Select **Auto contour** from the tool palette
- > Detected contours are displayed with a green outline



- To limit the search area, tap **Search area** in the workspace
- > The search area is displayed
- If required, resize the search area
- To acquire a single contour as a feature, tap the contour



- To acquire all contours as features, tap **Enter** in the Inspector
- > The new features are displayed in the feature list
- Convert the feature if the automatically determined geometry does not match
  Further information: "Converting a feature", Page 289

10.4.6 You can send the measured values to a computer

You can send contents from the measurement result preview to a computer via the RS-232 interface.

Prerequisites:

- The measured-value output has been configured
- The preview of measured values is active

Further information: "Configuring the measured value output", Page 231

Further information: "Configuring the measurement result preview", Page 229

▶ Measure a feature, e. g., a **Circle**

> The **Measurement result preview** opens

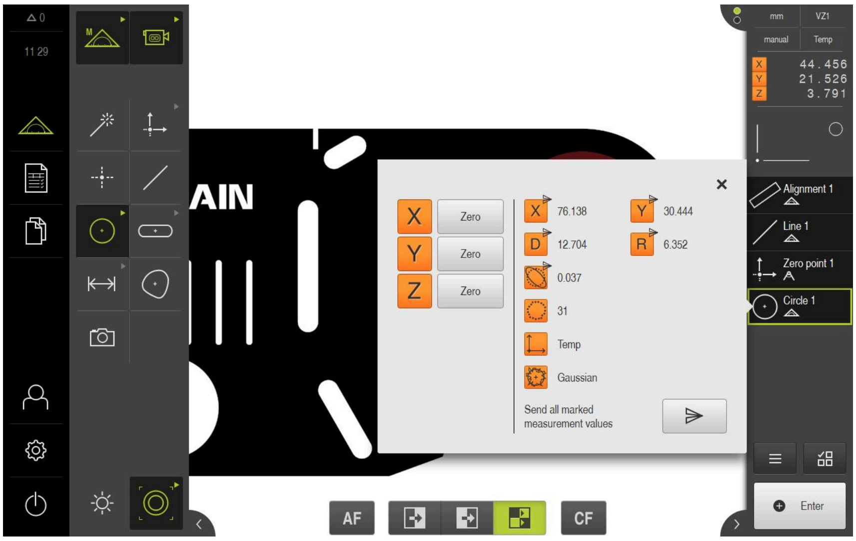


Figure 92: Sending in the **Measurement result preview**

▶ To select or deselect contents for the measured-value output, tap the corresponding **symbol**

> The selected contents are marked by the Send symbol

> All numerical values of the feature are available for selection.
> **Further information:** "Overview of parameters in the measurement result preview", Page 495

▶ Tap **Send**

> The measured values are sent to the computer once

10.5 Constructing features

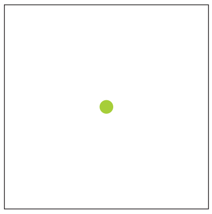
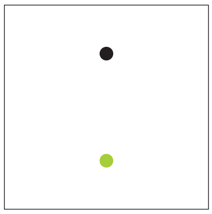
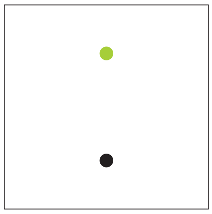
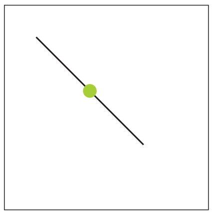
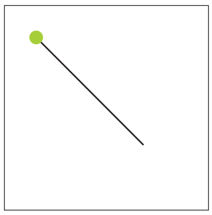
You can construct new features from measured, constructed or defined features. This is done by deriving new features from the existing features, e.g. by moving or copying.

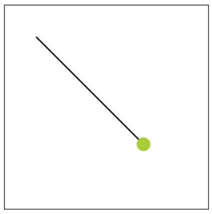
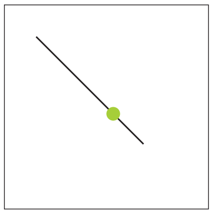
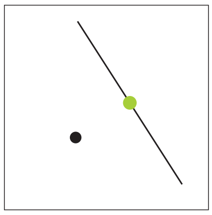
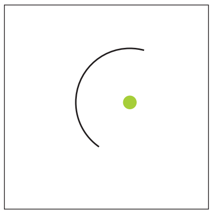
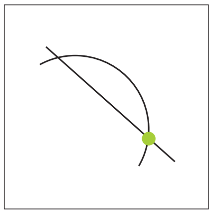
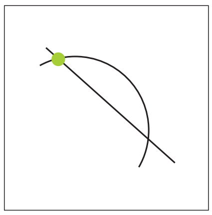
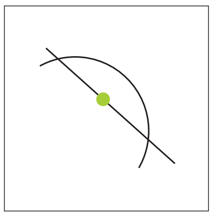
10.5.1 Overview of construction types

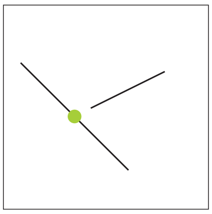
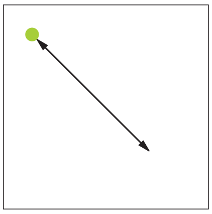
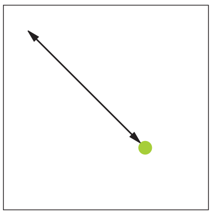
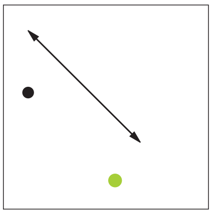
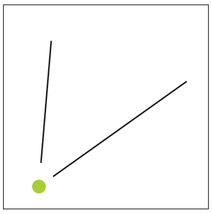
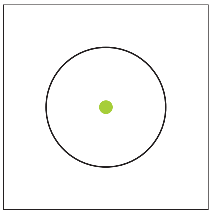
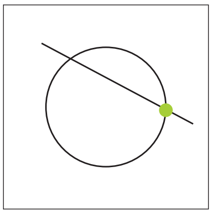
Existing features used for construction are referred to as parent features. Parent features can be measured, constructed or defined features.

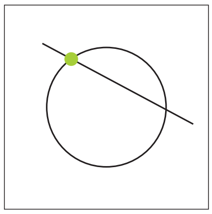
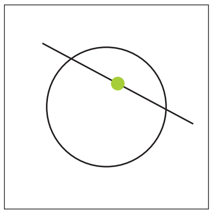
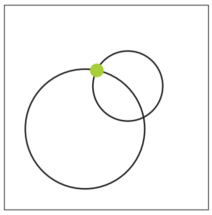
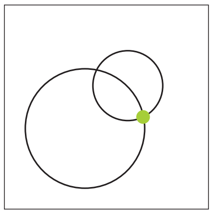
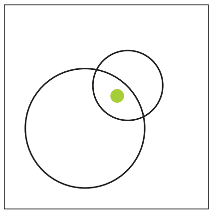
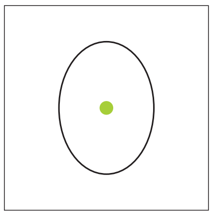
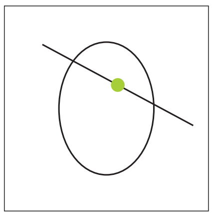
The overview shows the parent features and construction types that can be used for constructing a feature.

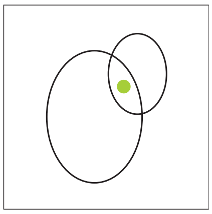
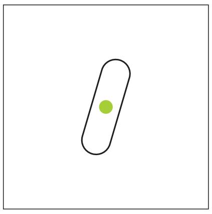
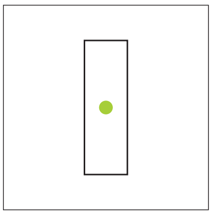
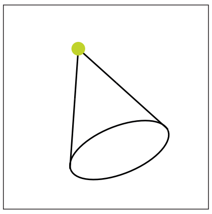
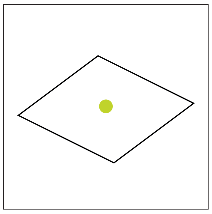
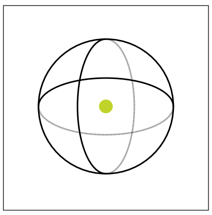
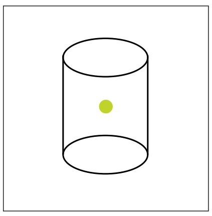
Point / Zero point

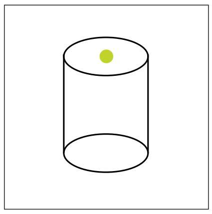
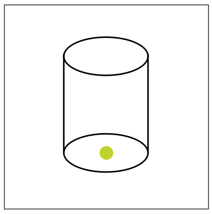
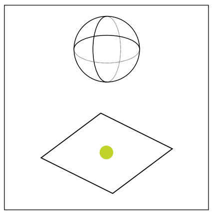
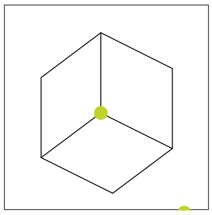
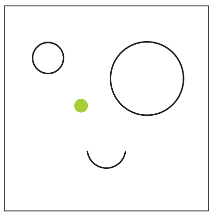
Parent feature	Construction type	Display
Point	**Copy**	
Point	**Minimum Y point**	
Point	**Maximum Y point**	
Line	**Center**	
Line	**End point 1**	

Parent feature	Construction type	Display
Line	**End point 2**	
Line	**Point of origin**	
Point and **Line**	**Perpendicular point**	
Arc	**Center**	
Arc and **Line**	**Intersection point 1**	
Arc and **Line**	**Intersection point 2**	
Arc and **Line**	**Perpendicular point**	

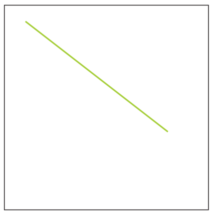
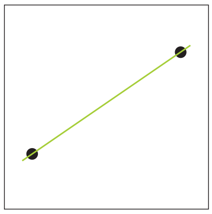
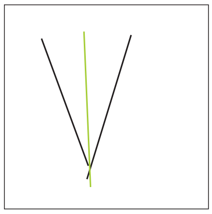
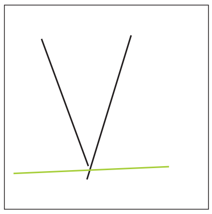
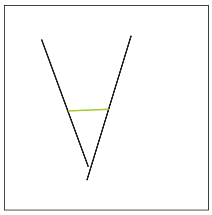
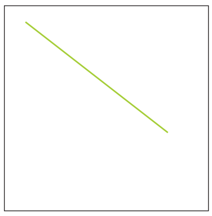
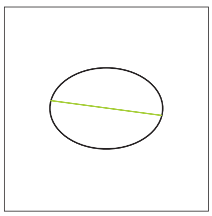
Parent feature	Construction type	Display
2x **Line**	**Intersection point**	
Distance	**End point 1**	
Distance	**End point 2**	
Point and **Distance**	**Shift**	
Angle	**Vertex**	
Circle	**Center**	
Circle and **Line**	**Intersection point 1**	

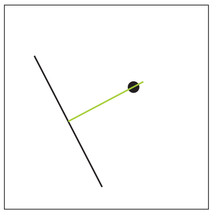
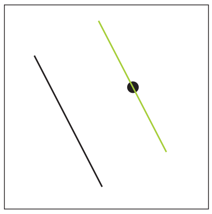
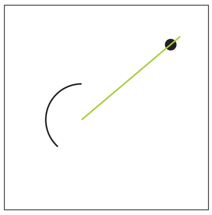
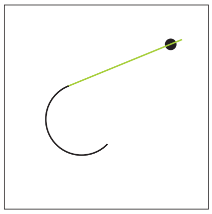
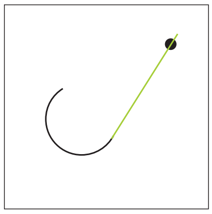
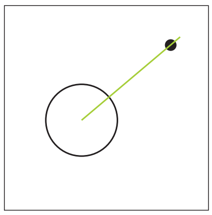
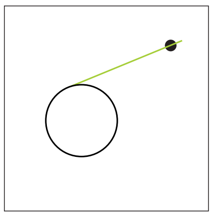
Parent feature	Construction type	Display
Circle and **Line**	**Intersection point 2**	
Circle and **Line**	**Perpendicular point**	
2x **Circle**	**Intersection point 1**	
2x **Circle**	**Intersection point 2**	
2x **Circle**	**Center**	
Ellipse	**Center**	
Ellipse and **Line**	**Perpendicular point**	

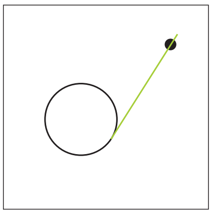
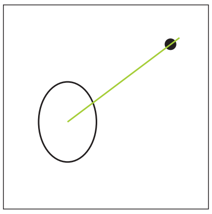
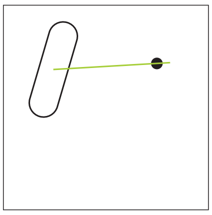
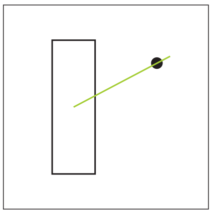
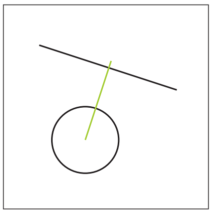
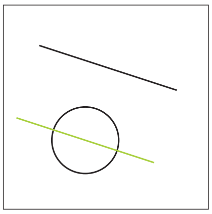
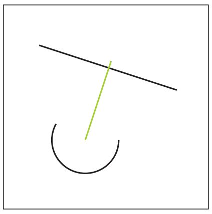
Parent feature	Construction type	Display
2x **Ellipse**	**Center**	
Slot	**Center**	
Rectangle	**Center**	
Cone	**Vertex**	
Plane	**Center**	
Sphere	**Center**	
Cylinder	**Center**	

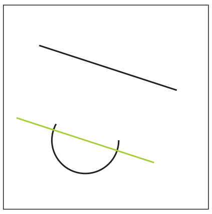
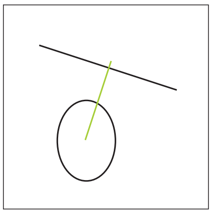
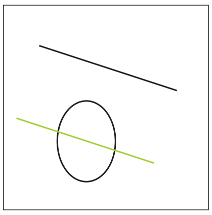
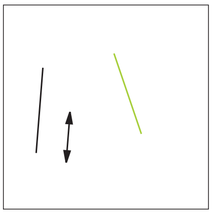
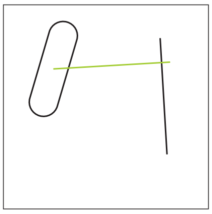
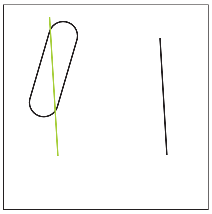
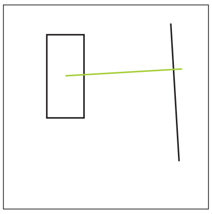
Parent feature	Construction type	Display
Cylinder	**End point 1**	
Cylinder	**End point 2**	
Plane and **Sphere**	**Perpendicular point**	
3x **Plane**	**Intersection point**	
Multiple features	**Average** from any number and combination of the center points of: ■ **Point** ■ **Slot** ■ **Rectangle** ■ **Circle** ■ **Arc** ■ **Ellipse** ■ **Sphere**	

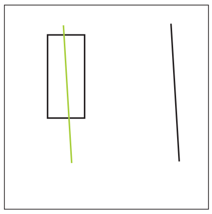
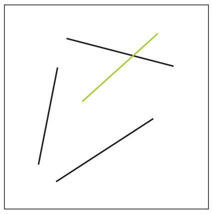
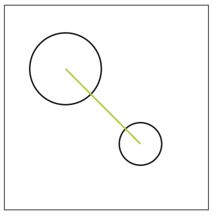
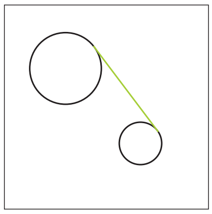
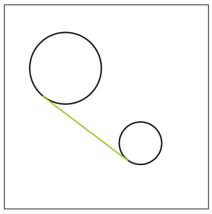
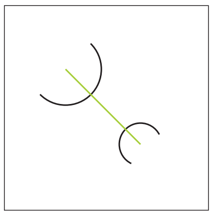
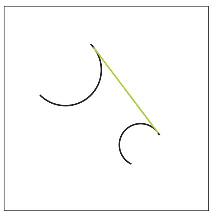
Line / Alignment

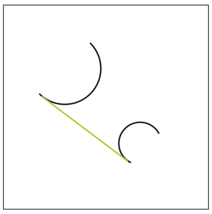
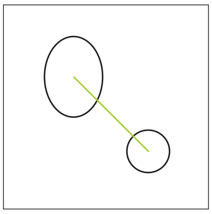
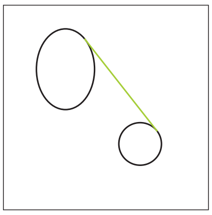
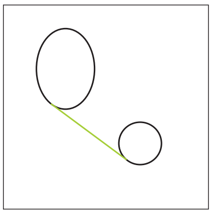
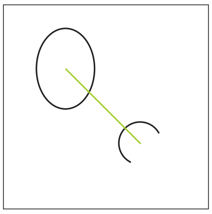
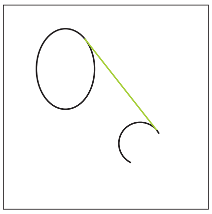
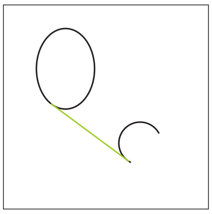
Parent feature	Construction type	Display
Line	**Copy**	
2x **Point**	**Center**	
2x **Line**	**Centerline 1**	
2x **Line**	**Centerline 2**	
2x **Line**	**Gauge line** (the length must be specified)	
Distance	**Centerline**	
Ellipse	**Semimajor axis**	

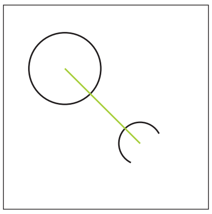
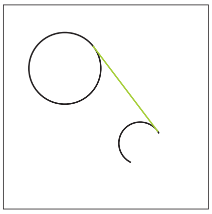
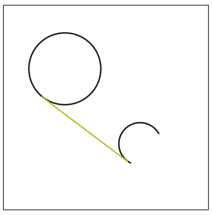
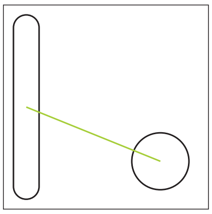
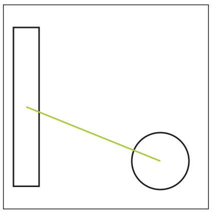
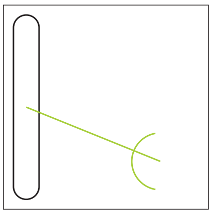
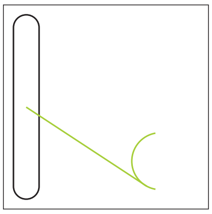
Parent feature	Construction type	Display
Point and **Line**	**Vertical**	
Point and **Line**	**Parallel**	
Point and **Arc**	**Center**	
Point and **Arc**	**Tangent 1**	
Point and **Arc**	**Tangent 2**	
Point and **Circle**	**Center**	
Point and **Circle**	**Tangent 1**	

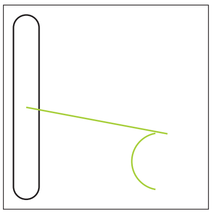
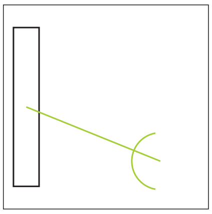
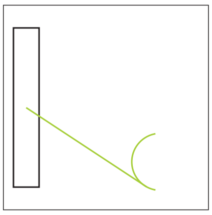
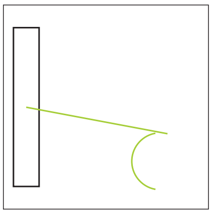
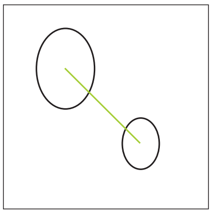
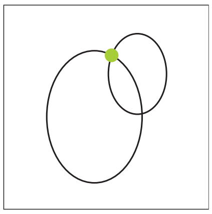
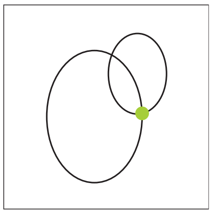
Parent feature	Construction type	Display
Point and **Circle**	**Tangent 2**	
Point and **Ellipse**	**Center**	
Point and **Slot**	**Center**	
Point and **Rectangle**	**Center**	
Line and **Circle**	**Vertical**	
Line and **Circle**	**Parallel**	
Line and **Arc**	**Vertical**	

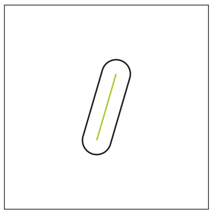
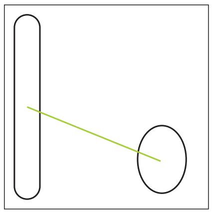
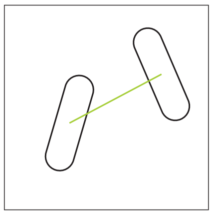
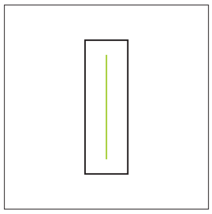
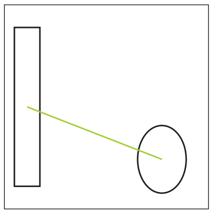
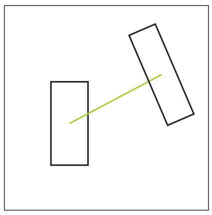
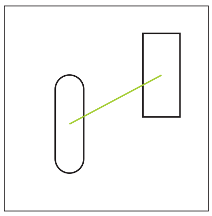
Parent feature	Construction type	Display
Line and **Arc**	**Parallel**	
Line and **Ellipse**	**Vertical**	
Line and **Ellipse**	**Parallel**	
Line and **Distance**	**Shift**	
Line and **Slot**	**Vertical**	
Line and **Slot**	**Parallel**	
Line and **Rectangle**	**Vertical**	

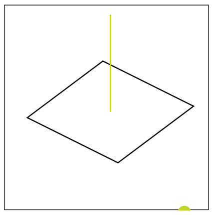
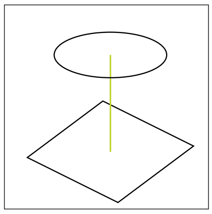
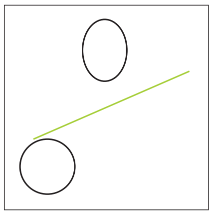
Parent feature	Construction type	Display
Line and **Rectangle**	**Parallel**	
Line and **Angle**	**Rotation**	
2x **Circle**	**Center**	
2x **Circle**	**Tangent 1**	
2x **Circle**	**Tangent 2**	
2x **Arc**	**Center**	
2x **Arc**	**Tangent 1**	

Parent feature	Construction type	Display
2x **Arc**	**Tangent 2**	
Circle and **Ellipse**	**Center**	
Circle and **Ellipse**	**Tangent 1**	
Circle and **Ellipse**	**Tangent 2**	
Arc and **Ellipse**	**Center**	
Arc and **Ellipse**	**Tangent 1**	
Arc and **Ellipse**	**Tangent 2**	

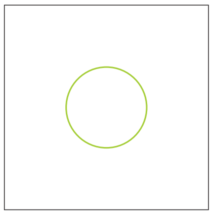
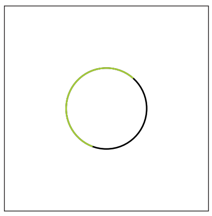
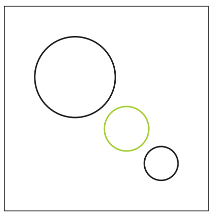
Parent feature	Construction type	Display
Circle and **Arc**	**Center**	
Circle and **Arc**	**Tangent 1**	
Circle and **Arc**	**Tangent 2**	
Circle and **Slot**	**Center**	
Circle and **Rectangle**	**Center**	
Arc and **Slot**	**Center**	
Arc and **Slot**	**Tangent 1**	

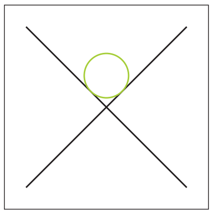
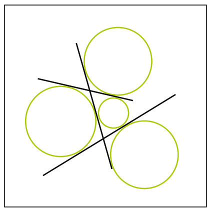
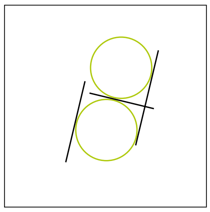
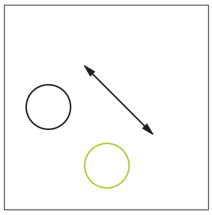
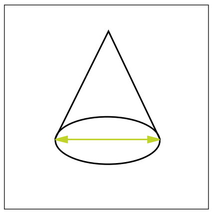
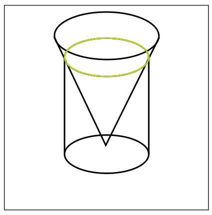
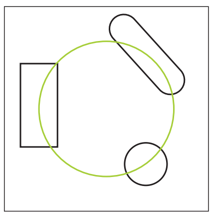
Parent feature	Construction type	Display
Arc and **Slot**	**Tangent 2**	
Arc and **Rectangle**	**Center**	
Arc and **Rectangle**	**Tangent 1**	
Arc and **Rectangle**	**Tangent 2**	
2x **Ellipse**	**Center**	
2x **Ellipse**	**Intersection point 1**	
2x **Ellipse**	**Intersection point 2**	

Parent feature	Construction type	Display
Slot	**Centerline**	
Slot and **Ellipse**	**Center**	
2x **Slot**	**Center**	
Rectangle	**Centerline**	
Rectangle and **Ellipse**	**Center**	
2x **Rectangle**	**Center**	
Slot and **Rectangle**	**Center**	

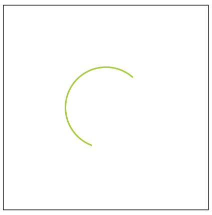
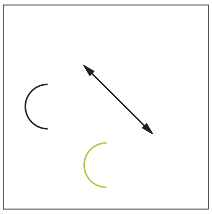
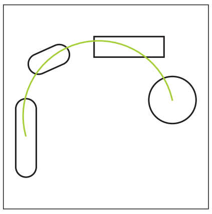
Parent feature	Construction type	Display
Plane	**Normal**	
Plane and **Circle**	**Perpendicular baseline**	
Multiple features	**Line** or **Alignment** from the center points of at least two features in any combination of: ▪ **Point** ▪ **Slot** ▪ **Circle** ▪ **Arc** ▪ **Ellipse** ▪ **Sphere**	

Circle

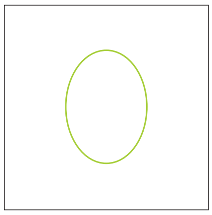
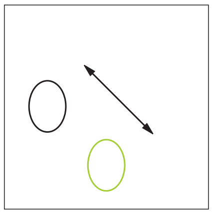
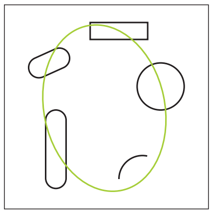
Parent feature	Construction type	Display
Circle	**Copy**	
Arc	**Copy** (circle superimposed on arc)	
2x **Circle**	**Average**	

Parent feature	Construction type	Display
2x **Line**	**Gauge circle**	
3x **Line**	**Circle 1**, **Circle 2**, **Circle 3**, **Circle 4**	
3x **Line**	**Circle 1**, **Circle 5**	
Circle and **Distance**	**Shift**	
Cone	**Gauge circle**	
Cone	**Intersection circle**	
Multiple features	**Circle** from the center points of at least three features in any combination of: ■ **Point** ■ **Slot** ■ **Circle** ■ **Arc** ■ **Ellipse** ■ **Sphere**	

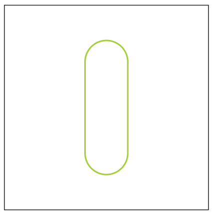
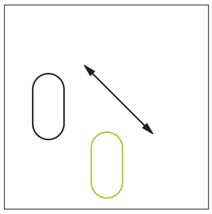
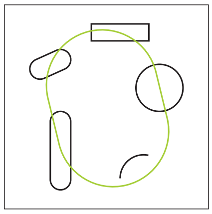
Arc

Parent feature	Construction type	Display
Arc	**Copy**	
Arc and **Distance**	**Shift**	
Multiple features	**Arc** from the center points of at least three features in any combination of: ■ **Point** ■ **Slot** ■ **Rectangle** ■ **Circle** ■ **Arc** ■ **Ellipse** ■ **Sphere**	

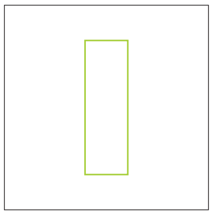
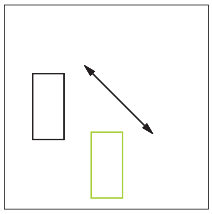
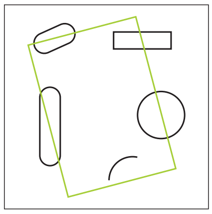
Ellipse

Parent feature	Construction type	Display
Ellipse	**Copy**	
Ellipse and **Distance**	**Shift**	
Multiple features	**Ellipse** from the center points of at least three features in any combination of: ■ **Point** ■ **Slot** ■ **Rectangle** ■ **Circle** ■ **Arc** ■ **Ellipse** ■ **Sphere**	

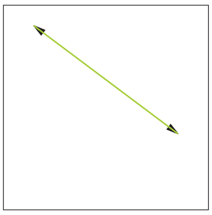
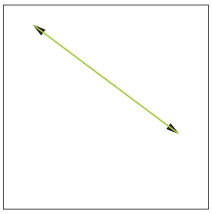
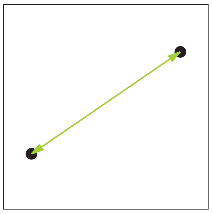
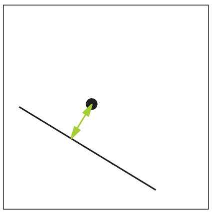
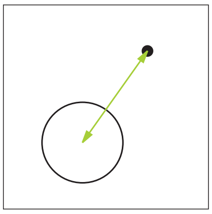
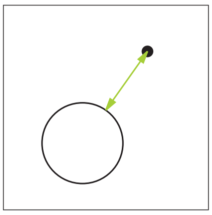
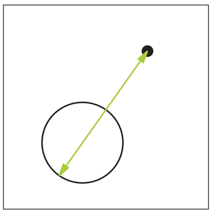
Slot

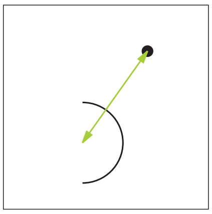
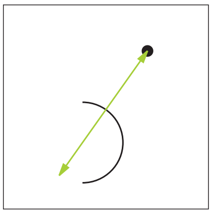
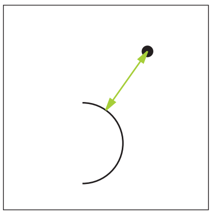
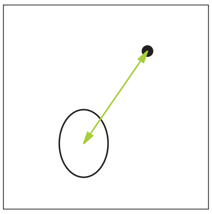
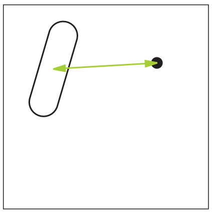
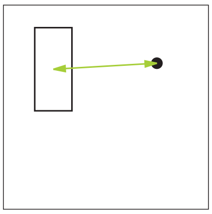
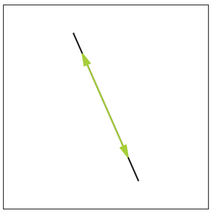
Parent feature	Construction type	Display
Slot	**Copy**	
Slot and **Distance**	**Shift**	
Multiple features	**Slot** from the center points of at least five features in any combination of: ■ **Point** ■ **Slot** ■ **Rectangle** ■ **Circle** ■ **Arc** ■ **Ellipse** ■ **Sphere**	

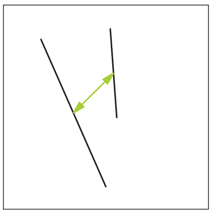
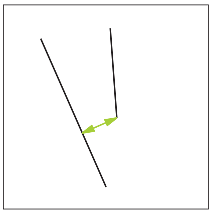
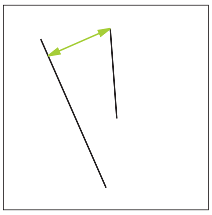
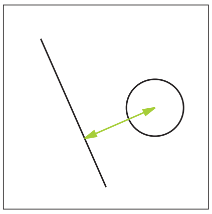
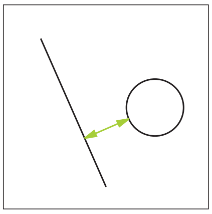
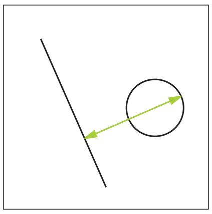
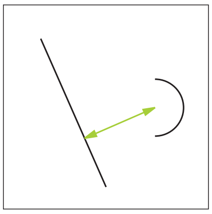
Rectangle

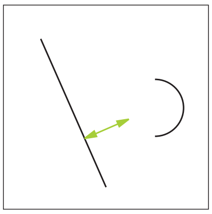
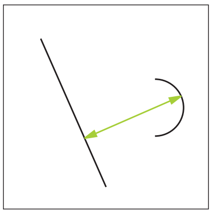
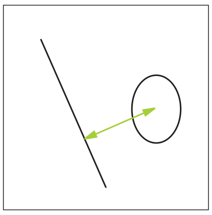
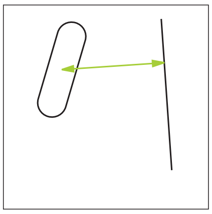
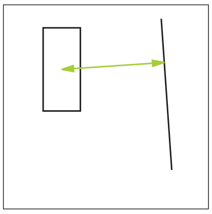
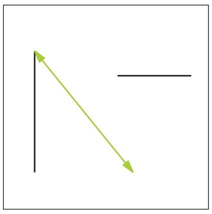
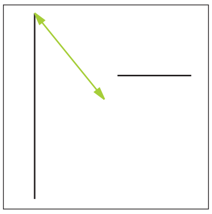
Parent feature	Construction type	Display
Rectangle	**Copy**	
Rectangle and **Distance**	**Shift**	
Multiple features	**Rectangle** from the center points of at least five features in any combination of: ■ **Point** ■ **Slot** ■ **Rectangle** ■ **Circle** ■ **Arc** ■ **Ellipse** ■ **Sphere**	

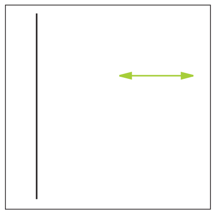
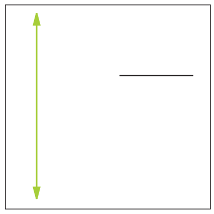
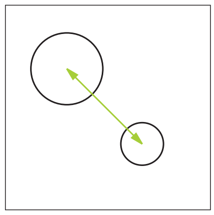
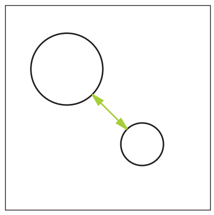
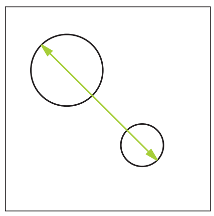
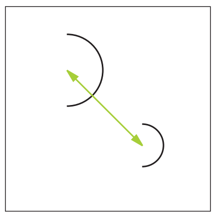
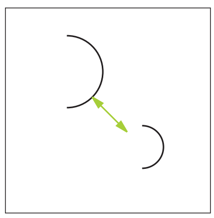
Distance

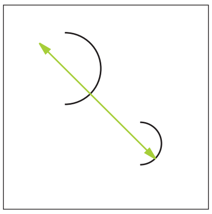
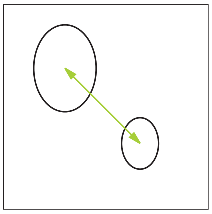
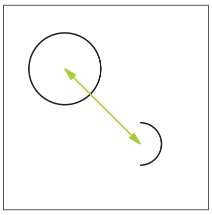
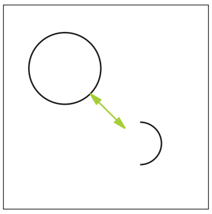
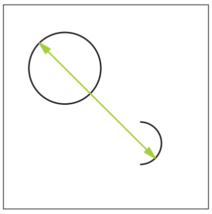
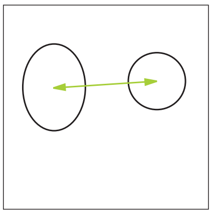
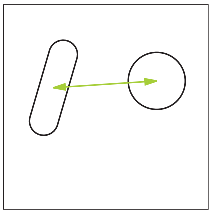
Parent feature	Construction type	Display
Distance	**Copy**	
Distance	**Direction change**	
2x **Point**	**Center**	
Point and **Line**	**Center**	
Point and **Circle**	**Center**	
Point and **Circle**	**Minimum**	
Point and **Circle**	**Maximum**	

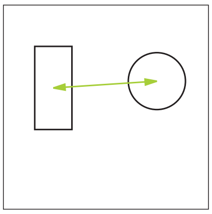
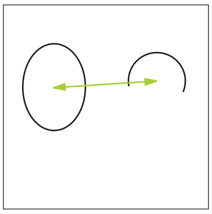
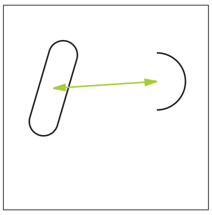
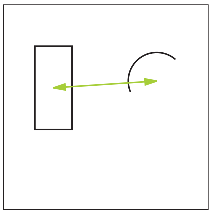
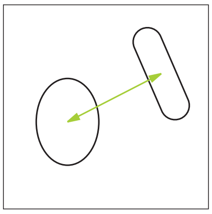
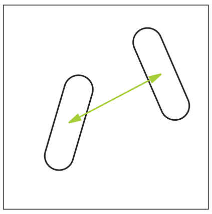
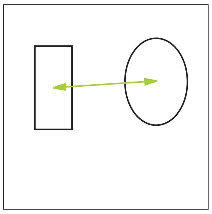
Parent feature	Construction type	Display
Point and **Arc**	**Center**	
Point and **Arc**	**Minimum**	
Point and **Arc**	**Maximum**	
Point and **Ellipse**	**Center**	
Point and **Slot**	**Center**	
Point and **Rectangle**	**Center**	
Line	**Length**	

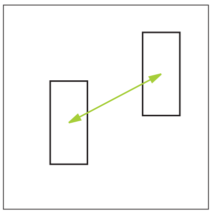
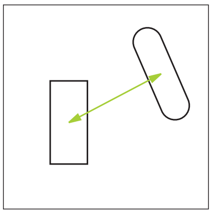
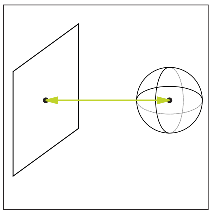
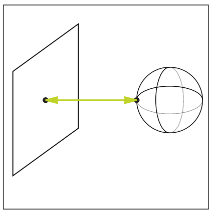
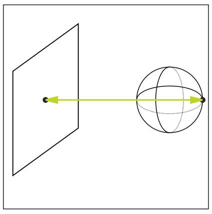
Parent feature	Construction type	Display
2x **Line**	**Center bounded**	
2x **Line**	**Minimum bounded**	
2x **Line**	**Maximum bounded**	
Line and **Circle**	**Center**	
Line and **Circle**	**Minimum**	
Line and **Circle**	**Maximum**	
Line and **Arc**	**Center**	

Parent feature	Construction type	Display
Line and **Arc**	**Minimum**	
Line and **Arc**	**Maximum**	
Line and **Ellipse**	**Center**	
Line and **Slot**	**Center**	
Line and **Rectangle**	**Center**	
2x **Distance**	**Sum**	
2x **Distance**	**Average**	

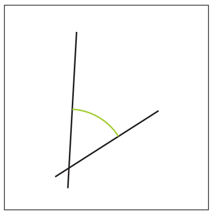
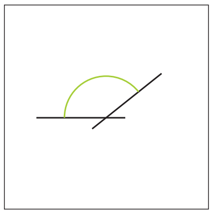
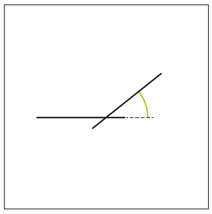
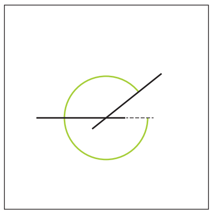
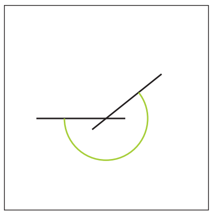
Parent feature	Construction type	Display
2x **Distance**	**Minimum**	
2x **Distance**	**Maximum**	
2x **Circle**	**Center**	
2x **Circle**	**Minimum**	
2x **Circle**	**Maximum**	
2x **Arc**	**Center**	
2x **Arc**	**Minimum**	

Parent feature	Construction type	Display
2x **Arc**	**Maximum**	
2x **Ellipse**	**Center**	
Circle and **Arc**	**Center**	
Circle and **Arc**	**Minimum**	
Circle and **Arc**	**Maximum**	
Circle and **Ellipse**	**Center**	
Circle and **Slot**	**Center**	

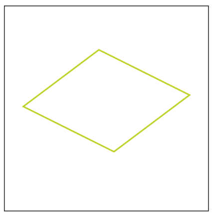
Parent feature	Construction type	Display
Circle and **Rectangle**	**Center**	
Arc and **Ellipse**	**Center**	
Arc and **Slot**	**Center**	
Arc and **Rectangle**	**Center**	
Slot and **Ellipse**	**Center**	
2x **Slot**	**Center**	
Rectangle and **Ellipse**	**Center**	

Parent feature	Construction type	Display
2x **Rectangle**	**Center**	
Slot and **Rectangle**	**Center**	
Sphere and **Plane**	**Center**	
Sphere and **Plane**	**Minimum**	
Sphere and **Plane**	**Maximum**	

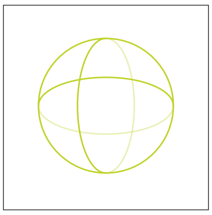
Angle

Parent feature	Construction type	Display
Angle	**Copy**	
2x **Line**	**Interior angle**	
2x **Line**	**180° - angle**	
2x **Line**	**180° + angle**	
2x **Line**	**360° - angle**	

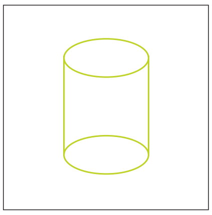
Plane

Parent feature	Construction type	Image
Plane	**Copy**	

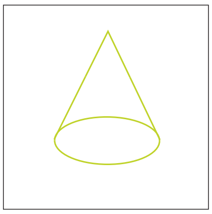
Sphere

Parent feature	Construction type	Image
Sphere	Copy	

Cylinder

Parent feature	Construction type	Image
Cylinder	Copy	

Cone

Parent feature	Construction type	Image
Cone	Copy	

10.5.2 Constructing a feature

- Tap **Measure** in the main menu
- Select the desired geometry in the geometry palette, e.g. **Distance**
- Select the required parent features in the feature list
- > The selected features are displayed in green
- > A new feature with the selected geometry is displayed

> If **Measure Magic** is selected in the geometry plane, then no new feature will be suggested in the feature list.
> - Select the desired geometry type

- Tap **Finish** in the new feature

> If a feature cannot be completed, check whether the selected parent features match the construction type.

- > The constructed feature is displayed in the workspace and the feature list

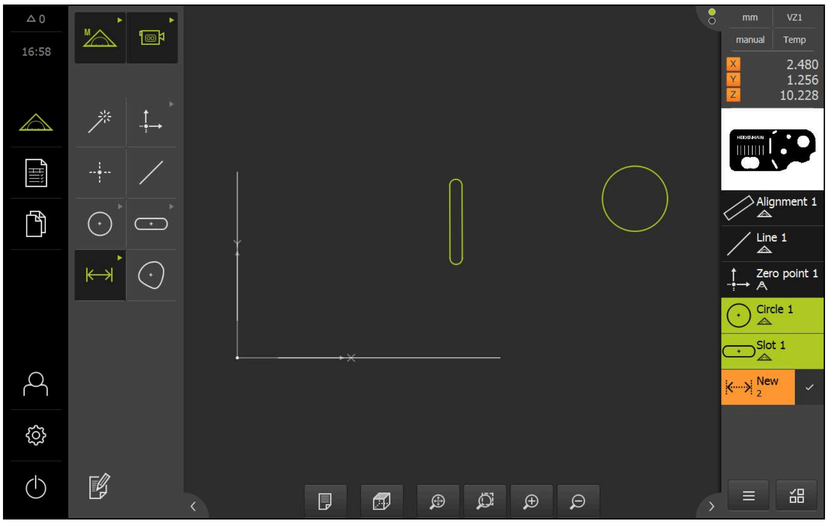


Figure 93: Constructed features in the features view of the workspace and feature list of the Inspector

10.5.3 Modifying a constructed feature

You can change the construction type of the constructed features later. Depending on the geometry and the parent features, you can select a different construction type.

- ▶ Drag the constructed feature from the feature list into the workspace
- > The Details dialog box appears with the **Overview** tab selected
- ▶ To rename the feature, tap the **input field** containing the current name
- ▶ Enter a name for the feature
- ▶ Confirm entry with **RET**
- > The new name is displayed in the feature list
- ▶ To change the construction type of the feature, select the type you want to use for the construction in the **Construction type** drop-down list

> The available construction types depend on the geometry and the parent features.
>
> **Further information:** "Overview of construction types", Page 331

- > The new construction type is applied
- ▶ To change the geometry type, select the desired geometry type in the **New type of geometry** drop-down list
- > The feature is displayed in the new form
- ▶ Tap **Close** to close the dialog

10.6 Defining features

In some situations, it is necessary to define features. This may be the case, for example, if a reference used in the technical drawing cannot be established on the measured object by means of measurement or construction. Here, you can define the reference on the basis of the coordinate system of the measured object.

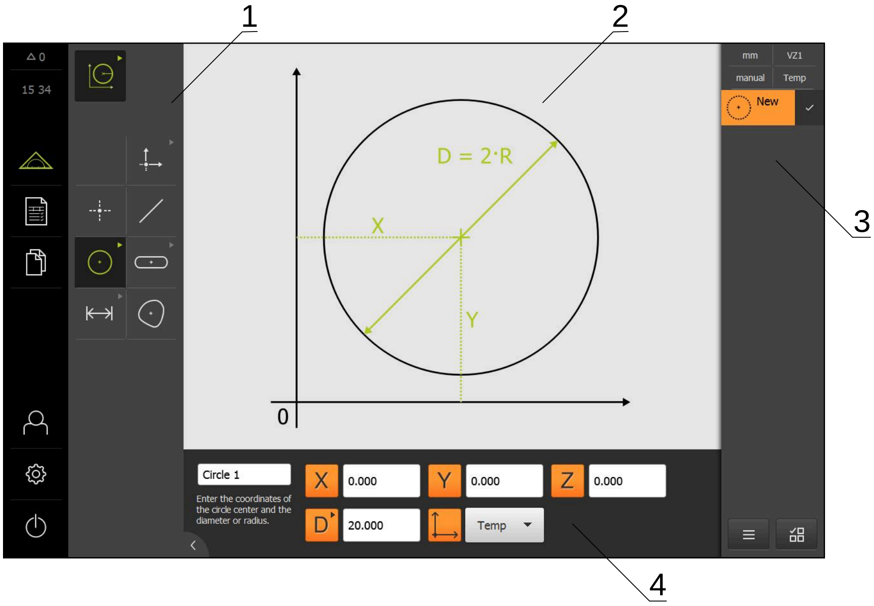
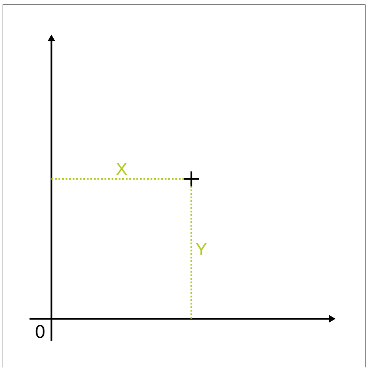
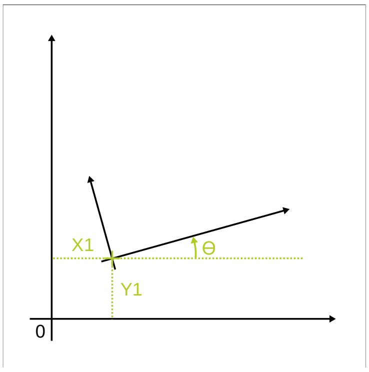
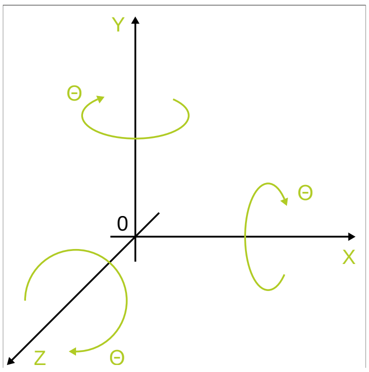
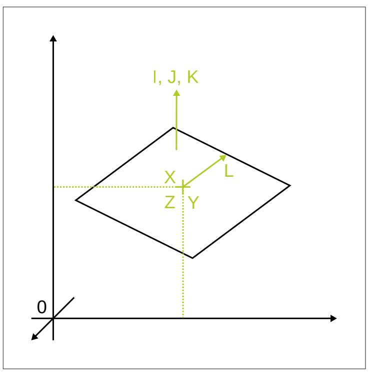


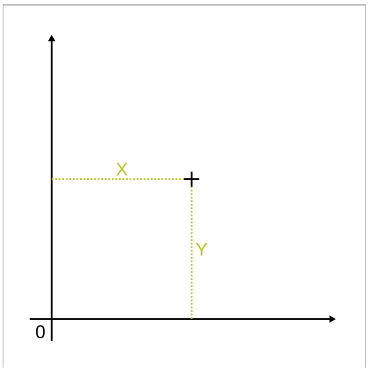
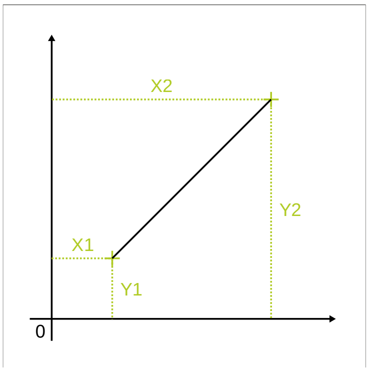
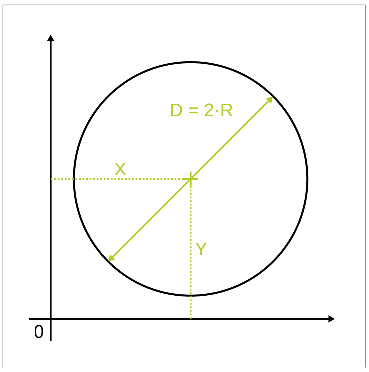
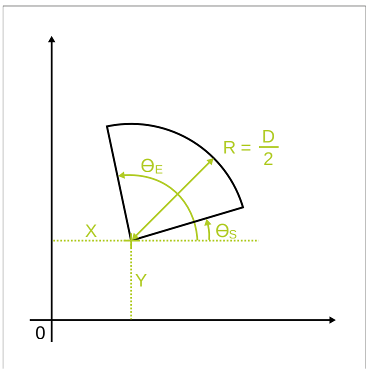
Figure 94: The **Define** function with **circle** geometry

1 Geometry palette
2 Display of the geometry
3 Feature list in the Inspector
4 Input fields for the geometry parameters (geometry-specific)

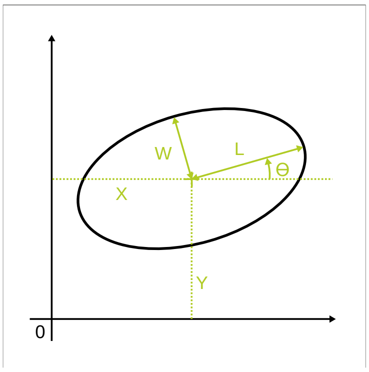
10.6.1 Overview of definable geometries

The overview shows the definable geometries and the required geometry parameters.

Display	Geometry parameters
	**Zero point** The feature is defined by the following values: ■ X: Position on the X axis ■ Y: Position on the Y axis
	**Alignment** The feature is defined by the following values: ■ X: Position on the X axis ■ Y: Position on the Y axis ■ θ: Direction with angle between X axis and alignment
	**Rotation** The feature is defined by the following values: ■ θ: Angle of rotation ■ Rotary axis
	**Plane** The feature is defined by the following values: ■ X: Position of the center point on the X axis ■ Y: Position of the center point on the Y axis ■ Z: Position of the center point on the Z axis ■ I: Position of the normal vector on the X axis ■ J: Position of the normal vector on the Y axis ■ K: Position of the normal vector on the Z axis ■ L: Length of the plane (for graphical representation)

Display	Geometry parameters
	**Point** The feature is defined by the following values: ■ X: Position on the X axis ■ Y: Position on the Y axis
	**Line** The feature is defined by the following values: ■ X1: Position of the first point on the X axis ■ Y1: Position of the first point on the Y axis ■ X2: Position of the second point on the X axis ■ Y2: Position of the second point on the Y axis
	**Circle** The feature is defined by the following values: ■ X: Position of the center point on the X axis ■ Y: Position of the center point on the Y axis ■ D: Diameter of the circle or ■ R: Radius of the circle ▶ To switch between diameter and radius, tap **D** or **R**
	**Arc** The feature is defined by the following values: ■ X: Position of the vertex on the X axis ■ Y: Position of the vertex on the Y axis ■ θ_S: Starting angle between the X axis and the first side ■ θ_E: End angle between the X axis and the second side enclosing the opening angle ■ D: Diameter of the arc or ■ R: Radius of the arc ▶ To switch between diameter and radius, tap **D** or **R**

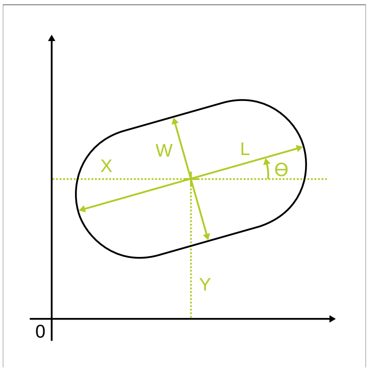
Display	Geometry parameters



Ellipse

The feature is defined by the following values:

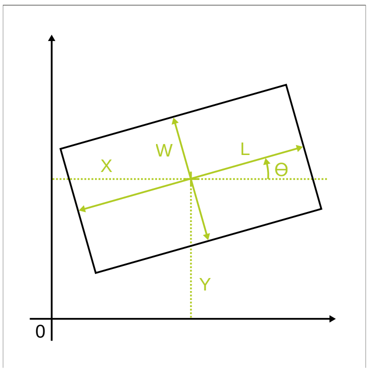
- X: Position of the center point on the X axis
- Y: Position of the center point on the Y axis
- W: Length of the minor axis
- L: Length of the reference axis
- θ: Angle between X axis and reference axis



Slot

The feature is defined by the following values:

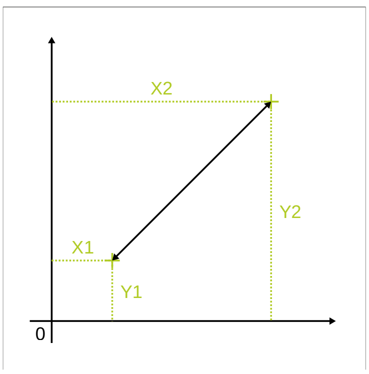
- X: Position of the center point on the X axis
- Y: Position of the center point on the Y axis
- W: Width of the slot
- L: Length of the slot (reference axis)
- θ: Angle between X axis and reference axis



Rectangle

The feature is defined by the following values:

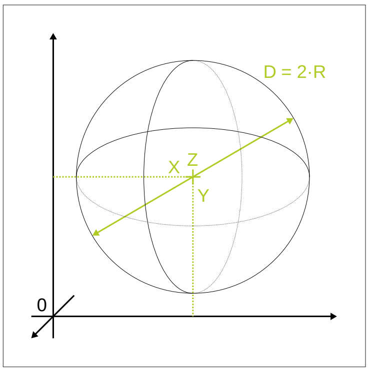
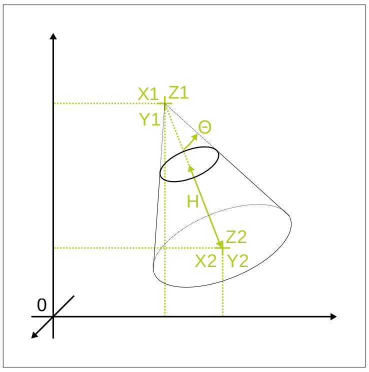
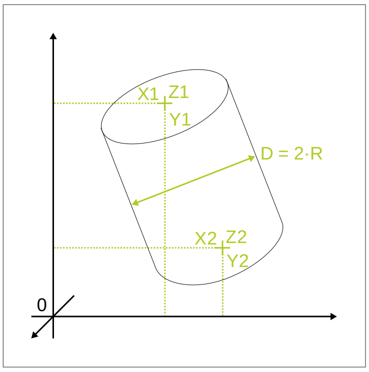
- X: Position of the center point on the X axis
- Y: Position of the center point on the Y axis
- W: Width of the rectangle
- L: Length of the rectangle (reference axis)
- θ: Angle between X axis and reference axis



Distance

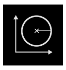
The feature is defined by the following values:

- X1: Position of the first point on the X axis
- Y1: Position of the first point on the Y axis
- X2: Position of the second point on the X axis
- Y2: Position of the second point on the Y axis

Display	Geometry parameters
	**Sphere** The feature is defined by the following values: ■ X: Position of the center point on the X axis ■ Y: Position of the center point on the Y axis ■ Z: Position of the center point on the Z axis ■ D: Diameter of the sphere or ■ R: Radius of the sphere ▶ To switch between diameter and radius, tap **D** or **R**
	**Cone** The feature is defined by the following values: ■ X1: Position of the apex on the X axis ■ Y1: Position of the apex on the Y axis ■ Z1: Position of the apex on the Z axis ■ X2: Position of the base center point on the X axis ■ Y2: Position of the base center point on the Y axis ■ Z2: Position of the base center point on the Z axis ■ **θ**: apex angle of the cone ■ H: Height of the cone
	**Cylinder** The feature is defined by the following values: ■ X1: Position of the top surface center point on the X axis ■ Y1: Position of the top surface center point on the Y axis ■ Z1: Position of the top surface center point on the Z axis ■ X2: Position of the base center point on the X axis ■ Y2: Position of the base center point on the Y axis ■ Z2: Position of the base center point on the Z axis ■ D: Diameter of the cylinder or ■ R: Radius of the cylinder ▶ To switch between diameter and radius, tap **D** or **R**

10.6.2 Defining a feature

- Tap **Measure** in the main menu



- Select **Define** in the function palette
- Select the desired geometry in the geometry palette

Further information: "Overview of definable geometries", Page 365

> A new feature is added to the feature list and displayed in the workspace

- Enter a name for the feature
- Confirm entry with **RET**
- Enter the geometry parameters of the feature
- Confirm entries with **RET**

- Tap **Finish** in the new feature

> The defined feature is displayed in the feature list

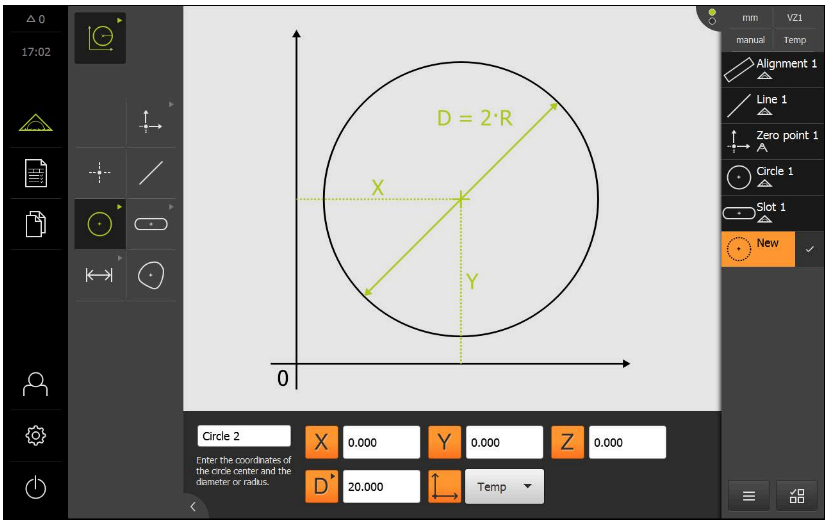


Figure 95: Defined features in the features view of the workspace and feature list of the Inspector

10.7 Working with coordinate systems

While performing a measuring task, you will probably work with different coordinate systems. The currently selected coordinate system is displayed in the **quick access menu**. This coordinate system will be assigned to new features. You can switch between coordinate systems in the quick access menu.

The following coordinate systems are available:

- **World**: Coordinate system of the measuring plate
- **Temp**: Temporary coordinate system
- User-defined coordinate systems

10.7.1 World coordinate system

The **World** coordinate system is the coordinate system of the measuring plate (product default).

10.7.2 Temp Temporary coordinate system

If you determine a new zero point or acquire a reference feature, the device changes to the temporary coordinate system named **Temp**. Any further changes to the coordinate system will apply to the **Temp** coordinate system. Features you assigned the **Temp** coordinate system to will be recalculated with each change made to the coordinate system.

10.7.3 User-defined coordinate systems

If you create a user-defined coordinate system, the product changes to this new coordinate system. The name of this coordinate system will appear in the quick access menu. Features you assigned the **Temp** coordinate system to will be assigned the new coordinate system.

User-defined coordinate systems can be created manually or automatically.

Creating a coordinate system manually:

- ▶ Acquire a reference element, e.g. **Zero point** or **Alignment**
- ▶ Rename the coordinate system

Creating a coordinate system automatically:

- ▶ Enable the **Create coordinate system automatically** setting
- ▶ Acquire a reference feature or determine a new zero point manually

For a detailed description of these steps, please refer to the following sections in this chapter.

> A user-defined coordinate system can be saved as a file to re-use it for later measurements or in measuring programs.
>
> **Further information:** "Saving a coordinate system", Page 378

10.7.4 Adapting a coordinate system

There are several ways to adapt a coordinate system:

Parameter	Procedure
Zero point	Acquire a feature with the **Zero point** geometry: ■ Measuring the zero point ■ Constructing the zero point ■ Defining the zero point Determine the zero point manually: ■ Setting the current position as zero point (set axis to zero) ■ Overwriting the position value ■ Setting the feature's center point as the zero point
Alignment	Acquire a feature with the **Alignment** geometry: ■ Measuring the alignment ■ Constructing an alignment ■ Defining an alignment Determine the alignment manually: ■ Adopting the alignment of a feature
Rotation for 3-D geometries	Acquire a feature with the **Rotation** geometry: ■ Define rotation
Reference plane for 3-D geometries	Acquire a feature with the **Reference plane**, **Reference cylinder** or **Reference cone** geometry: ■ Measuring a reference plane ■ Measuring a reference cylinder ■ Measuring a reference cone

Further information: "Geometries for determining the coordinate system", Page 304

A detailed description of the recommended procedure for determining the workpiece coordinate system can be found in the "Quick Start" chapter.

Further information: "Quick Start", Page 241

If you adapt the coordinate system, all features that were assigned the **Temp** coordinate system will be re-calculated. Features that were assigned the **World** coordinate system or a user-defined coordinate system will keep their reference.

Measuring the zero point

- Tap **Measure** in the main menu
- Select **Manual measuring** in the function palette
- Select **Zero point** in the geometry palette
- Acquire a measuring point at the desired position
- > A new feature is displayed in the feature list
- Tap **Finish** in the new feature
- > The coordinate system is adjusted

Constructing the zero point

- Tap **Measure** in the main menu
- Select **Manual measuring** in the function palette
- Select **Zero point** in the geometry palette
- Select the parent features in the feature list
- > A new feature is displayed in the feature list
- Tap **Finish** in the new feature
- > The coordinate system is adjusted

Further information: "Overview of construction types", Page 331

Defining the zero point

- Tap **Measure** in the main menu
- Select **Define** in the function palette
- Select **Zero point** in the geometry palette
- > A new feature is displayed in the feature list
- Enter the coordinates of the new datum
- Enter a name for the new coordinate system, if required
- Confirm each entry with **RET**
- Tap **Finish** in the new feature
- > The coordinate system is adjusted

Further information: "Overview of definable geometries", Page 365

Setting the current position as zero point

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette
- If you want to create a user-defined coordinate system, activate the following setting in the quick access menu: **Create coordinate system automatically**
- If needed, tap **Position preview** in the Inspector
- Move to the desired position

- In the workspace, press and hold the **axis key** of the desired axis
- \> The position value of the axis is set to zero
- \> The coordinate system is adjusted

Overwriting the position value

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette
- If you want to create a user-defined coordinate system, activate the following setting in the quick access menu: **Create coordinate system automatically**
- If needed, tap **Position preview** in the Inspector
- Move to the desired position

- In the working space, tap the **axis key** or the position value
- Enter the desired position value
- Confirm your input with **RET**
- \> The coordinate system is adjusted

Setting the feature's center point as the zero point

You can use any feature to set the zero point. For this purpose, set the position value of one or more axes at the feature's center point to zero.

- Measuring a feature
- \> The measurement result preview appears

or

- Drag the feature from the feature list into the workspace
- \> The **Details** dialog box appears with the **Overview** tab selected
- \> The position values of the axes reference the feature's center point

- To set an axis position to zero, tap **Zero** next to the axis position
- \> The position value of the axis is set to zero
- \> The coordinate system is adjusted
- Repeat for other axis positions, if required

Measuring the alignment

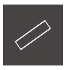
At least two measuring points are required to measure an alignment.

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette

- If required, select the **XY** projection plane in the quick access menu

Further information: "Selecting the projection plane", Page 128



- Select **Alignment** in the geometry palette
- Acquire multiple measuring points on the reference edge
- > A new feature is displayed in the feature list

- Tap **Finish** in the new feature
- > The coordinate system is adjusted

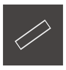
Constructing an alignment

- Tap **Measure** in the main menu

- Select **Manual measuring** in the function palette

- If required, select the **XY** projection plane in the quick access menu

Further information: "Selecting the projection plane", Page 128



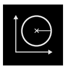
- Select **Alignment** in the geometry palette
- Select the parent features in the feature list
- > A new feature is displayed in the feature list

- Tap **Finish** in the new feature
- > The coordinate system is adjusted

Further information: "Overview of construction types", Page 331

Defining an alignment

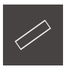
- Tap **Measure** in the main menu



- Select **Define** in the function palette

- If required, select the **XY** projection plane in the quick access menu

Further information: "Selecting the projection plane", Page 128



- Select **Alignment** in the geometry palette
- > A new feature is displayed in the feature list
- Enter the parameters of the alignment
- Enter a name for the new coordinate system, if required
- Confirm each entry with **RET**

- Tap **Finish** in the new feature
- > The coordinate system is adjusted

Further information: "Overview of definable geometries", Page 365

Adopting the alignment of a feature

You can adjust the alignment of the coordinate system manually by defining a feature's principal axis as X axis.

- If required, select the **XY** projection plane in the quick access menu

Further information: "Selecting the projection plane", Page 128

- Measuring a feature
- > The measurement result preview appears

- To adjust the alignment to the principal axis of a **Line**, **Slot** or **Rectangle** feature, tap **Align**

- To adjust the alignment to the principal axis of a **Cone** feature, tap **Align**

- To adjust the alignment to the principal axis of a **Cylinder** feature, tap **Align**
- > The principal axis of the feature is defined as new X axis.
- > The coordinate system is adjusted

Define rotation

- ▶ Tap **Measure** in the main menu
- ▶ Select **Define** in the function palette
- ▶ Select **Rotation** in the geometry palette
- > A new feature is displayed in the feature list
- ▶ Enter the parameters of the rotation
- ▶ Enter a name for the new coordinate system, if required
- ▶ Confirm each entry with **RET**
- ▶ Tap **Finish** in the new feature
- > The coordinate system is adjusted

Measuring a reference plane

A minimum of three measuring points is required to measure a reference plane.

- ▶ Tap **Measure** in the main menu
- ▶ Select **Manual measuring** in the function palette
- ▶ Select **Reference plane** in the geometry palette
- ▶ Acquire multiple measuring points on the reference plane
- > A new feature is displayed in the feature list
- ▶ Tap **Finish** in the new feature
- > The coordinate system is adjusted

Measuring a reference cylinder

At least six measuring points are required to measure a reference cylinder. Measure a circle near the base surface and another circle near the top surface of the reference cylinder. Acquire a minimum of three measuring points per circle.

To conclude the measurement, the product aligns the reference plane perpendicularly to the principal axis of the reference cylinder.

- ▶ Tap **Measure** in the main menu
- ▶ Select **Manual measuring** in the function palette
- ▶ Select **Reference cylinder** in the geometry palette
- ▶ Point measurement
- > A new feature is displayed in the feature list
- ▶ Tap **Finish** in the new feature
- > The coordinate system is adjusted

Measuring a reference cone

At least six measuring points are required to measure a reference cone. Measure a circle near the base surface and another circle near the tip of the reference cone. Acquire a minimum of three measuring points per circle.

Upon conclusion of the measurement, the product aligns the reference plane perpendicularly to the principal axis of the reference cone.

- ▶ Tap **Measure** in the main menu

- ▶ Select **Manual measuring** in the function palette

- ▶ Select **Reference cone** in the geometry palette
- ▶ Point measurement
- > A new feature is displayed in the feature list

- ▶ Tap **Finish** in the new feature
- > The coordinate system is adjusted

10.7.5 Assigning names to coordinate systems

Once you have named a user-defined coordinate system, you can assign the coordinate system to the desired features.

Assigning names automatically

- ▶ Activate the following setting in the quick access menu: **Create coordinate system automatically**
- > For each change, the product creates a new coordinate system named **COSx** (**x** = sequential number)

Further information: "Creating a coordinate system automatically", Page 126

Renaming a coordinate system

When you acquire a reference feature, you can rename the coordinate system in the **Details** dialog of this reference feature.

- ▶ Drag the reference feature from the feature list into the workspace

- ▶ Tap the **Coordinate system** input field
- ▶ Enter a new name for the coordinate system
- ▶ Confirm your input with **RET**
- > The new coordinate system is displayed with its new name in the quick access menu

> **i** If you determine the zero point manually, you cannot rename the coordinate system later on.

> **i** A user-defined coordinate system can be saved as a file to re-use it for later measurements or in measuring programs.
> **Further information:** "Saving a coordinate system", Page 378

10.7.6 Saving a coordinate system

You can save a user-defined coordinate system as a 5RF file and re-use it later.

- In the quick access menu, select the user-defined coordinate system
- Tap **Auxiliary functions** in the Inspector
- Tap **Save as**
- In the dialog, select the storage location, e.g. **Internal**/**Programs**
- Tap the input field
- Enter the file name
- Confirm your input with **RET**
- Tap **Save as**
- > The coordinate system is saved under the selected file name

> The file name is not linked to the name of the coordinate system. The name of the coordinate system is kept when you save the file.

10.7.7 Opening a coordinate system

Saved coordinate systems can be opened via the Inspector's auxiliary functions.

- Tap **Auxiliary functions** in the Inspector
- Tap **Open**
- In the dialog, select the storage location, e.g. **Internal**/**Programs**
- Tap the desired file
- Confirm entry with **Select**
- > The new coordinate system is displayed in the quick access menu

10.7.8 Assigning a coordinate system to features

- Drag the feature from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- Select the desired coordinate system from the **Coordinate system** drop-down list
- > The new coordinate system now applies
- > The displayed position values reference the selected coordinate system
- Tap **Close** to close the dialog

11

Measurement evaluation

11.1 Overview

This chapter describes how you can evaluate measurements and specify tolerances.

Measurement evaluation and tolerancing are carried out based on features that have been measured or constructed in the “Quick Start” chapter.

Further information: "Quick Start", Page 241

> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

11.2 Measurement evaluation

During a measurement, the product determines features from the captured measuring points. Depending on the number of measuring points captured, a fitting algorithm is used to calculate the appropriate substitute feature and display it as a feature in the feature list. The Gaussian fitting algorithm is used by default.

The following functions are available:

- Changing the fitting algorithm
- Converting the geometry type

Activation

- Tap **Measure** in the main menu
- > The user interface for measuring, constructing and defining appears
- Drag the feature from the feature list into the workspace
- > The **Details** dialog appears with the **Overview** tab selected

Short description

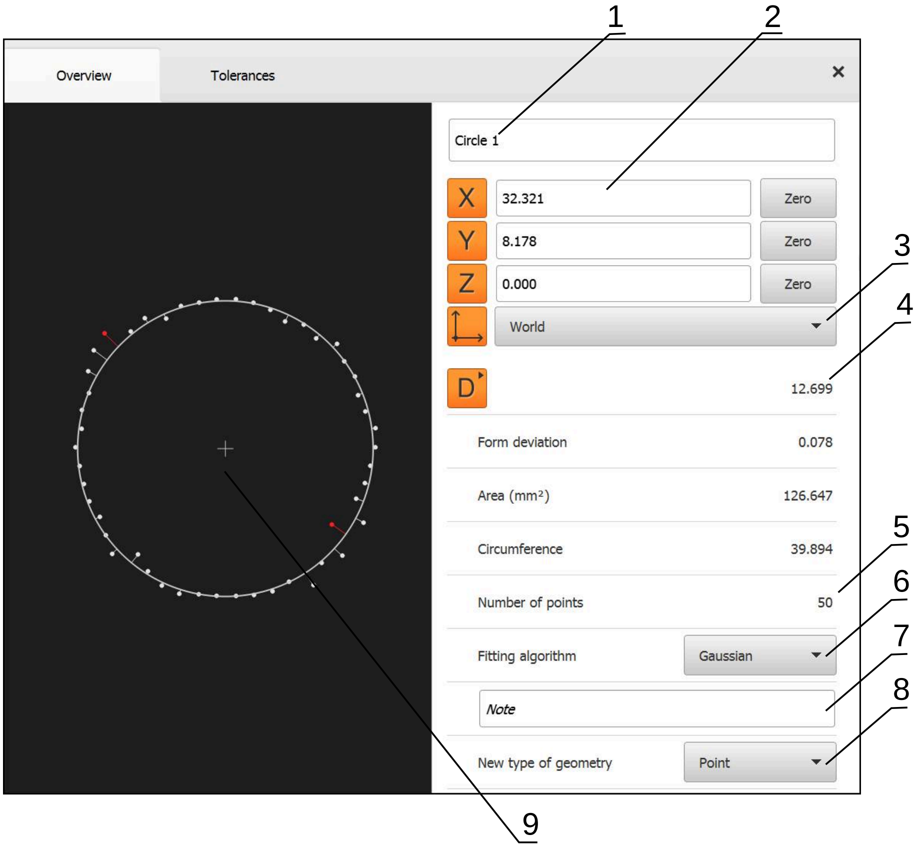


Figure 96: **Overview** tab in the **Details** dialog

1 Name of the feature
2 Axis positions of the center point
3 Coordinate system referenced by the coordinate values of the feature
4 Feature parameter, depending on the geometry type: For the circle geometry type, it is possible to toggle between radius and diameter
5 Number of measuring points used for calculating the feature
6 Fitting algorithm used for calculating the feature; depends on the geometry and the number of measuring points
7 2-D plane into which the feature is projected; there is not projection for the "3D" display
8 **Note** text field; if annotations are active, its contents will be shown in the features view
9 List of geometry types to which the feature can be converted
10 View of the measuring points and the shape

Depiction of the measuring points and the form

Figure 97: Measuring points and form

- The measuring points with the greatest deviations within the fitting algorithm are displayed in red
- The measuring points that are not used for the fitting algorithm according to the measuring point filter settings are displayed in gray
- The measuring points used for the fitting algorithm are displayed in white
- The distances between the measuring points for the calculated form are depicted as lines (symbolic representation)

11.2.1 Fitting algorithm

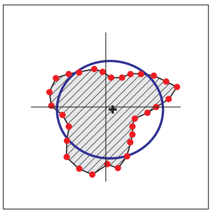
Short description

If the number of points captured during the measurement of a feature exceeds the mathematical minimum number of points, there are more points than necessary for determining the geometry. The geometry is thus overdetermined. Therefore, fitting algorithms are used to calculate the appropriate substitute feature.

The following fitting algorithms are available:

- Gaussian
- Minimum zone
- Max. inscribed
- Min. circumscribed

The fitting algorithms are described below, using a circle as an example:

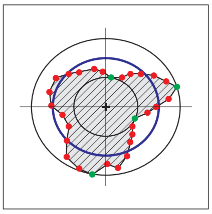


Gaussian

Fitting algorithm that calculates a substitute feature that is optimally centered between all measuring points.

The statistical mean of all captured measuring points is used for the calculation. All measuring points are weighted equally.

Gaussian is the default setting.

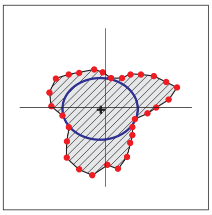


Minimum zone

Fitting algorithm that calculates a geometry from two reference circles. One circle lies on the two outermost measuring points. The other circle lies on the two innermost measuring points. The two circles have the same center.

The substitute feature is located halfway between the two circles.

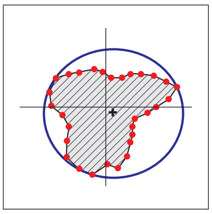
The algorithm is suitable for measuring form error.



Max. inscribed

Fitting algorithm that calculates a substitute feature that is located within all measuring points and, at the same time, is as large as possible.

The algorithm is suitable e.g. for measuring holes when checking mating sizes.



Min. circumscribed

Fitting algorithm that calculates a substitute feature that is located outside the measuring points and, at the same time, is as small as possible.

The algorithm is suitable e.g. for measuring pins or shafts when checking mating sizes.

> **i** The center of the minimum circumscribed circle does not coincide with the center of the maximum inscribed circle.

Overview

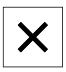
The following overview shows the possible fitting algorithms for the features.

Geometry	Fitting algorithm			
	Gaussian	**Minimum**	**Max. inscribed**	**Min. circum-scribed**
Zero point	X	-	-	-
Alignment	X	X	-	-
Reference plane	X	-	-	-
Point	X	-	-	-
Even	X	X	-	-
Circle	X	X	X	X
Arc	X	X	-	-
Ellipse	X	-	-	-
Slot	X	-	-	-
Rectangle	X	-	-	-
Distance	X	-	-	-
Angle	X	-	-	-
Blob	X	-	-	-
Plane	X	X	-	-
Sphere	X	-	-	-
Cone	X	-	-	-
Cylinder	X	-	-	-

11.2.2 Evaluating a feature

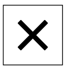
Renaming a feature

- ▶ Drag the feature from the feature list into the workspace
- \> The **Details** dialog box appears with the **Overview** tab selected
- ▶ Tap the input field containing the current name
- ▶ Enter a new name for the feature
- ▶ Confirm entry with **RET**
- \> The new name is displayed in the feature list
- ▶ Tap **Close** to close the dialog



Selecting the coordinate system

- Drag the feature from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- Select the desired coordinate system from the **Coordinate system** drop-down list
- > The new coordinate system now applies
- > The displayed position values reference the selected coordinate system



- Tap **Close** to close the dialog

Further information: "Working with coordinate systems", Page 370

Selecting the Fitting algorithm

You can adjust the fitting algorithm depending on the measured feature. The Gaussian fitting algorithm is used by default.

Further information: "Fitting algorithm", Page 382

- Drag a feature, e.g.a **Circle**, from the features list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- > The fitting algorithm used is shown in the **Fitting algorithm** drop-down list
- In the **Fitting algorithm** drop-down list, select the desired fitting algorithm (e.g., **Minimum circumscribed**)
- > The feature is displayed according to the selected fitting algorithm

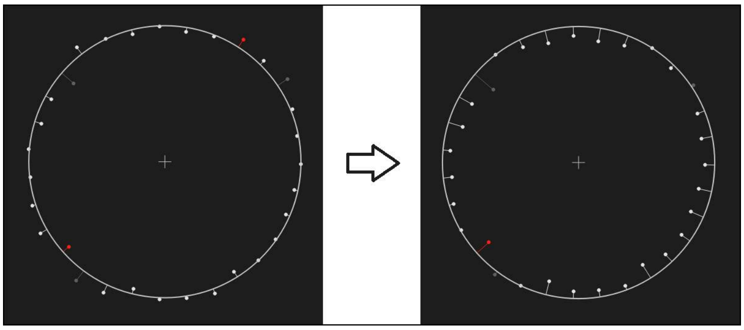
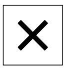


Figure 98: **Circle** feature with new fitting algorithm



- Tap **Close** to close the dialog

Converting a feature

The feature can be converted to a different type of geometry. The list of possible geometry types is provided as a drop-down list in the **Details** dialog.

- ▶ Drag a feature (e.g., a **Slot**) from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected
- > The geometry type of the feature is displayed
- ▶ In the **New type of geometry** drop-down list, select the type of geometry, for example **Point**

> The **2-D profile** geometry type is currently not yet supported.

- > The feature is displayed in the new form

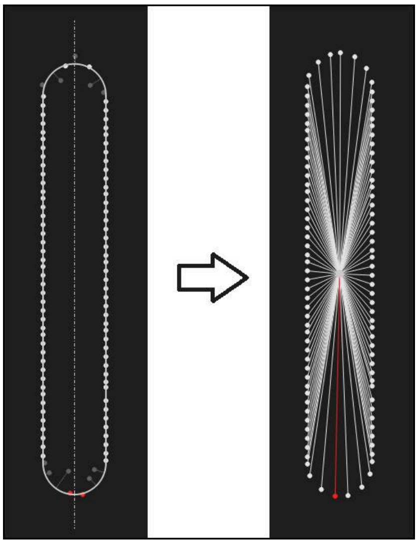
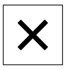


Figure 99: Type of geometry changed from **Slot** to **Point**



- ▶ Tap **Close** to close the dialog

11.3 Defining tolerances

This section describes which tolerances are available on the unit and how tolerances can be configured and activated. The activation and configuration of tolerances will be performed using the measured and constructed features in the "Quick Start" chapter as examples.

Activation

- ▶ Tap **Measure** in the main menu
- ▶ Drag the feature from the feature list into the workspace
- > The **Details** dialog appears with the **Overview** tab selected
- ▶ Tap the **Tolerances** tab
- > The tab for tolerancing the selected feature is displayed

Short description

Figure 100: **Details** dialog with **Tolerances** tab

1 Display of general tolerance
2 List of tolerances, depending on feature
3 Status of the tolerance: active and within the tolerance or active and outside the tolerance

On the **Tolerances** tab, you can define the geometrical tolerancing of a measured or constructed feature. The tolerances are grouped.

Depending on the feature, you can define the following tolerances:

- Size tolerances (e.g., diameter, width, length, and angle of the reference axis)
- Form tolerances (e.g., roundness)
- Location tolerances (e.g., position, concentricity)
- Directional tolerances (e.g., angularity, parallelism, perpendicularity)
- Runout tolerances

The tolerances can be activated or deactivated for each feature. To define tolerances for a feature, tolerance values can be entered manually, or standard values can be taken over from general tolerances (e.g., the ISO 2768 standard).

i	Tolerances cannot be applied to reference features, such as zero point, alignment, and reference plane.

Display of toleranced features

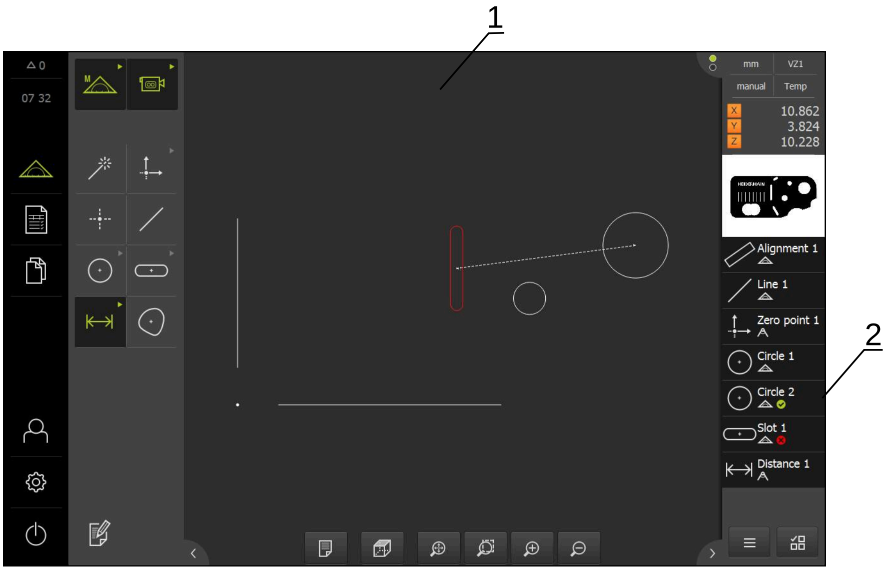


Figure 101: Toleranced features in the features view of the workspace and feature list of the Inspector

1 Feature (red) with one or more tolerance values exceeded
2 Feature list with toleranced features, indicated by the colored symbol

The features preview in the workspace displays a feature in red if at least one of its tolerance limits has been exceeded. The features must not be selected, because selected elements are displayed in green independently of the tolerance check.

The results of the tolerance check are indicated by symbols in the feature list and in the **Tolerances** tab.

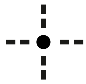
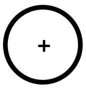
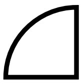
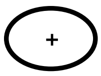
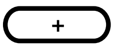
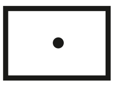
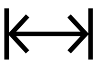
Symbol	Meaning
	The activated tolerances of the feature are met.
	One or more activated tolerances of the feature are exceeded.

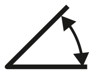
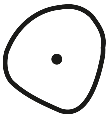
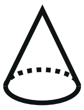
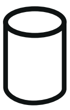
The symbol does not appear until all of the required fields have been populated and the tolerance check was able to be conducted.

Example: During the configuration of the concentricity tolerance, the reference feature must be selected so that the tolerance check can be conducted.

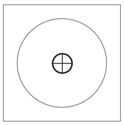
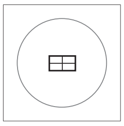
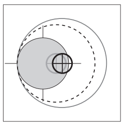
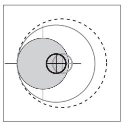
11.3.1 Overview of tolerances

The following overview shows the tolerances that can be defined for a feature.

Feature	Size	Form	Location	Direction	Runout
Point		-	⌖	-	-
Line		⏤	⌖	∥ ⊥	-
Circle		○	⌖ ◎	-	↗
Arc		○	⌖ ◎	-	↗
Ellipse		-	⌖	-	-
Slot		-	⌖	-	-
Rectangle		-	⌖	-	-
Distance		-	-	-	-

Feature	Size	Form	Location	Direction	Runout
Angle		-	-	-	-
Blob		-	⌖	-	-
Plane	-	⏥	-	// ⊥	-
Sphere		○	⌖ ◎	-	-
Cone		-	-	-	-
Cylinder		⌭	-	-	-

Overview of position tolerance types

Symbol	Display	Tolerance type
		**Circular tolerance zone** A circular tolerance zone is set around the nominal dimension of the feature's position. The position of the center point defines the position of the feature. The center point of the feature must be within the tolerance zone.
		**Rectangular tolerance zone** A rectangular tolerance zone is set around the nominal dimension of the feature's position. The center point of the feature must be within the tolerance zone.
		**Maximum material requirement (MMR)** The maximum material requirement allows tolerance compensation between the position tolerance and the size tolerance. The maximum material requirement is applied to features of the circle and arc types. It defines a tolerance for the feature with respect to a geometrically ideal counterpart to check the joinability of the workpiece.
		**Least material requirement (LMR)** The least material requirement defines the requirements for the minimum material thicknesses of a feature. It defines a tolerance for the feature with respect to a geometrically ideal counterpart that must be fully enclosed by the feature.

11.3.2 Configuring general tolerances

General tolerances contain standard values that can be taken over for the tolerancing of measured features. The unit provides a selection of standard values for the ISO 2768 standard or for the decimal place tolerance, for example.

The following overview shows which general tolerances are available for a specific tolerance.

Overview of general tolerances

Tolerances	General tolerances

Size	■ ISO 2768
	■ Decimal places
	■ ISO 286 for the diameter and radius parameters of the following feature types:
	  ■ Circle
	  ■ Arc
	  ■ Sphere
	  ■ Cylinder

Form	ISO 2768
Location	None
Direction	ISO 2768
Runout	ISO 2768

Taking over the standard values for a feature requires the following steps:

- For any features: Selection of the desired general tolerance (default setting: ISO 2768 standard)
- For an individual feature: Activation of a tolerance (e.g., form tolerance) with the preselected general tolerance

If you activate a tolerance with standard values, then the standard values for this tolerance can be subsequently overwritten.

If you do not select a general tolerance, then tolerance values can only be entered manually.

> If general tolerances are changed for features overall, then these changes take effect for all existing and new elements. For activated tolerances, the new values are automatically taken over.
>
> Exception: If a tolerance value for a feature has been manually entered or changed, then the existing tolerance value is retained.

Selecting and modifying a general tolerance

- ▶ Drag any feature from the feature list into the workspace
- > The **Overview** tab is displayed
- ▶ Tap the **Tolerances** tab
- > The tab for tolerancing the selected feature is displayed
- ▶ Tap **General tolerances**

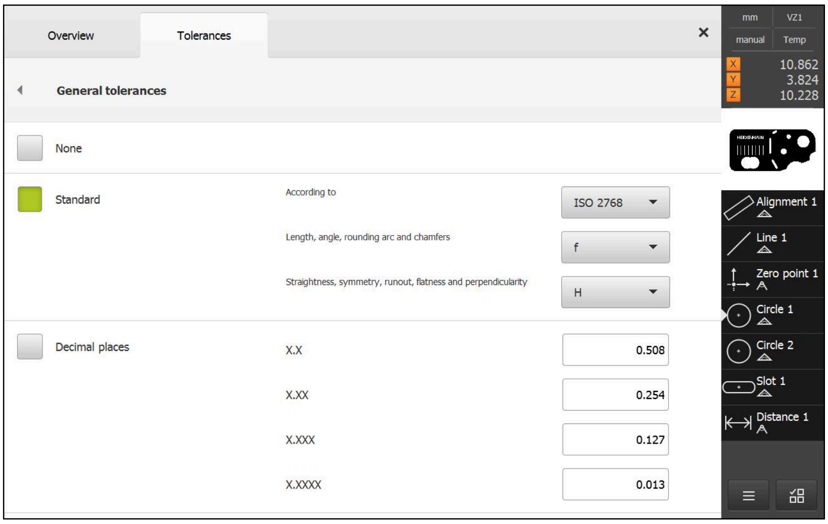


Figure 102: **General tolerances** menu in the **Details** dialog

Standard: General tolerance according to ISO 2768

The standard values of the ISO 2768 standard are taken over as the tolerance values. All of the tolerance classes of the standard are available for selection on the unit. The standard values cannot be changed for features overall.

- ▶ To select the general tolerances, tap the checkbox in front of **Standard**

- > The checkbox is now shown in green
- ▶ Select the desired standard from the **According to** drop-down list
- ▶ Select the desired tolerance class from the **Length, angle, rounding arc and chamfers** drop-down list
- ▶ Select the desired tolerance class from the **Straightness, symmetry, runout, flatness and perpendicularity** drop-down list
- ▶ Tap **General tolerances**
- > The selected general tolerance is displayed on the **Tolerances** tab
- > The general tolerance is preselected as soon as a tolerance is activated

> ℹ The ISO 2768 standard does not provide any standard values for location tolerances.

Decimal place tolerance

The tolerance value is determined by the number of decimal places. Depending on how many decimal places you select in the measurement evaluation, a corresponding standard value is applied.

Standard values of the unit:

Decimal places	Tolerance value (mm)
0.1	+/- 0.5080
0.01	+/- 0.2540
0.001	+/- 0.1270
0.0001	+/- 0.0127

The standard values of the unit can be modified for features overall.

- To perform tolerancing based on decimal places, tap on the checkbox in front of **Decimal places**

- > The checkbox is now shown in green
- Tap an input field
- Enter a value for the tolerance limit
- Confirm the entry with **RET**
- Repeat the last three steps for additional decimal places
- Tap **General tolerances**
- > The decimal place tolerance is shown on the **Tolerances** tab
- > The general tolerance is preselected as soon as a tolerance is activated.

> Decimal place tolerancing is only available for size tolerances. For all other tolerances, tolerance values can only be entered manually.

No general tolerance

Tolerance values can only be entered manually.

- To deactivate the general tolerances, tap on the checkbox in front of **None**

- > The checkbox is now shown in green
- Tap **General tolerances**
- > No general tolerance is displayed on the **Tolerances** tab
- > For the activation of a tolerance, a tolerance value must be entered manually

11.3.3 Setting size tolerances on a feature

You can define the size tolerances for the following geometry parameters:

Symbol	Meaning	Feature types
X	Position of the center point on the X axis	All feature types
Y	Position of the center point on the Y axis	All feature types
Z	Position of the center point on the Z axis	All feature types
W	Width	■ Ellipse ■ Slot ■ Rectangle
L	Length	■ Straight line ■ Ellipse ■ Slot ■ Rectangle ■ Distance
A	Surface area	■ Circle ■ Ellipse ■ Slot ■ Rectangle ■ Blob
C	Circumference	■ Circle ■ Ellipse ■ Slot ■ Rectangle ■ Blob
Θ	Angle between the principal axis of the feature and the X axis of the coordinate system	■ Straight line ■ Arc ■ Ellipse ■ Rectangle ■ Angle ■ Cone
Θ_S	Starting angle	■ Arc
Θ_E	End angle	■ Arc
D	Diameter	■ Circle ■ Arc ■ Sphere ■ Cylinder

Symbol	Meaning	Feature types
R	Radius	■ Circle ■ Arc ■ Sphere ■ Cylinder

> **i** The procedure for setting the size tolerances is the same for all features. The following description shows how to set the size tolerance for the axis position X of a circle.

> **i** For the Diameter (D) and Radius (R) parameters of the sphere, cone, circle, and circular arc feature types, the fit tolerance table of the ISO 286 standard can be selected as an alternative.

- ▶ Drag the feature from the feature list into the workspace
- > The **Overview** tab is displayed
- ▶ Tap the **Tolerances** tab
- > The tab for tolerancing the selected feature is displayed

X

- ▶ Tap the **X** size tolerance
- > An overview of the selected size tolerance appears

- ▶ Activate tolerancing of the measured value with the **ON/OFF** sliding switch
- > The selection and input fields become active

Activating a tolerance (ISO 2768 standard)

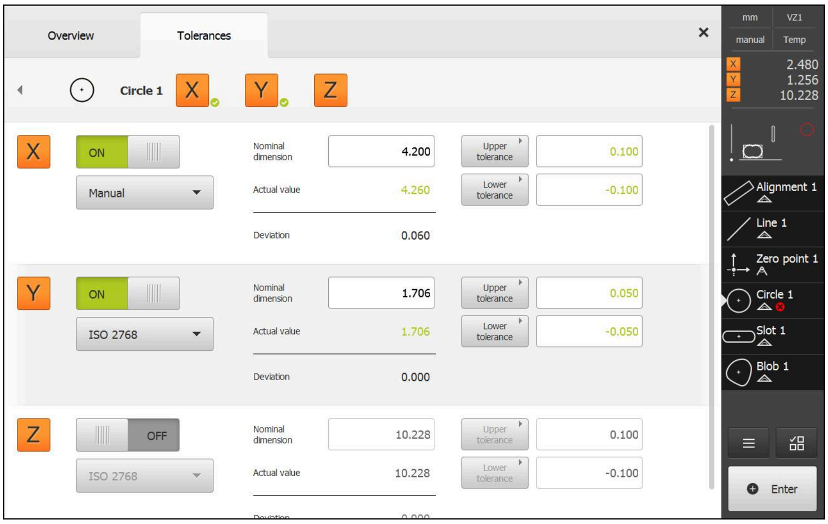
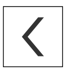


Figure 103: **Size tolerances** overview with activated **ISO 2768** tolerance for **X**

> The nominal and actual dimensions are displayed
▶ Tap the **Nominal dimension** input field to enter the nominal dimension
▶ Enter the desired value
▶ Confirm entry with **RET**
> The upper and lower tolerance or the upper and lower limit are displayed

> **i** The tolerance limits are entered automatically based on the nominal dimension and the selected general tolerance.

▶ To switch between the **Upper tolerance** and **Upper limit** input fields, tap **Upper tolerance** or **Upper limit**
> If the actual value is within the tolerance, then the actual value and the tolerance values are shown in green.
> If the actual value is outside of the tolerance, then the actual value and the exceeded tolerance values are shown in red



▶ Tap the **tab**
> The **Tolerances** tab is displayed
> The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

Activating a tolerance (Decimal places)

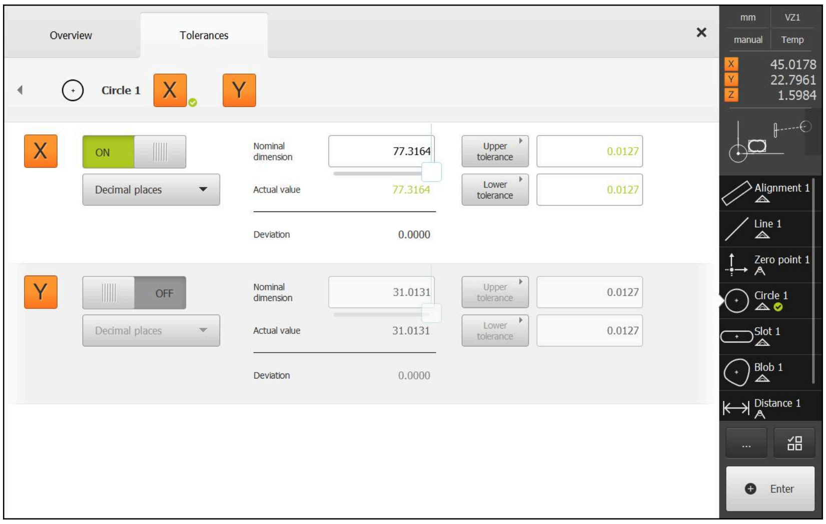


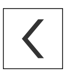
Figure 104: **Size tolerances** overview with activated **Decimal places** tolerance for **X**

- > The nominal and actual dimensions are displayed
- ▶ Tap the **Nominal dimension** input field to enter the nominal dimension
- ▶ Enter the desired value
- ▶ Confirm entry with **RET**

- ▶ Use the slider below **Nominal dimension** to set the tolerance limit (number of decimal places)
- > The upper and lower tolerance limit values or the upper limit and lower limit are displayed

> The tolerance limits are entered automatically based on the nominal dimension and the selected general tolerance.

- ▶ To switch between the **Upper tolerance** and **Upper limit** input fields, tap **Upper tolerance** or **Upper limit**
- > If the actual value is within the tolerance, then the actual value and the tolerance limits are shown in green
- > If the actual value is outside of the tolerance, then the actual value and the exceeded tolerance limit are shown in red



- ▶ Tap **Back**
- > The **Tolerances** tab is displayed
- > The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

Setting the tolerance limits manually

Tolerance values can be entered manually for all tolerances. If a general tolerance is selected, then the tolerance values can be subsequently overwritten. A manually entered value applies only to the opened feature.

- To switch between the **Upper tolerance** and **Upper limit** input fields, tap **Upper tolerance** or **Upper limit**
- Tap the **Upper tolerance** or **Upper limit** input field
- Enter the desired value
- Confirm entry with **RET**
- > The adjusted tolerance value is applied
- Tap the **Lower tolerance** or **Lower limit** input field
- Enter the desired value
- Confirm entry with **RET**
- > The adjusted tolerance value is applied
- > If the actual value is within the tolerance, then the actual value and the tolerance values are show in green
- > If the actual value is outside of the tolerance, then the actual value and the exceeded tolerance value are shown in red
- > If a general tolerance has been preselected, then the selection in the drop-down list switches to **Manual**
- Tap **Back**
- > The **Tolerances** tab is displayed
- > The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

> If general tolerances are changed for features overall, then these changes do not take effect for manually entered tolerance values. Manually entered tolerance values are retained.

> If the fit tolerance table of the ISO 286 standard is selected, then changes made to general tolerances for features overall do not have an effect on this tolerance value. The tolerance value from the ISO 286 standard is retained.

11.3.4 Setting form tolerances on a feature

You can specify form tolerances for the following geometry parameters:

Symbol	Meaning	Feature types
⏤	Straightness	■ Straight line
○	Roundness	■ Circle ■ Arc ■ Sphere
⏥	Flatness	■ Plane
⌭	Cylindricity	■ Cylinder

> **i** The procedure for setting the form tolerances is the same for all features. The following description shows how to perform roundness tolerancing for a circle.

- ▶ Drag the feature from the feature list into the workspace
- > The **Overview** tab is displayed
- ▶ Tap the **Tolerances** tab
- > The tab for tolerancing the selected feature is displayed

○

- ▶ Tap **Roundness**
- > An overview of the selected form tolerance appears

- ▶ Activate tolerancing of the measured value with the **ON/OFF** sliding switch
- > The selection and input fields become active

Activating a tolerance (ISO 2768 standard)

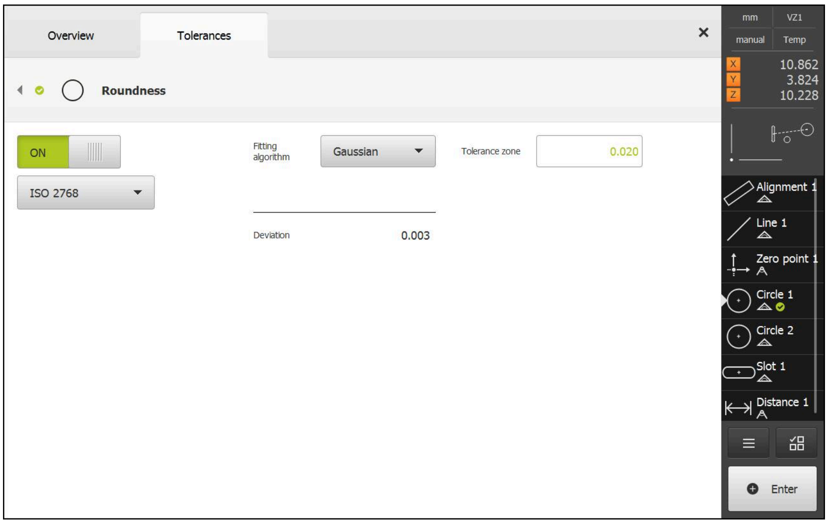


Figure 105: **Form tolerances** overview with activated **Roundness** tolerance as per **ISO 2768**

> The fitting algorithm is activated

> The tolerance zone of the selected general tolerance is displayed

> The tolerance zone is taken over from the provided table of the selected general tolerance.

> The deviation from the ideal form is displayed

▶ Select the desired fitting algorithm

> The deviation is now updated

> The value of the tolerance zone is shown in green if the deviation is within the tolerance zone

> The value of the tolerance zone is shown in red if the deviation is outside the tolerance zone

▶ Tap **Back**

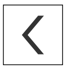
> The **Tolerances** tab is displayed

> The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

Setting the tolerance zone manually

The tolerance zone can be entered manually. If a general tolerance is selected, then the value of the tolerance zone can be subsequently overwritten. The manually entered value applies only to the opened feature.

- ▶ Tap the **Tolerance zone** input field
- ▶ Enter the desired value
- ▶ Confirm entry with **RET**
- > The adjusted tolerance value is applied
- > The value of the tolerance zone is shown in green if the deviation is within the tolerance zone
- > The value of the tolerance zone is shown in red if the deviation is outside the tolerance zone
- > If a general tolerance has been selected, then the selection in the drop-down list switches to **Manual**



- ▶ Tap **Back**
- > The **Tolerances** tab is displayed
- > The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

11.3.5 Setting location tolerances for a feature

You can define position tolerances for the following geometry parameters:

Symbol	Meaning	Feature types
⌖	Position	■ Point ■ Line ■ Circle ■ Arc ■ Ellipse ■ Slot ■ Rectangle ■ Blob ■ Sphere
◎	Concentricity	■ Point ■ Line ■ Circle ■ Arc ■ Ellipse ■ Slot ■ Rectangle ■ Blob ■ Sphere

> **i** The procedure for setting location tolerances is identical for all features. The following describes the procedure for setting a position tolerance for a circle with a circular tolerance zone.

▶ Drag the feature from the feature list into the workspace

> The **Overview** tab is displayed

▶ Tap the **Tolerances** tab

> The tab for tolerancing the selected feature is displayed

⌖

▶ Tap **Position**

> An overview of the selected position tolerance appears

> The selection of position tolerance types is now displayed
Further information: "Overview of tolerances", Page 388

▶ Activate tolerancing of the measured value with the **ON/OFF** sliding switch

> The selection and input fields become active

Setting the tolerance zone manually

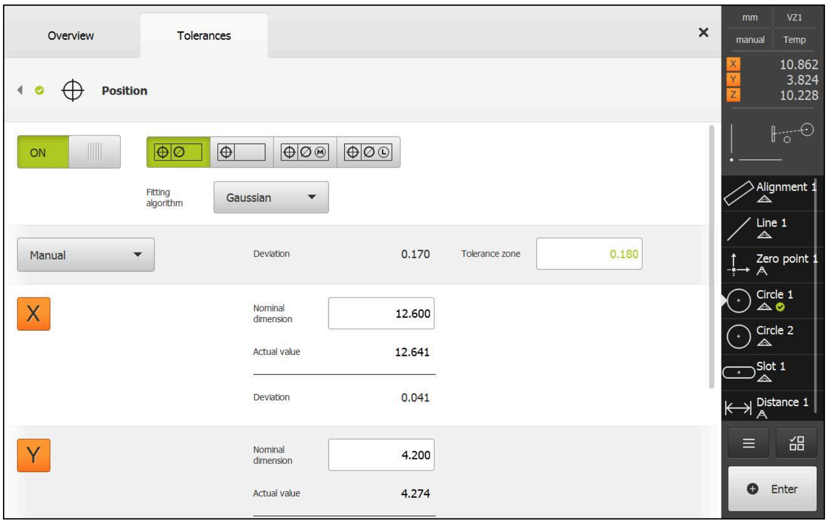
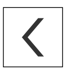


Figure 106: **Location tolerances** overview with activated **Position** tolerance

- ▶ Select the fitting algorithm for tolerancing from the **Fitting algorithm** drop-down list

- ▶ Tap **Circular tolerance zone**
- > The tolerance zone is displayed
- > The nominal and actual dimensions are displayed
- ▶ To enter the nominal dimension for **X**, tap the **Nominal dimension** input field
- ▶ Enter the desired value
- ▶ Confirm entry with **RET**
- ▶ To enter the nominal dimension for **Y**, tap the **Nominal dimension** input field
- ▶ Enter the desired value
- ▶ Confirm entry with **RET**
- > The tolerance zone is updated according to the entered nominal values
- > The deviation is now updated
- > The value of the tolerance zone is shown in green if the deviation is within the tolerance zone
- > The value of the tolerance zone is shown in red if the deviation is outside the tolerance zone



- ▶ Tap **Back**
- > The **Tolerances** tab is displayed
- > The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

11.3.6 Setting runout and directional tolerances for a feature

You can define runout and directional tolerances for the following geometry parameters:

Directional tolerances

Symbol	Meaning	Feature types
//	Position	■ Straight line ■ Plane
⊥	Concentricity	■ Straight line ■ Plane

Runout tolerances

Symbol	Meaning	Feature types
↗	Radial runout	■ Circle ■ Arc

A reference feature is required for setting the runout and directional tolerances.

> **i** Runout tolerances and directional tolerances (parallelism and perpendicularity) are set in the same way. The following section describes how to perform perpendicularity tolerancing for a straight line. The alignment is used as the reference object for tolerancing.

- ▶ Drag the feature from the feature list into the workspace
- \> The **Overview** tab is displayed
- ▶ Tap the **Tolerances** tab
- \> The tab for tolerancing the selected feature is displayed

⊥

- ▶ Tap **Perpendicularity**
- \> An overview of the perpendicularity tolerance appears

- ▶ Activate tolerancing of the measured value with the **ON/OFF** sliding switch
- \> The selection and input fields become active

Activating a tolerance (ISO 2768 standard)

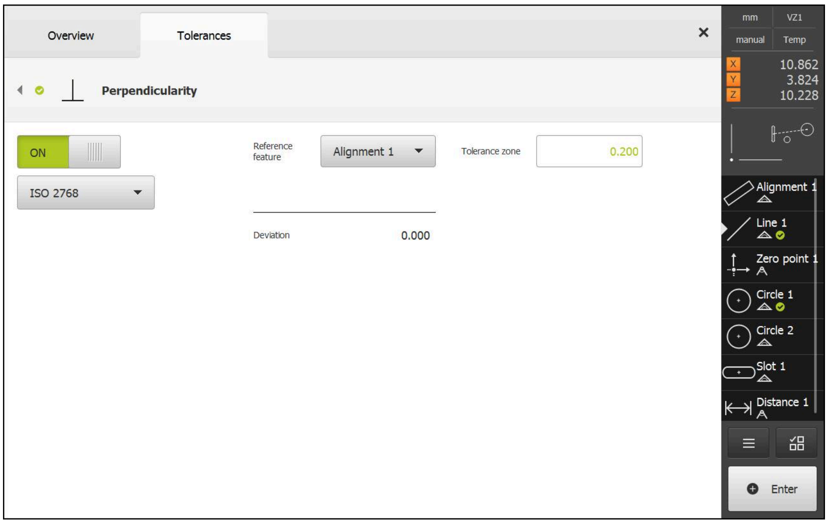


Figure 107: **Directional tolerances** overview with activated **Perpendicularity** tolerance as per **ISO 2768**

- In the **Reference feature** drop-down list, select the **Alignment** feature
- > The deviation is displayed
- > The tolerance zone is displayed

> The tolerance zone is taken over from the provided table of the selected general tolerance.

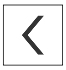
- > The value of the tolerance zone is shown in green if the deviation is within the tolerance zone
- > The value of the tolerance zone is shown in red if the deviation is outside the tolerance zone

- Tap **Back**
- > The **Tolerances** tab is displayed
- > The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

Setting the tolerance zone manually

The tolerance zone can be adjusted manually to differ from the general tolerance specified for the respective feature. The modified tolerance value applies only to the currently open feature.

- ▶ Tap the **Tolerance zone** input field to manually adjust the tolerance zone
- ▶ Enter the desired value
- ▶ Confirm entry with **RET**
- > The value of the tolerance zone is shown in green if the deviation is within the tolerance zone
- > The value of the tolerance zone is shown in red if the deviation is outside the tolerance zone
- > The display in the drop-down list switches to **Manual** after the adjustment



- ▶ Tap **Perpendicularity**
- > The **Back** tab is now displayed
- > The results of the tolerance check are shown on the **Tolerances** tab and, after the dialog has been closed, are displayed in the feature list

11.4 Adding annotations

You can add an annotation to every feature in the features view (e.g., measurement information or informational texts).

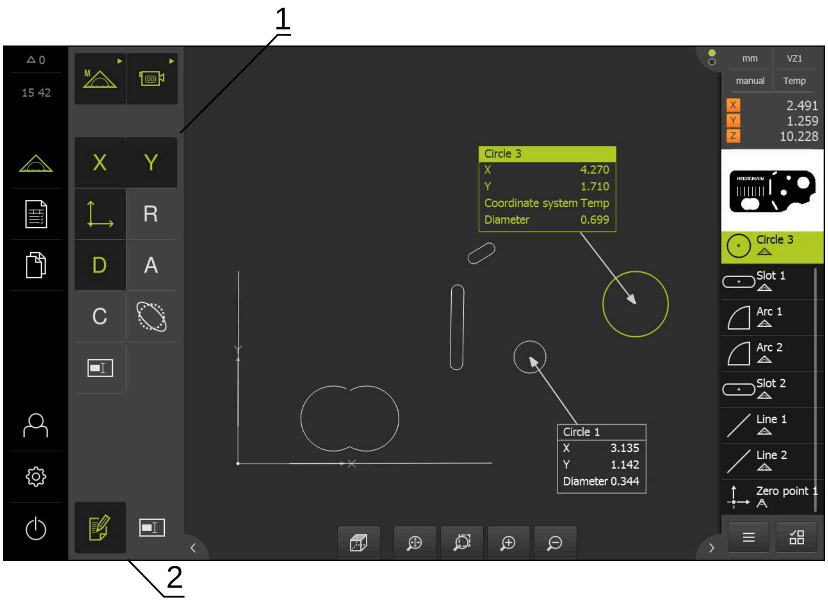


Figure 108: Operating elements for annotations and feature with annotations

1 Operating elements for adding annotations to one or more features
2 The **Edit annotations** operating element

11.4.1 Adding measurement information to features

- ▶ Tap **Measure** in the main menu
- ▶ Select **Manual measuring** in the function palette
- ▶ If applicable, tap **Features preview** in the Inspector
- > The features view is displayed in the workspace
- ▶ Tap **Edit annotations**
- ▶ Select one or more features in the feature list
- > The controls for adding annotations are now shown
  Further information: "Editing annotations", Page 120
- ▶ To add annotations to the selected features, tap the corresponding controls
- > The annotations are now displayed in the workspace
- ▶ To place an annotation in a different position, drag the it to the desired location in the workspace
- ▶ To leave the editing mode, tap **Edit annotations** again

> **i** If you select multiple features with different geometry types, then only those operating elements are displayed that are available for all objects. If an annotation has already been added to a portion of the selected features, then the associated operating element is depicted in dashed lines

11.4.2 Adding notes

In the features view, you can add notes to previously measured features. In doing so, you have the option of adding notes to individual features or to an area made up of more than one feature.

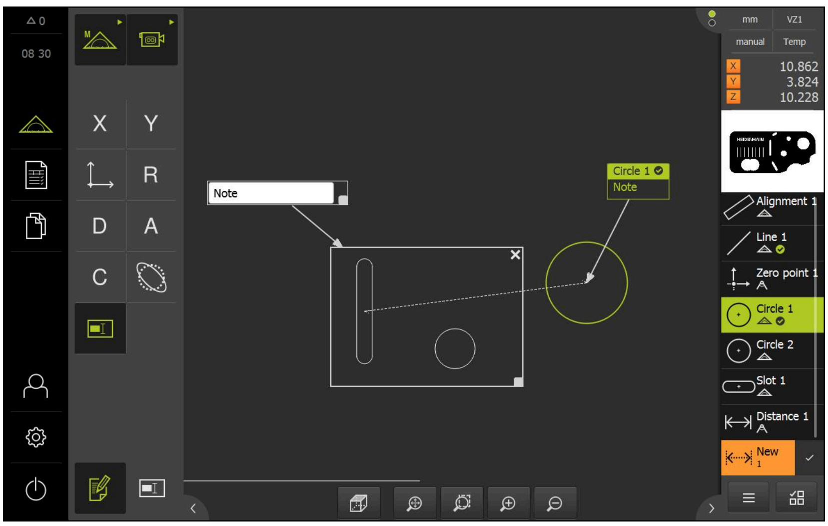


Figure 109: Features view with note for an area and with note for a single feature

1 Note regarding a feature
2 Note regarding an area

Adding notes to features

- Tap **Measure** in the main menu
- Select **Manual measuring** in the function palette
- If applicable, tap **Features preview** in the Inspector
- > The features view is displayed in the workspace
- Drag the desired feature (e.g., a **Circle**) from the feature list into the workspace
- > The **Details** dialog appears with the **Overview** tab selected
- In the **Note** input field, enter the text that is to be shown as a note for the feature in the features view

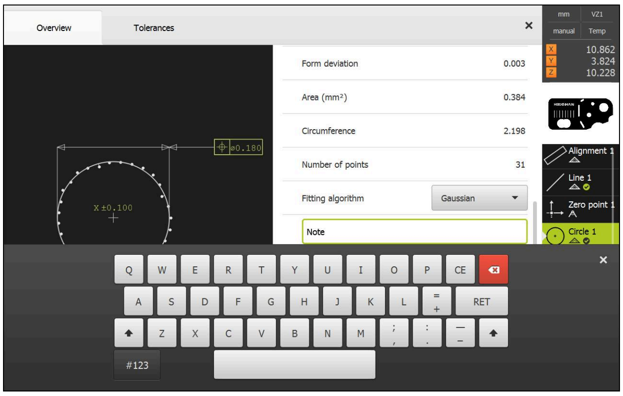


Figure 110: Note in the input field

- Confirm your input with **RET**
- In the **Details** dialog, tap **Close**
- Tap **Edit annotations**
- In the feature list, select the feature for which the note text has been entered
- > The controls for adding annotations are now shown
- Tap the **Note** control
- > The text is now displayed as an annotation in the workspace

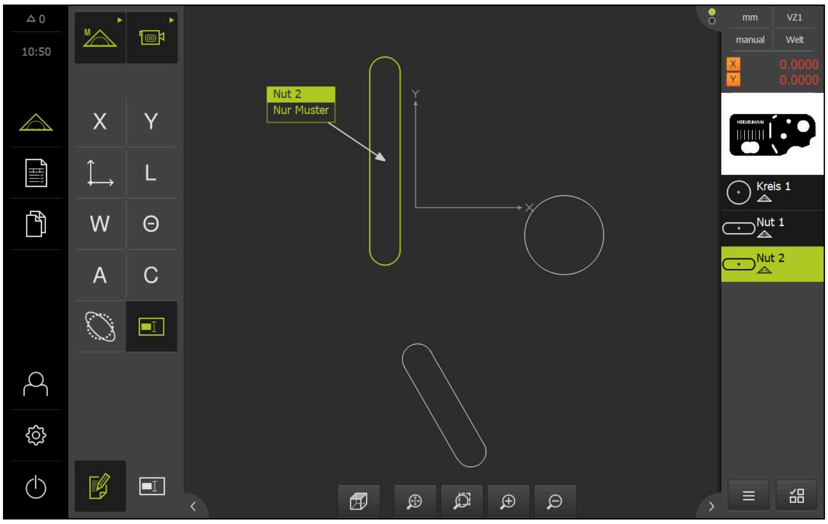


Figure 111: Features view with note for a feature

Adding notes to areas

- Tap **Measure** in the main menu
- Select **Manual measuring** in the function palette
- If applicable, tap **Features preview** in the Inspector
- > The features view is displayed in the workspace
- Tap **Edit annotations**
- Tap the **Note** control
- > An area window and a text window appear
- Adjust the size of the area window and text window and drag them to the desired position
- Enter the desired text in the **Note** input field
- Tap **Close**
- > The text is shown in the **Note** input field

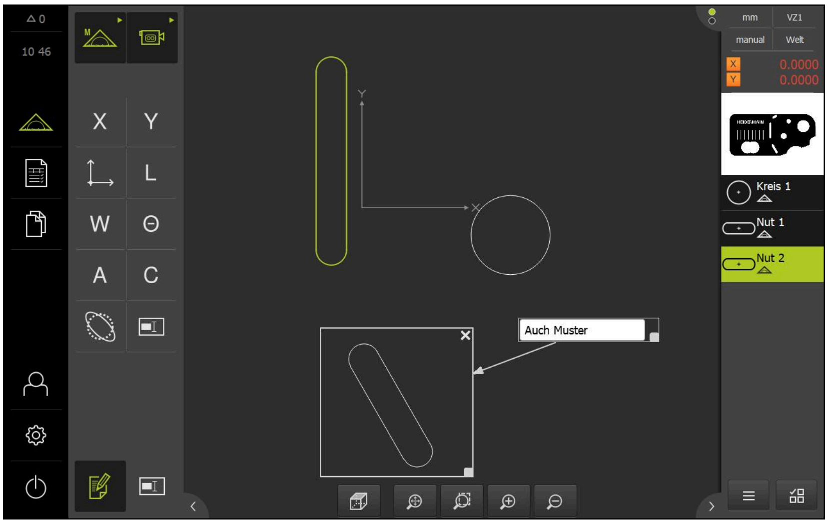


Figure 112: Features view with note for an area

11.5 Sending measured values to a computer

There are several ways to send selected contents to a computer

Prerequisite: Measured-value output must be configured

Further information: "Configuring the measured value output", Page 231

The following options are available:

- Send measured values from the **Measurement result preview**

  Prerequisite: The **Measurement result preview** is active
- Send measured values from the **Details** dialog

11.5.1 Send measured values from the Measurement result preview

Prerequisite: The **Measurement result preview** is active

Further information: "Configuring the measurement result preview", Page 229

- Measure a feature, e. g., a **Circle**
- > The **Measurement result preview** opens

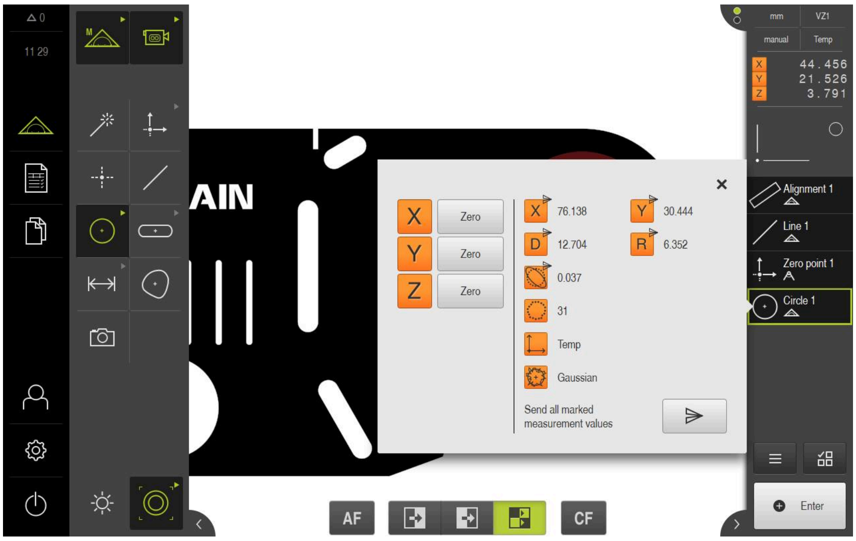


Figure 113: Sending in the **Measurement result preview**

- To select or deselect contents for the measured-value output, tap the corresponding **symbol**
- > The selected contents are marked by the Send symbol

> All numerical values of the feature are available for selection.
> **Further information:** "Overview of parameters in the measurement result preview", Page 495

- Tap **Send**
- > The measured values are sent to the computer once

11.5.2 Send measured values from the Details dialog

- Drag a feature (e.g., a **Circle**) from the feature list into the workspace
- > The **Details** dialog box appears with the **Overview** tab selected

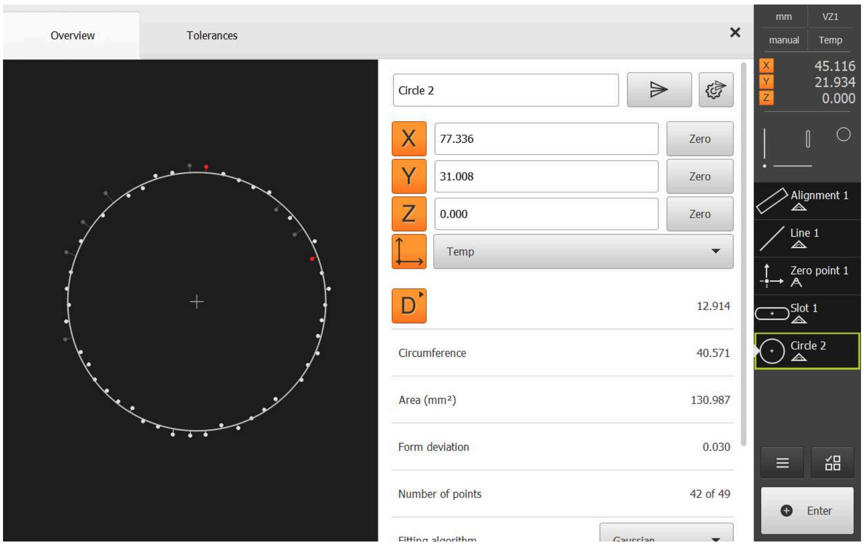


Figure 114: Sending in the **Details** dialog

- Tap **Content of the data transfer**
- > A dialog box for selecting the contents appears

> All numerical values of the feature are available for selection.
> **Further information:** "Overview of parameters in the measurement result preview", Page 495

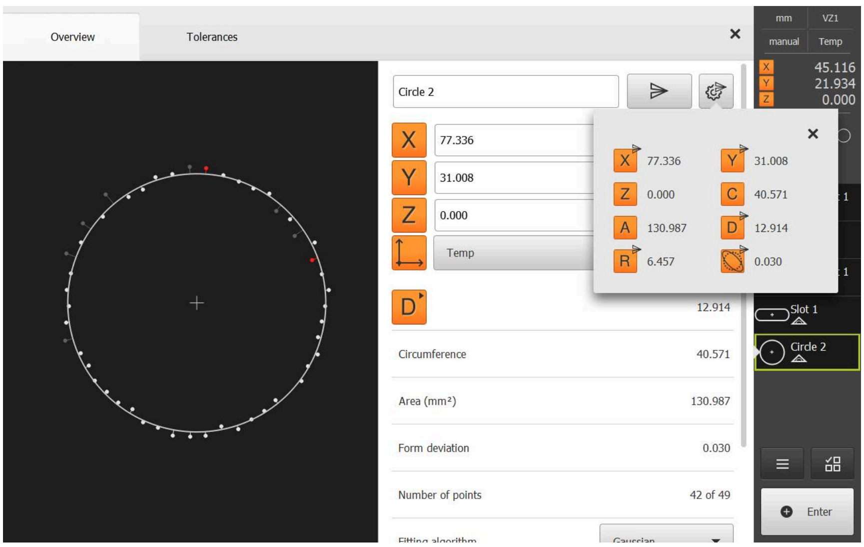
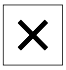


Figure 115: Content of the data transfer in the **Details** dialog

- To select or deselect contents, tap the corresponding **Symbol**
- > The selected contents are marked by the Send symbol



- Tap **Close**
- > The selection is saved for all elements of the same geometry type.

- Tap **Send**
- > The measured values are sent to the computer once

12

Programming

12.1 Overview

This chapter describes how you can create and edit measuring programs and how you can use them for recurring measuring tasks.

> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

Short description

The product can record and save the steps of a measuring process, and run them sequentially as a batch process. This batch processing is referred to as the "measuring program."

In a measuring program, you can thus combine multiple working steps, such as measuring point acquisition and tolerancing, into a single process. This simplifies and standardizes the measuring process. The working steps of a measuring program are referred to as program steps. The program steps are displayed in the program step list in the Inspector.

> The unit records every measuring process and work step as a program step regardless of the current view in the Inspector, the features list, or the program step list. The operator can switch the view between the feature list and the program step list at any time.

Activation

- ▶ Tap **Measure** in the main menu
- > The user interface for measuring, constructing, and defining appears

- ▶ Tap **Auxiliary functions** in the Inspector
- ▶ Tap **Program step list** in the dialog
- > The program step list is displayed in the Inspector
- > The program control is displayed in the workspace

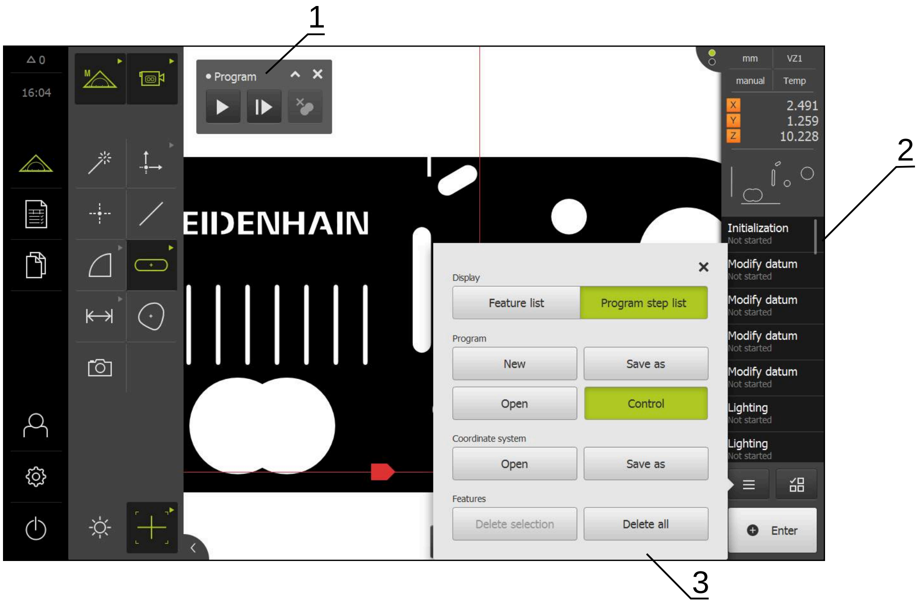


Figure 116: Displays and controls of measuring programs

1 Program control with operating elements
2 Program step list
3 Miscellaneous functions

12.2 Overview of the program steps

A measuring program can contain the following program steps. When the corresponding event occurs, the program step is automatically added to the program step list.

Program step	Event	Function
Initialization	This program step exists in every program. It cannot be deleted	Defines the settings for the execution of the measuring program
Auto enter	First measuring point acquisition	Defines the settings for automatic measuring point acquisition
Units	First measuring point acquisition	Defines the settings with respect to the units and the type of coordinate system
Magnification	First measuring point acquisition and adjustment of magnification	Defines the magnification settings for the subsequent program run
Lighting	Adjustment of lighting in the lighting palette	Defines the lighting settings for the subsequent program run
Focus	Determination of the focal plane	Starts the wizard for determining the focal plane
Contrast threshold	Adjusting the contrast threshold in the contrast bar	Defines the contrast settings for the subsequent program run
Start	Measurement of a feature	Conducts the measuring point acquisition; in some situations, user intervention may be required
Calculate	Measurement of a feature	Calculates a feature from the acquired measuring points
Construct	Construction of a feature	Constructs a feature based on the saved parameters
Define	Definition of a feature	Defines a feature based on the saved parameters
Modify datum	Manual determination of a zero point (datum) (set axis to zero or overwrite axis position)	Creates a new coordinate system in the same way as when recording a measuring program
Save	Saving a coordinate system	Saves a new coordinate system in the same way as when recording a measuring program
Load	Loading a coordinate system	Loads a coordinate system in the same way as when recording a measuring program; the coordinate system is selected in the quick access menu
Delete	Deleting a feature	Deletes a feature (e.g. an auxiliary feature) in the same way as when recording a measuring program

12.3 Using the program control

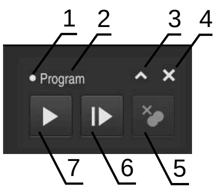
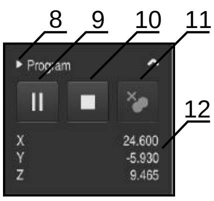
You can control the execution of an active measuring program directly in the workspace.

12.3.1 Calling the program control

If the program control is not displayed in the workspace, you can call the program control in the following way:

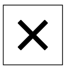
- ▶ Tap **Miscellaneous functions** in the Inspector
- ▶ Tap **Control** in the dialog
- > The **program control** is displayed in the workspace
- ▶ To move the **program control** in the workspace, drag the **program control** to the desired location

12.3.2 Operating elements of the program control

Operating element	Short description
	Before the start of the measuring program, the program control shows the following information: ■ **1:** Status of the measuring program A dashed circle is displayed while a program step is being edited ■ **2:** Name of the measuring program (e.g. **Program**) Unsaved measuring programs are displayed in italics ■ **3: Minimize** The program control is minimized ■ **4: Close** The program control is closed ■ **5: Run** The measuring program is run ■ **6: Single steps** The measuring program is run step by step ■ **7: Remove breakpoints** Breakpoints that were set while editing a measuring program are cleared
	After the start of the measuring program, the program control shows the following information: ■ **8:** Status of the measuring program Program steps are being executed ■ **9: Pause** The measuring program is paused ■ **10: Terminate** The measuring program is terminated ■ **11: Remove breakpoints** Breakpoints that were set while editing a measuring program are cleared ■ **12: Distance-to-go display** (only in features view) The distance-to-go to the target point is shown

12.3.3 Closing the program control

If no measuring program is currently being executed or edited, you can close the program control.



- Tap **Close** to close the program control

12.4 Working with the positioning aid

During positioning to the next nominal position, the product assists you by displaying a graphic positioning aid ("traversing to zero"). A scale is shown underneath each axis you traverse to zero. The graphic positioning aid is a small square that symbolizes the target position of the measuring point.

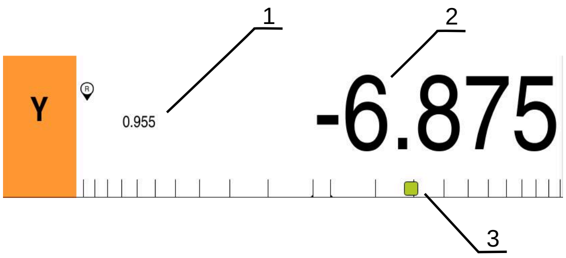


Figure 117: Position display with graphical positioning aid

1 Distance-to-go
2 Actual value
3 Positioning aid

The positioning aid moves across the measuring scale when the target position of the tool center measuring point is located within a range of ± 5 mm of the nominal position. The color also changes in the following way:

Display of positioning aid	Meaning
Red	Target position of the tool center measuring point is moving away from the nominal positions
Green	Target position of the tool center measuring point is moving toward the nominal position

12.5 Working with the guidance assistant

The guidance assistant is displayed in the features view when you activate the OED sensor (software option) or the TP sensor (software option).

The guidance assistant assists you in positioning during the execution of a measuring program.

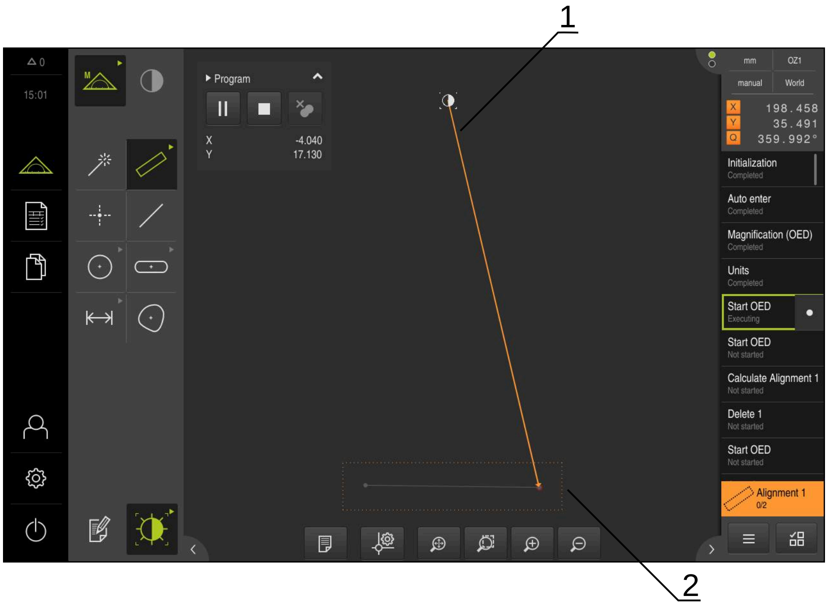


Figure 118: Guidance assistant in the features view

1 Guidance assistant
2 Target range

Activating the guidance assistant

If you have activated the guidance assistant, then the features view of the unit displays an auxiliary line between the current position and the next target position.

▶ Drag the **Initialization** program step to the left into the workspace

> The settings are displayed

▶ Use the **ON/OFF** slider to activate the **Guidance assistant in features view** setting

▶ Tap **Finish** in the program step

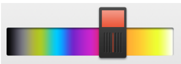
> The settings are applied

Further information: "Initialization", Page 426

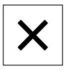
Configuring the guidance assistant

You can configure the guidance assistant in order to use it efficiently. You can configure the target range in which the measuring point acquisition is enabled, and you can adjust the depiction of the target range and the guidance assistant.

- ▶ Tap **Settings** in the features view
- > The **Settings** dialog appears
- ▶ In the **Size of target zone** input field, enter the desired range in mm
- ▶ Confirm the entry with **RET**



- ▶ If necessary, change the settings for the **Color of target zone** and the **Color of guidance assistant**



- ▶ To close the **Settings** dialog, tap **Close**
- > The selected parameters are saved

12.6 Recording a measuring program

The product records all measurement working steps. The working steps are displayed as program steps in the program step list. You can use any working step for a measuring program.

To start recording a new measuring program, proceed as described below.

> **i** Unsaved work steps are deleted before a new measuring program is recorded.

- ▶ Tap **Miscellaneous functions** in the Inspector
- ▶ In the Auxiliary functions dialog, tap **New**
- ▶ To delete existing program steps, confirm the message with **OK**
- > All features and program steps are deleted
- > An empty feature list or a new program step list appears, depending on the selection
- ▶ Perform the measuring process on the measured object (e.g., align measured object, acquire and evaluate features, generate measurement report)
- > All program steps are displayed in the program step list
- ▶ Saving a measuring program

Further information: "Saving a measuring program", Page 298

12.7 Saving a measuring program

In order to be able to execute a measuring process repeatedly, you need to save the executed work steps as a measuring program.

- ▶ Tap **Miscellaneous functions** in the Inspector
- ▶ In the Auxiliary functions dialog, tap **Save as**
- ▶ Select the storage location in the dialog, e.g. **Internal/Programs**
- ▶ Tap within the input field and enter the name for the measuring program
- ▶ Confirm entry with **RET**
- ▶ Tap **Save as**
- > The measuring program is saved
- > The name of the measuring program is displayed on the program control

12.8 Starting a measuring program

A measuring program that has been recorded or executed recently can be started from the program control. Program steps requiring user intervention are supported by a wizard. User intervention may be required under the following conditions, for example:

- The measuring points are outside the live image (only if the VED sensor is active)
- The settings of the camera optics must be adjusted (e.g., magnification of the camera)
- The measured object must be positioned manually using the axes of the measuring plate

> The user interface is locked while a program is running. Only the program control buttons and/or sliders and **Enter** are enabled.

- ▶ Tap **Run** on the program control
- > The program steps are executed
- > Program steps that are currently being executed or that require user intervention are highlighted
- > When user intervention is required, the measuring program stops
- ▶ Perform the required user intervention
- > The execution of the program steps is resumed until the next user intervention is required or the end of the program is reached
- > The successful completion of the measuring program is displayed
- ▶ Tap **Close** in the message
- > The features are displayed in the features preview

12.9 Opening a measuring program

> If you open a measuring program, then the current measuring program will be closed. All unsaved changes in the current measuring program will be lost.
>
> - Save any changes made to the current measuring program before opening another measuring program
>
> **Further information:** "Saving a measuring program", Page 298

- Tap **Auxiliary functions** in the Inspector
- In the Auxiliary functions dialog, tap **Open**
- Confirm the message with **OK**
- > The **Internal**/**Programs** folder is now displayed
- Navigate to storage location of the measuring program
- Tap the name of the measuring program
- Tap **Select**
- > The user interface for measuring, constructing and defining appears
- > The program step list containing the program steps of the measuring program is displayed
- > The selected measuring program is displayed on the program control

12.10 Editing a measuring program

You can edit an automatically recorded or saved measuring program from the program step list. You thus have the option, for example, of adding the measurement of an additional feature, or correcting correcting lighting or references, or of adapting a measuring program to new part specifications without having to re-record it. Individual program steps can be deleted.

> If you change the coordinate system or the sensor configuration or insert program steps linked to them into an existing measuring program, the subsequent features must be remeasured. This helps you avoid measuring errors.

> It is recommended that you create a backup copy of the measuring program before deleting program steps. It is not possible to restore deleted program steps.

Further information: "Copying a file", Page 455

12.10.1 Adding program steps

You can add work steps to an existing measuring program. To include the new work steps in the measuring program, you need to save the measuring program again.

- In the program step list, highlight the program step after which the new work step is to be inserted
- Execute the new work step
- > The work step is added to the program step list as a new program step

> To apply changes in a measuring program, you must save the measuring program again.
> **Further information:** "Saving a measuring program", Page 298

12.10.2 Editing program steps

You can later modify the program steps listed below (e.g., in order to correct measuring program settings or tolerances).

> If you change program steps and tap **Finish**, then the changes to the program steps take effect and cannot be reset.

> To apply changes in a measuring program, you must save the measuring program again.
> **Further information:** "Saving a measuring program", Page 298

Initialization

The **Initialization** program step contains settings for the execution of the measuring program. You can adjust these settings. The **Initialization** program step cannot be deleted.

Parameters	Settings
Fixturing Indicates whether there is a fixture for aligning the measured object. If there is a fixture, then parts can be placed in the same position. The alignment does not have to be remeasured	■ **None**: There is no fixture. The alignment of the measured object must be remeasured for every measurement ■ **Permanent**: There is a permanent fixture. The alignment of the measured object is taken over from the measuring program ■ **Temporary**: There is a temporary fixture. The alignment of the measured object must be remeasured at the beginning of every measurement series. For all further measurements, the alignment of the measured object is taken over from the measuring program Default setting: **Permanent**
Number of program runs Defines how many times the program will automatically run in a row	Setting range: **1** to **10000000** Default setting: **1**
Guidance assistant in features view Defines whether the measuring tool is graphically connected to the target position by an auxiliary line	■ **ON**: The current position and target position are connected by an auxiliary line ■ **OFF**: No graphic support Default setting: **ON**
Clear the feature list Defines whether features from the feature list are deleted, overwritten, or appended prior to every measuring program execution	■ **Delete features**: The individual features are deleted ■ **Overwrite features**: The individual features remain available and are overwritten ■ **Append features**: When the program is executed multiple times, the newly measured features are appended Default setting: **Delete features**
Mode of the VED guidance assistant Defines whether the measuring tool will navigate to the edge automatically as soon as the next measuring point arrives in the workspace	■ **Snap in**: The measuring tool will move to the edge automatically as soon as the edge is visible in the workspace ■ **Centering**: The measuring tool remains in the center of the workspace. The operator must manually traverse to the desired position Default setting: **Snap in**
Coordinate system Specifies whether the measuring program will be started from a user-defined coordinate system	■ **Yes**: A saved coordinate system will be used ■ **No**: The **World** standard coordinate system will be used Default setting: **No**
Path of coordinate-system file	Location of the user-defined coordinate system (5RF file) **Further information:** "Working with coordinate systems", Page 370

Parameters	Settings
Create report Defines whether a measurement report is generated and saved automatically	■ **No** ■ **Yes, current configuration**: The measurement report will be created with the current configuration at the location specified ■ **Yes, selected configuration**: The measurement report will be created with the specified measurement report template at the location specified Default setting: **No**
Export Specifies in which format a report, which as been created automatically, will be saved additionally	■ **Print**: The measurement report is printed on the configured printer ■ **PDF**: The measurement report is saved as a printable PDF file. The values are no longer editable ■ **CSV**: The values in the measurement report are exported to a text file, separated by semicolons. The values can be edited in spreadsheet software
Report based on	The location of the measurement report template used for the report to be created
Path of report file	Path and name of the report file to be created

Modifying the program step:

- ▶ Drag the program step to the left into the workspace
- > The settings are displayed
- ▶ Change the settings
- ▶ Tap **Finish** in the program step
- > The settings are applied

Auto enter

The **Auto enter** program step applies settings to the measuring point acquisition.

Parameters	Settings
Auto enter Activates automatic measuring point acquisition	■ **ON**: Automatic measuring point acquisition is activated ■ **OFF**: Automatic measuring point acquisition is deactivated Default setting: **OFF**
Auto enter timeout in ms Defines how long a measuring tool must stand still at a position until a measuring point is automatically acquired	Setting range: **150** to **10000** Default setting: **500**

Modifying the program step:

- ▶ Drag the program step to the left into the workspace
- > The settings are displayed
- ▶ Change the settings
- ▶ Tap **Finish** in the program step
- > The settings are applied

Units

The **Units** program step defines the global units and coordinate systems for the entire measuring program.

Parameters	Settings
Unit for linear values	■ **Millimeters** ■ **Inch** Default setting: **Millimeters**
Unit for angular values	■ **Radian** ■ **Decimal degrees** ■ **Deg-Min-Sec** Default setting: **Decimal degrees**
Type of coordinate system	■ **Cartesian** ■ **Polar** Default setting: **Cartesian**

Modifying the program step:

- ▶ Drag the program step to the left into the workspace
- > The settings are displayed
- ▶ Change the settings
- ▶ Tap **Finish** in the program step
- > The settings are applied

Lighting

The **Lighting** program step defines the lighting settings for the subsequent program run.

Modifying the program step:

- ▶ Drag the program step for setting the lighting to the left into the workspace
- > The lighting palette is displayed
- ▶ Adjust the lighting settings manually

or

- ▶ Select the desired preset
  Further information: "Lighting palette", Page 108
- ▶ Tap **Finish** in the program step
- > The settings are applied

> This program step will affect all subsequent program steps. If you change settings or insert the program step into an existing measuring program, then the subsequent features must be remeasured. This helps you avoid measuring errors.

Focus

The **Focus** program step starts the wizard for determining the focal plane (position on the Z axis) for the subsequent program steps. In this program step, you define the measuring tool position on the X and Y axes.

Modifying the program step:

- Drag the **Focus** program step to the left into the workspace
- Move the measuring tool to its new position on the X and Y axes
- Tap **Finish** in the program step
- > The settings are applied

> This program step will affect all subsequent program steps. If you change settings or insert the program step into an existing measuring program, then the subsequent features must be remeasured. This helps you avoid measuring errors.

Contrast threshold

The **Contrast threshold** program step defines the contrast threshold for the subsequent program run.

Modifying the program step:

- Drag the **Contrast threshold** program step to the left into the workspace
- Adjust the contrast threshold using the **Contrast bar** slider
  Further information: "Contrast bar", Page 105
- Tap **Finish** in the program step
- > The settings are applied

> This program step will affect all subsequent program steps. If you change settings or insert the program step into an existing measuring program, then the subsequent features must be remeasured. This helps you avoid measuring errors.

Start (measuring point acquisition)

The **Start** program step executes the measuring point acquisition with the selected measuring tool and the defined settings.

Modifying the program step:

- Drag the program step to the left into the workspace
- Adjust the measuring tool (e.g., position, size, or alignment)
- Acquire the desired measuring points
- Tap **Finish** in the program step
- > The settings are applied

Calculate, Construct, or Define

The following program steps create a new feature:

- **Calculate** calculates a feature from the acquired measuring points with the parameters that have been set (e.g., fitting algorithm and tolerances)
- **Construct** Constructs a feature from the selected features points with the parameters that have been set
- **Define** defines a feature with the parameters that have been set

Modifying the program step:

- ▶ Drag the program step to the left into the workspace
- > The **Overview** and **Tolerances** tabs are displayed
- ▶ On the **Overview** tab, adjust the settings of the feature

Further information: "Evaluating a feature", Page 383

- ▶ In the **Tolerances** tab, adjust the tolerancing of the feature

Further information: "Defining tolerances", Page 385

- ▶ Tap **Close** to close the dialog
- > The settings are applied

For the measurement and calculation of a feature, the **Start** (measuring point acquisition) and **Calculate** program step must follow each other in sequence. If one or both of the program steps are missing, then the measuring program cannot be executed.

12.10.3 Using coordinate systems in measuring programs

All steps for the creation and use of coordinate systems are taken into account when a measuring program is recorded and are saved along with the program. When you execute a measuring program, reference features and user-defined coordinate systems will be created, renamed, and selected automatically. This is done in the same way as during the recording of the measuring program.

To save a user-defined coordinate systems, select the **Save** program step; to load and select it, use the **Load** program step.

If you specify a user-defined coordinate system in the **Initialization** program step, the measuring program will be started from this coordinate system.

Further information: "Initialization", Page 426

In the settings of the **Calculate**, **Construct**, or **Define** program steps, you can adjust the assignment of a coordinate system to a feature, depending on how you created the feature.

Further information: "Calculate, Construct, or Define", Page 430

If you create a new coordinate system by setting an axis to zero or by overwriting an axis position, the **Modify datum** program step will be added. This program step cannot be edited.

Further information: "Working with coordinate systems", Page 370

12.10.4 Deleting a program step

- Drag the program step to the right out of the program step list
- The program step is deleted from the program step list

> To apply changes in a measuring program, you must save the measuring program again.
> **Further information:** "Saving a measuring program", Page 298

12.10.5 Setting and removing breakpoints

When creating or editing a measuring program, you can stop the program run at specified points. After being started, the measuring program stops at a breakpoint and needs to be resumed or terminated. A breakpoint can be set at any program step of the measuring program.

> Breakpoints cannot be saved in the measuring program.

Setting a breakpoint

- Tap the program step
- The program step is highlighted
- The breakpoint is displayed at the program step

- Tap **Breakpoint**
- A dot appears next to the name of the program step
- The breakpoint is set

Removing a breakpoint

- Tap the program step containing the breakpoint
- The program step is highlighted
- The breakpoint is displayed at the program step

- Tap **Breakpoint**
- The dot next to the name of the program step is removed
- The breakpoint is cleared

Removing all breakpoints

- Tap **Remove breakpoints** on the program control
- All breakpoints are removed

13

Measurement reports

13.1 Overview

This chapter describes how you can create measurement reports based on templates and how you can create and alter your own measurement report templates.

> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

Short description

In the **Measurement report** main menu, you can create detailed reports for your measuring tasks. You can document one or more measured features in a measurement report. The measurement reports can be printed, exported and saved. For the creation of measurement reports, you can choose between several standard templates.

Using the integrated editor, you can create custom report templates and adapt them as needed.

Further information: "Creating and editing a template", Page 441

Activation

▶ Tap **Measurement report** in the main menu

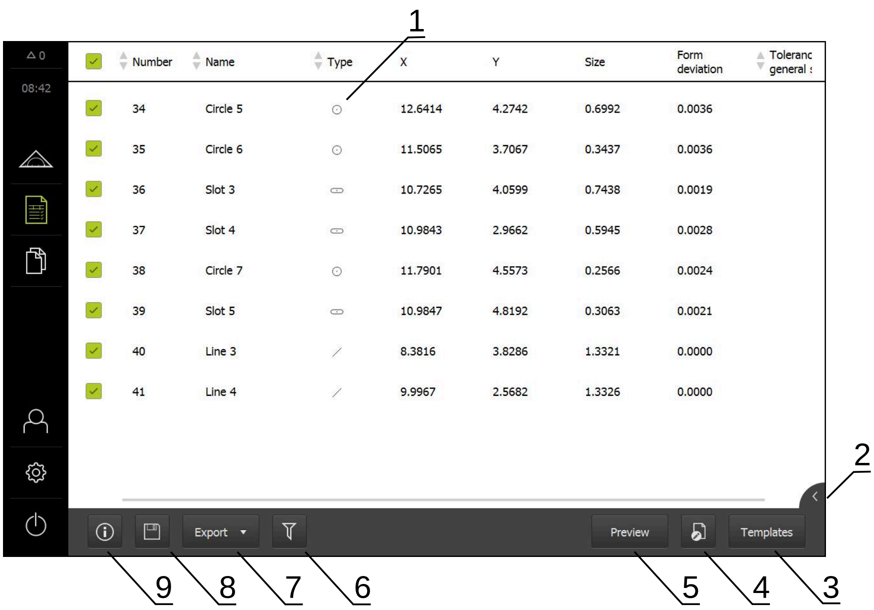


Figure 119: **Measurement report** menu

1 List of measured features and their properties
2 Opens the features preview
3 Displays the measurement report templates
4 Edit the current template
5 Print preview of the current measurement report
6 Filter for the list of measured features
7 Exports the current measurement report
8 Saves the current measurement report
9 Display information on the current report

13.2 Managing templates for measurement reports

You can copy existing default templates, or edit, rename or delete custom templates.

Displaying operating elements

- Tap **Measurement report** in the main menu
- Tap **Templates**
- In the list, drag the name of the template to the right
- > The controls for managing the templates are displayed

Copying a template

- Tap **Copy to**
- > The editor opens

Further information: "Creating and editing a template", Page 441

- To duplicate the template, tap **Save as**
- > The **Save as** dialog appears
- Select storage location (e.g. **Internal**/**Reports**
- Enter a name for the template
- Confirm entry with **RET**
- Confirm copying with **Save as**
- > The copy of the template is saved

Editing a template

- Tap **Edit file**
- > The editor opens

Further information: "Creating and editing a template", Page 441

Renaming a template

- Tap **Rename file**
- Change the file name in the dialog
- Confirm entry with **RET**
- Tap **OK**

Deleting a template

- Tap **Delete selection**
- Tap **Delete**
- > The template for the measurement report is deleted

13.3 Creating a measurement report

The measurement results can be displayed, saved, and printed as a measurement report.

The following steps are necessary to create a measurement report:

- "Selecting the features and the template"
- "Entering information on the measuring task"
- "Selecting document settings"
- "Saving a measurement report"
- "Exporting or printing a measurement report"

13.3.1 Selecting the features and the template

- ▶ Tap **Measurement report** in the main menu
- > The list of measured features is displayed, based on the measurement report template that was selected last
- > All features in the list are activated and the boxes are displayed in green
- ▶ To remove a feature from the measurement report, tap its box

> The feature list can be filtered by various criteria.
> **Further information:** "Filtering features", Page 293

- ▶ To change the measurement report template, tap **Templates**
- ▶ Select the desired measurement report template
- ▶ Tap **OK**
- > The list of measured features is adapted to the selected measurement report template

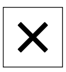
Filtering features

You can filter the feature list in the **Features** menu by various criteria. This means that only features meeting the filter criteria are displayed, e.g., only circles with a specific minimum diameter. You can use any combination of filters.

> The filter function controls how the feature list is displayed. It does not affect the contents of the measurement report.

- ▶ Tap **Filter**

- ▶ Select the desired filter criterion in the dialog
- ▶ Select the operator
- ▶ Select the function



- ▶ Tap **Close** to activate the filter criteria

Filtercriterion	Operator	Function
Type	**Is**	Only features of the selected geometry type are shown.
	Is not	Only features of geometry types that are not selected are shown.
Size	**Equal**	Only features of the specified size are shown.
	Greater than	Only features that are larger than the specified size are shown.
	Less than	Only features that are smaller than the specified size are shown.
Tolerance	**Is**	Only features that fulfill the selected characteristic are shown.
	Is not	Only features that do not fulfill the selected characteristic are shown.
Creation type	**Is**	Only features that fulfill the selected characteristic are shown.
	Is not	Only features that do not fulfill the selected characteristic are shown.

13.3.2 Entering information on the measuring task

> The available information depends on the configuration of the template.

- Tap **Information**
- To customize the date and time in the measurement report, select the desired option from the **Timestamp** drop-down list
  - **Set manually**: When creating the report, the system uses the date and time you entered manually
  - **Set automatically**: When creating the report, the system enters the current date and time
- Select an existing user from the **User name** drop-down list
- If you want another user to be displayed in the measurement report, select **Other user**
- Enter the name of the user into the input field
- Confirm your input with **RET**
- Enter the number of the measurement job into the **Job** input field
- Confirm your input with **RET**
- Enter the part number of the measured object into the **Part number** input field
- Confirm your input with **RET**
- Tap **Close** to close the dialog

13.3.3 Selecting document settings

- Tap **Information**
- Tap the **Document** tab
- To adjust the unit of measurement for linear measurement values, select the desired unit of measurement in the **Unit for linear values** drop-down list
  - **Millimeters**: Display in millimeters
  - **Inch**: Display in inches
- To reduce or increase the number of displayed **Decimal places for linear values**, tap **-** or **+**
- To adjust the unit of measurement for angular values, select the desired unit of measurement in the **Unit for angular values** drop-down list
  - **Decimal degrees**: Display in degrees
  - **Radian**: Display in radians
  - **Deg-Min-Sec**: Display in degrees, minutes, and seconds
- To adjust the format for the date and time, select the desired format in the **Date and time format** drop-down list
  - **hh:mm DD-MM-YYYY**: Time and date
  - **hh:mm YYYY-MM-DD**: Time and date
  - **YYYY-MM-DD hh:mm**: Date and time
- To customize the print format, select the corresponding settings in the drop-down lists of the following parameters:
  - **Duplex printing**: Duplex printing, flipped along the long or short edge of the page
  - **Page header**: The page header will appear on the title page or on every page
  - **Header of data chart**: The header will appear on the title page or on every page
  - **Display feature view** (with annotations): ON/OFF
- Tap **Close** to close the dialog

13.3.4 Opening previews

You can display both the features and the measurement report in a preview.

Opening the features preview

- Tap the **tab**
- > The features preview opens
- > The arrow changes direction

- To close the features preview, tap the **tab**

If you added annotations to your features, they will also be shown in the features preview.

Further information: "Adding annotations", Page 292

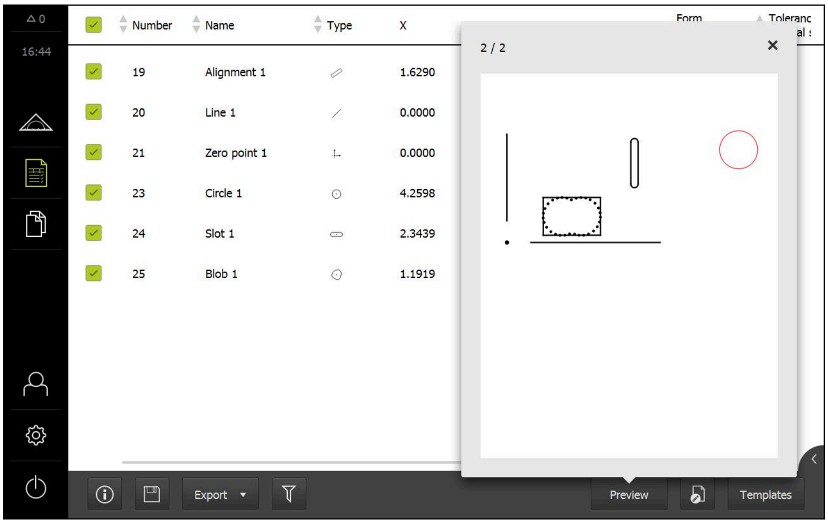
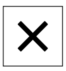


Figure 120: **Measurement report** menu with feature list and features preview

Opening the measurement report preview

- Tap **Preview**
- > The measurement report preview opens
- To browse the pages, tap the left or right edge of the preview pane



- Tap **Close** to close the preview

13.3.5 Saving a measurement report

Measurement reports are saved in the XMR data format.

- Tap **Save as**
- In the dialog, select the storage location, e.g. **Internal**/**Reports**
- Enter a name for the measurement report
- Confirm your input with **RET**
- Tap **Save as**
- > The measurement report is saved

> In the **File management** main menu, you can open and edit saved reports.
> **Further information:** "Managing folders and files", Page 453

> The XMR data format has been changed for the current firmware version. You can no longer open or edit files saved in the XMR data format of the previous version.

13.3.6 Exporting or printing a measurement report

You have various possibilities for exporting measurement reports or printing them on the installed printer. You can export a PDF or CSV file or send the measurement report to a computer via the available RS-232 interface.

Exporting the measurement report

- Select the desired export format from the **Export** drop-down list:
  - **Export as PDF**: The measurement report is saved as a printable PDF file. The values are no longer editable
  - **Export as CSV**: The values in the measurement report are exported to a text file, separated by semicolons. The values can be edited in spreadsheet software
  - **Export via RS-232**: The values in the measurement report are sent in table view to a computer
    Prerequisite: The measured-value output has been configured
- Select the storage location for the PDF and CSV files in the dialog, e. g. **Internal**/**Reports**
- Enter a name for the measurement report
- Confirm the entry with **RET**
- Tap **Save as**
- > The measurement report is exported in the selected format and stored in the storage location

Printing the measurement report

- Tap the **Export** drop-down list
- Tap **Print** in the drop-down list
- > The measurement report is output to the specified printer
  Further information: "Configuring the printer", Page 211

13.4 Creating and editing a template

With the editor, you can create or edit your own templates for measurement reports.

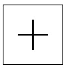
The following steps are necessary to create a new template:

- Opening a new template with the editor
- Editing the default settings for the measurement report
- Configuring the page header
- Configuring the report header
- Defining the data for the measurement report
- Saving the template

13.4.1 Opening a new template with the editor

A new template can be added or created from existing templates.

- ▶ Tap **Measurement report** in the main menu
- ▶ Tap **Templates**
- > The **Add** button appears in the list of templates



- ▶ Tap **Add** to create a new template
- > The **Default settings** for the new template are displayed

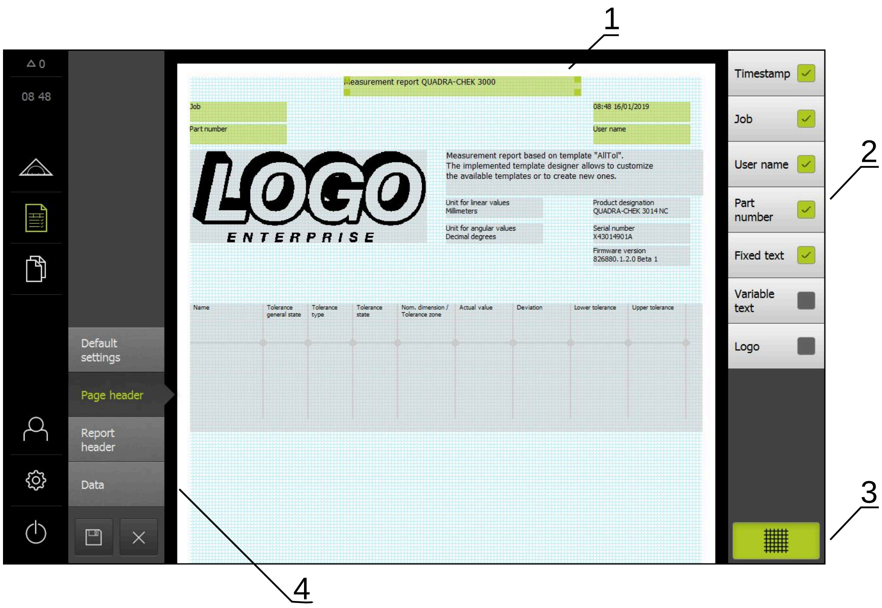


Figure 121: Editor for measurement report templates

1 Template areas
2 Form fields in the layout
3 List of form fields
4 Grid controls for displaying and hiding the auxiliary lines in the editor

Hiding or displaying auxiliary lines

A grid of auxiliary lines is displayed in the background to help you align the fields in the form. The auxiliary line grid is not printed.

> The grid of auxiliary lines is always active. All fields of the form are automatically aligned with it.

- Tap **Grid** to display or hide the grid of auxiliary lines

13.4.2 Editing the default settings for the measurement report

- Select the default template to be used as the basis from the **Template** drop-down list
- To adjust the unit of measurement for linear measurement values, select the desired unit of measurement in the **Unit for linear values** drop-down list
  - **Millimeters**: Display in millimeters
  - **Inch**: Display in inches
- To reduce or increase the number of displayed **Decimal places for linear values**, tap **-** or **+**
- To adjust the unit of measurement for angular values, select the desired unit of measurement in the **Unit for angular values** drop-down list
  - **Decimal degrees**: Display in degrees
  - **Radian**: Display in radians
  - **Deg-Min-Sec**: Display in degrees, minutes, and seconds
- To adjust the format for the date and time, select the desired format in the **Date and time format** drop-down list
  - **hh:mm DD-MM-YYYY**: Time and date
  - **hh:mm YYYY-MM-DD**: Time and date
  - **YYYY-MM-DD hh:mm**: Date and time
- To customize the print format for the template, select the corresponding settings in the drop-down lists of the following parameters:
  - **Duplex printing**
  - **Page header**
  - **Header of data chart**
  - **Paper size**
  - **Orientation**
- Use the **ON/OFF** slider to activate or deactivate the display of the following elements:
  - **Display page header**
  - **Display report header**
  - **Display feature view** (with annotations)

13.4.3 Configuring the page header

> The menu is only available if the **Display page header** setting is active in the **Default settings** menu.

The form fields listed below can be added to the **Page header** of the measurement report. During the creation of the measurement report, the form fields are filled according to the entries made.

Form field	Meaning and application
Timestamp	The date and time are added.
Job	The job name is added.
User name	The user name is added.
Part number	The part number is added.
Fixed text	Fixed text is added to the template. ▶ Tap the **Fixed text** form field in the template > An input field opens ▶ Enter the desired text ▶ To close the input field, tap anywhere outside the input field
Variable text	Variable text is added. You can type the variable text into the template. When creating the measurement report, you can overwrite the text as needed.
Logo	A logo is added. ▶ Tap the **Logo** form field in the template > A dialog appears ▶ Select the desired logo in its storage location ▶ Tap **OK** to close the dialog > The logo is added to the template

Adding or removing fields

▶ To add or remove a form field, tap it in the list of form fields
> Active form fields are identified by a check mark
> By tapping it, you add the form field to the template at its default position or remove it from the template

Resizing a form field

You can adjust the size of the form field using the square handles at the corner of the field.

▶ Tap **Grid** to use auxiliary lines for easy alignment
▶ Drag the square handle of the corresponding form field to the desired size
> The change to the form field is applied

Positioning a form field

You can position the form fields in the template according to your own preferences.

- ▶ Tap **Grid** to use auxiliary lines for easy alignment
- ▶ Drag the form field to the desired position in the template
- > The change to the form field is applied

13.4.4 Configuring the report header

> The menu is only available if the **Display report header** parameter is active in the **Default settings** menu.

Adding or removing form fields

The form fields listed below can be added to the **Report header** of the measurement report. During the creation of the measurement report, the form fields are filled according to the entries made.

Form field	Meaning and application
Timestamp	The date and time are added.
Job	The job name is added.
User name	The user name is added.
Part number	The part number is added.
Fixed text	Fixed text is added to the template. ▶ Tap the **Fixed text** form field in the template > An input field opens ▶ Enter text ▶ To close the input field, tap anywhere outside the input field
Variable text	Variable text is added. You can type the variable text into the template. When creating the measurement report, you can overwrite the text as needed.
Logo	A logo is added. ▶ Tap the **Logo** form field in the template > A dialog appears ▶ Select the desired logo in its storage location ▶ Tap **Select** to close the dialog > The logo is added to the template
Omitted features	The number of measured features that are not displayed in the measurement report is added.
Failed tolerances	The number of features that are out of tolerance is added.
Product designation	The product designation of the device is added.
Serial number	The serial number of the product is added.
Firmware version	The firmware version currently installed on the product is added.

Adding or removing fields

- ▶ To add or remove a form field, tap it in the list of form fields
- > Active form fields are identified by a check mark
- > By tapping it, you add the form field to the template at its default position or remove it from the template

Resizing a form field

You can adjust the size of the form field using the square handles at the corner of the field.

- ▶ Tap **Grid** to use auxiliary lines for easy alignment
- ▶ Drag the square handle of the corresponding form field to the desired size
- > The change to the form field is applied

Positioning a form field

You can position the form fields in the template according to your own preferences.

- ▶ Tap **Grid** to use auxiliary lines for easy alignment
- ▶ Drag the form field to the desired position in the template
- > The change to the form field is applied

13.4.5 Defining data for a measurement report

The form fields listed below can be added to the data table of the measurement report. During the creation of the measurement report, the data is filled in according to the entries made and depending on the measured features.

Form field	Meaning and application
Name	The name of the feature is added.
Type	The feature type is added.
Number	The number of the feature is added.
Cartesian position	The position in Cartesian coordinates is added.
Polar position	The position in polar coordinates is added.
X	The X coordinate (Cartesian) is added.
Y	The Y coordinate (Cartesian) is added.
Z	The Z coordinate (Cartesian) is added.
X distance	For features of the **Distance** geometry type, the distance on the X axis is added
Y distance	For features of the **Distance** geometry type, the distance on the Y-axis is added.
Z distance	For features of the **Distance** geometry type, the distance on the Z axis is added.
Coordinate system	The coordinate system used for the feature is added.
r	The radial coordinate (polar) is added.
φ	The angular coordinate (polar) is added.
Size	The main dimension of the feature (e.g., the length of a straight line) is added.
Length	The length of the feature is added.
Width	The width of the feature is added.
Radius	The radius of the feature is added.
Diameter	The diameter of the feature is added.
Angle	The angle of the feature is added. For features of the **Arc** geometry type, the angle, starting angle and end angle are entered. For elements of the **Rotation** geometry type, the angle of rotation is added.
Rotation axis	For features of the **Rotation** geometry type, the rotational axis is entered.
Fitting algorithm	The fitting algorithm applied to the feature is inserted.
No. of points / parent features	For measured features, the number of measuring points is added. For constructed features, the number of parent features is added.
Form deviation	The maximum deviation from the calculated ideal geometry is added.

Form field	Meaning and application
	Applies only to features that have been measured using more than the mathematically required number of points.
Creation type	The symbol of the process used for creating the feature is added (measuring, constructing, or defining).
Tolerance general state	The overall status of all of the tolerances that have been applied to the feature are added (e. g., **Passed**, if all of the individual tolerances are good).
Tolerance type	The tolerance types applied to the feature are added.
Tolerance state	The states of the tolerances applied to the feature are added.
Tol. fitting algorithm	The fitting algorithm used in the tolerance check is added. Whether a tolerance fitting algorithm is used depends on the geometry type.
Nom. dimension / Tolerance zone	The nominal dimension or the value of the tolerance zone of a tolerance applying to a feature is added.
Actual value	The actual dimension of a tolerance applied to the feature is added.
Deviation	The difference between nominal dimension and actual dimension is added.
Lower tolerance	The lower tolerance limit of a tolerance applied to the feature is added.
Upper tolerance	The upper tolerance limit of a tolerance applied to the feature is added.
Lower limit	The lower limit of a tolerance applied to the feature is added.
Upper limit	The upper limit of a tolerance applied to the feature is added.
Trend [-/+++]	The trend of the deviation is added. The tolerance zone is divided into seven segments. The result is assigned to the corresponding segment. The corresponding segment is shown as a trend: ■ Segment -3: **---** ■ Segment -2: **--** ■ Segment -1: **-** ■ Segment 0: **.** ■ Segment +1: **+** ■ Segment +2: **++** ■ Segment +3: **+++**

Form field	Meaning and application
Reference, bonus	The reference feature of a tolerance applied to the feature is added. If a material requirement is being used, the existing tolerance bonus is added.

Adding or removing fields

- ▶ To add or remove a form field, tap the **form field** in the list
- > Active form fields are identified by a check mark
- > By tapping it, you add the form field as a column to the data table, or remove it from the data table

Changing the column order

The order of the columns in the data table is controlled via a separate dialog.

- ▶ Tap and hold the desired column in the table
- > A dialog opens.
- ▶ To change the position of a column in the dialog, drag its name to the desired position
- ▶ To swap the positions of two columns, tap their names successively as indicated in the wizard
- > The changes to the data table are applied

Changing the column widths

To adjust the width of the columns in the data table, use the diamond-shaped handles.

- ▶ Tap **Grid** to use auxiliary lines for easy alignment
- ▶ Adjust the column width by dragging the diamond-shaped handles
- > Columns that are outside the print area are marked red
- > The changes to the data table are applied

13.4.6 Saving a template

The templates are saved in the XMT data format.

- ▶ To save the template, tap **Save as**
- > The **Save as** dialog appears
- ▶ Select the storage location (e. g., **Internal**/**Reports**)
- ▶ Enter a name for the template
- ▶ Confirm entry with **RET**
- ▶ Tap **Save as**
- > The template is saved and can be used for measurement reports

> **i** The XMT data format has been changed for the current firmware version. Files saved in the XMT data format of the previous version can no longer be used. However, you can still open these templates and then adapt and save them as required.

13.4.7 Exiting or canceling the creation of a template

When creating or editing a template, you need to save the template before closing it. Otherwise, the editing process will be canceled and the changes will be discarded.

Further information: "Saving a template", Page 448

- Tap **Close** to exit or cancel the creation of the template or measurement report
- Tap **OK** to close the message
- > The editor is closed

14

File management

14.1 Overview

This chapter describes the **File management** menu and its functions.

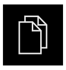
> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

Short description

The **File management** menu shows an overview of the files stored in the product’s memory.

Any connected USB mass storage products (FAT32 format) or available network drives are shown in the list of storage locations. The USB mass storage products and the network drives are displayed with their name or drive designation.

Activation



- ▶ Tap **File management** in the main menu
- > The user interface for file management is displayed

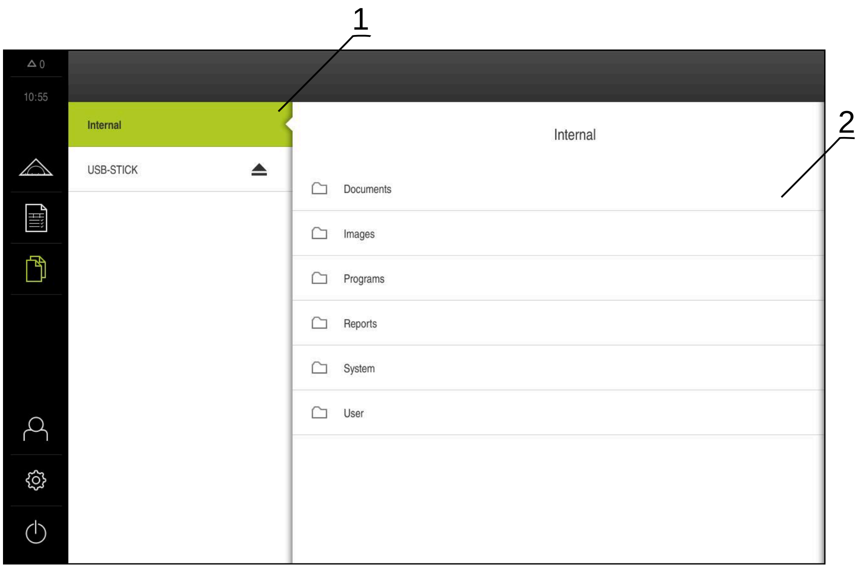


Figure 122: **File management** menu

1 List of available storage locations
2 List of folders in the selected storage location

14.2 File types

In the **File management** menu you can edit the following file types:

Type	Use	Manage	View	Open	Print
*.xmp	Measuring programs	✓	✓	✓	–
*.xmr	Measurement reports	✓	✓	–	–
*.xmt	Measurement report templates	✓	–	–	–
*.mcc	Configuration files	✓	–	–	–
*.dro	Firmware files	✓	–	–	–
*.svg, *.ppm	Image files	✓	–	–	–
*.jpg, *.png, *.bmp	Image files	✓	✓	–	–
*.csv	Text files	✓	–	–	–
*.txt, *.log, *.xml	Text files	✓	✓	–	–
*.pdf	PDF files	✓	✓	–	✓

14.3 Managing folders and files

Folder structure

In the **File management** menu, the files in the **Internal** storage location are saved in the following folders:

Folders	Application
Documents	Document files with instructions and service addresses
Images	Images of measured objects as reference material
Reports	Stored measurement reports and measurement report templates
System	Audio files and system files
User	User data

Creating a new folder

- ▶ Drag the icon of the folder in which you want to create a new folder to the right
- > The operating elements are displayed

- ▶ Tap **Create a new folder**
- ▶ Tap the input field in the dialog and enter a name for the new folder
- ▶ Confirm entry with **RET**
- ▶ Tap **OK**
- > A new folder is created

Moving a folder

- ▶ Drag the icon of the folder you want to move to the right
- > The operating elements are displayed
- ▶ Tap **Move to**
- ▶ In the dialog, select the folder to which you want to move the folder
- ▶ Tap **Select**
- > The folder is moved

Copying a folder

- ▶ Drag the icon of the folder you want to copy to the rightt
- > The operating elements are displayed
- ▶ Tap **Copy to**
- ▶ In the dialog, select the folder to which you want to copy the folder
- ▶ Tap **Select**
- > The folder is copied

> **i** If you copy a folder to the folder it is stored in, the suffix "_1" is appended to the name of the copied folder.

Renaming a folder

- ▶ Drag the icon of the folder you want to rename to the right
- > The operating elements are displayed
- ▶ Tap **Rename folder**
- ▶ Tap the input field in the dialog and enter a name for the new folder
- ▶ Confirm the entry with **RET**
- ▶ Tap **OK**
- > The folder is renamed

Moving a file

- ▶ Drag the icon of the file you want to move to the rightt
- > The operating elements are displayed
- ▶ Tap **Move to**
- ▶ In the dialog, select the folder to which you want to move the file
- ▶ Tap **Select**
- > The file is moved

Copying a file

- ▶ Drag the icon of the file you want to copy to the right
- \> The operating elements are displayed
- ▶ Tap **Copy to**
- ▶ In the dialog, select the folder to which you want to copy the file
- ▶ Tap **Select**
- \> The file is copied

> If you copy a file to the folder it is stored in, the suffix "_1" is appended to the name of the copied file.

Renaming a file

- ▶ Drag the icon of the file you want to rename to the right
- \> The operating elements are displayed
- ▶ Tap **Rename file**
- ▶ Tap the input field in the dialog and enter a name for the new file
- ▶ Confirm the entry with **RET**
- ▶ Tap **OK**
- \> The file is renamed

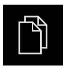
Deleting a folder or file

The folders and files you delete will be permanently deleted and cannot be recovered. If you delete a folder, all subfolders and files contained in that folder will also be deleted.

- ▶ Drag the icon of the file you want to delete to the right
- \> The operating elements are displayed
- ▶ Tap **Delete selection**
- ▶ Tap **Delete**
- \> The folder or file is deleted

14.4 Viewing and opening files

Viewing files



- Tap **File management** in the main menu
- Navigate to the storage location of the desired file
- Tap the file
- > A preview image (only with PDF and image files) as well as information about the file are displayed

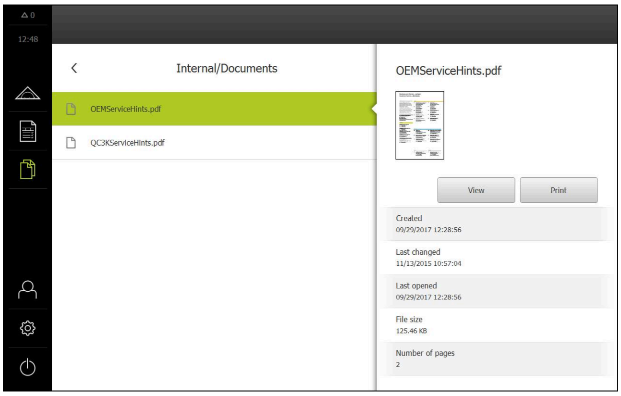
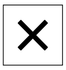


Figure 123: **File management** menu with preview image and file information

- Tap **View**
- > The file contents are displayed

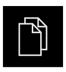


- Tap **Close** to close the view

> In this view, you can print PDF files on the printer configured in the product by tapping **Print**.

Opening measuring programs

Measuring programs saved as a *.xmp file type can be viewed or opened for editing.



- Tap **File management** in the main menu
- Select the **Internal** storage location
- Tap the **Programs** folder
- Tap the desired file
- To display the measuring program, tap **View**
- To edit the measuring program, tap **Open**
- > The measuring program is opened in the Inspector

Opening and recreating a measurement report

Measurement reports saved as a *.xmr file type can be viewed or recreated. A new measurement report uses the template, the template settings, and the selected features for recreating.

- Tap **File management** in the main menu
- Select the **Internal** storage location
- Tap the **Reports** folder
- Tap the desired file
- To display the measurement report, tap **View**
- To recreate the measurement report, tap **Recreate report**
- In the dialog box, select the storage location, e.g. **Internal/Reports**
- Enter the name of the new measurement report
- Confirm your input with **RET**
- Tap **Save as**
- > The new measurement report is created based on the already existing measurement report
- > The new measurement report is saved

14.5 Exporting files

You can export files to an external USB mass storage device (FAT32 format) or to the network drive. You can either copy or move the files:

- If you copy files, duplicates of the files will remain stored in the product
- If you move files, the files will be deleted in the product

- Tap **File management** in the main menu
- In the **Internal** storage location, navigate to the file you want to export
- Drag the icon of the file to the right
- > The operating elements are displayed
- To copy the file, tap **Copy file**
- To move the file, tap **Move file**
- In the dialog, select the storage location to which you want to export the file
- Tap **Select**
- > The file is exported to the USB mass storage device or the network drive

Safely removing a USB mass storage device

- Tap **File management** in the main menu
- Navigate to the list of storage locations
- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

14.6 Importing files

You can import files from a USB mass storage device (FAT32 format) or a network drive into the product. You can either copy or move the files:

- If you copy files, duplicates of the files will remain on the USB mass storage device or the network drive
- If you move files, the files will be deleted from the USB mass storage device or the network drive

- ▶ Tap **File management** in the main menu
- ▶ On the USB mass storage device or network drive, navigate to the file you want to import
- ▶ Drag the icon of the file to the right
- > The operating elements are displayed
- ▶ To copy the file, tap **Copy file**
- ▶ To move the file, tap **Move file**
- ▶ In the dialog, select the storage location to which you want to save the file
- ▶ Tap **Select**
- > The file is stored on the product

Safely removing a USB mass storage device

- ▶ Tap **File management** in the main menu
- ▶ Navigate to the list of storage locations
- ▶ Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- ▶ Disconnect the USB mass storage device

15

Settings

15.1 Overview

This chapter describes the setting options and the associated settings parameters for the product.

The basic setting options and settings parameters for commissioning and product setup are outlined in the respective chapters:

Further information: "Commissioning", Page 135

Further information: "Setup", Page 201

Short description

Depending on the type of user that is logged in to the product, settings and settings parameters can be edited and changed (edit permission).

If a user logged in to the product has no edit permission for a setting or a settings parameter, the setting or settings parameter is grayed out and cannot be opened or edited.

Depending on the software options that have been activated on the product, various settings and settings parameters are available in the Settings menu.

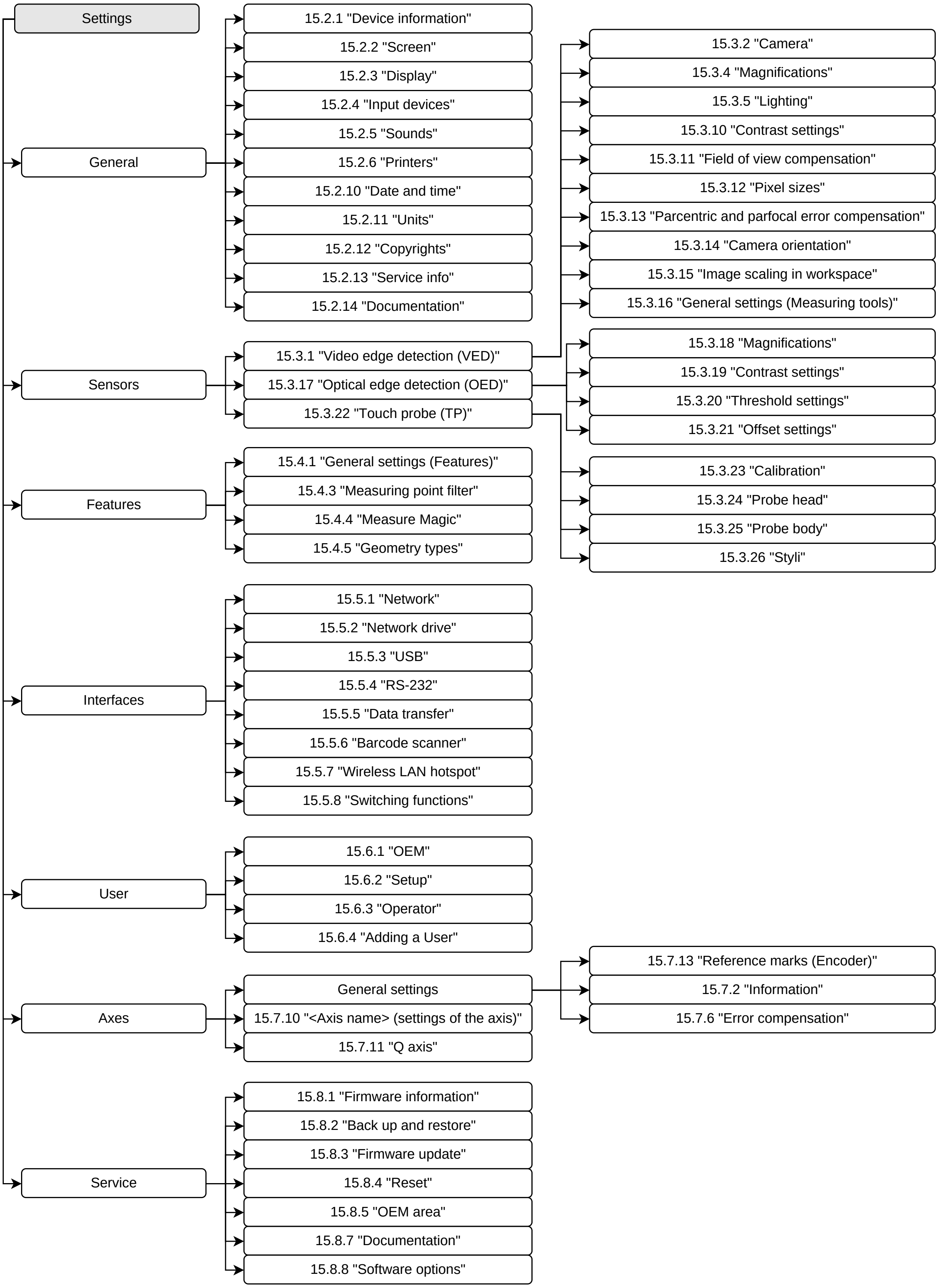
If, for example, the QUADRA-CHEK 3000 VED software option is not activated on the unit, then the settings parameters that are necessary for this software option are not displayed on the unit.

Function	Description
General	General settings and information
Sensors	Configuration of sensors and sensor-dependent functions
Features	Configuration of measuring point acquisition and features
Interfaces	Configuration of interfaces and network drives
User	Configuration of users
Axes	Configuration of connected encoders and error compensation
Service	Configuration of software options, service functions and information

Activation

- Tap **Settings** in the main menu

15.1.1 Overview of the Settings menu



15.2 General

This chapter describes settings for configuring the operation and display and for setting up printers.

15.2.1 Device information

Path: **Settings ► General ► Device information**

The overview displays basic information about the software.

Parameter	Displays the information
Product designation	Product designation of the product
Part number	ID number of the unit
Serial number	Serial number of the product
Firmware version	Version number of the firmware
Firmware built on	Firmware creation date
Last firmware update on	Date of most recent firmware update
Free memory space	Free memory space in the internal storage location **Internal**
Free working memory (RAM)	Free RAM on the system
Number of unit starts	Number of times the product was started up with the current firmware
Operating time	Operating time of the product with the current firmware

15.2.2 Screen

Path: **Settings ► General ► Screen**

Parameter	Explanation
Brightness	Brightness of the screen ■ Setting range: **1 % ... 100 %** ■ Default setting: **85 %**
Energy-save-mode timeout	Time until energy-save mode is activated ■ Setting range: **0 min ... 120 min** If the value is set to 0, the power-saving mode is deactivated ■ Default setting: **30** minutes
Quit the energy saving mode	Required actions to reactivate the screen ■ **Tap and drag**: Touch the touchscreen and drag the arrow upwards from the lower edge ■ **Tap**: Touch the touchscreen ■ **Tap or axis movement**: Touch the touchscreen or move the axis ■ Default setting: **Tap and drag**

15.2.3 Display

Path: **Settings ▶ General ▶ Display**

Parameter	Explanation
Digits before the decimal point for size-adjusted axis display	The number of digits in front of the decimal point indicates the size at which the position values are displayed. If the number of digits in front of the decimal point is exceeded, then the display is reduced in size so that all of the digits can be shown. ■ Setting range: **0 ... 6** ■ Default value: **3**

15.2.4 Input devices

Path: **Settings ▶ General ▶ Input devices**

Parameter	Explanation
Touchscreen sensitivity	The sensitivity of the touchscreen can be adjusted in three levels ■ **Low (contamination)**: allows operating the touchscreen if it is dirty ■ **Normal (standard)**: allows operating the touchscreen under normal conditions ■ **High (gloves)**: allows operating the touchscreen while wearing gloves ■ Default setting: **Normal (standard)**
Mouse substitute for multitouch gestures	Specifies whether mouse operation should replace operation using the touchscreen (multitouch) Settings: ■ **Auto (until first multitouch)**: Touching the touchscreen causes mouse deactivation ■ **On (no multitouch)**: Operation only possible with the mouse, the touchscreen is deactivated ■ **Off (only multitouch)**: Operation only possible with the touchscreen, the mouse is deactivated ■ Default setting: **Auto (until first multitouch)**
USB keyboard layout	If a USB keyboard is connected: ■ Language selection of the keyboard assignment

15.2.5 Sounds

Path: **Settings** ► **General** ► **Sounds**

The available sounds are grouped into categories. The sounds differ within a category.

Parameter	Explanation
Speaker	Use of the built-in speaker on the rear panel of the product ■ Settings: **ON** or **OFF** ■ Default setting: **ON**
Speaker volume	Volume of the product's speaker ■ Setting range: **0 % ... 100 %** ■ Default setting: **50 %**
Measuring point acquired	Sound to be played after a measuring point was acquired When you select a setting, the associated sound is played ■ Settings: **Standard**, **Guitar**, **Robot**, **Outer space**, **No sound** ■ Default setting: **Standard**
Message and Error	Sound to be played when a message is displayed When you select a setting, the associated sound is played ■ Settings: **Standard**, **Guitar**, **Robot**, **Outer space**, **No sound** ■ Default setting: **Standard**
Measurement successful	Sound to be played when the measurement was successful When you select a setting, the associated sound is played ■ Settings: **Standard**, **Guitar**, **Robot**, **Outer space**, **No sound** ■ Default setting: **Standard**
Touch tone	Sound to be played when using a touch element When you select a setting, the associated sound is played ■ Settings: **Standard**, **Guitar**, **Robot**, **Outer space**, **No sound** ■ Default setting: **Standard**

15.2.6 Printers

Path: **Settings** ► **General** ► **Printers**

Parameters	Explanation
Default printer	List of printers configured on the product
Properties	Settings of the selected default printer **Further information:** "Properties", Page 465
Add printer	Adds a **USB printer** or **Network printer** **Further information:** "Add printer", Page 465
Remove printer	Removes a **USB printer** or **Network printer** connected to the product **Further information:** "Remove printer", Page 466

15.2.7 Properties

Path: **Settings ▶ General ▶ Printers ▶ Properties**

Parameters	Explanation
Resolution	Print resolution in dpi ■ The setting range and default setting depend on the printer type
Paper size	Specification of paper size and dimensions ■ The setting range and default setting depend on the printer type
Feed tray	Specification of the paper feeder ■ The setting range and default setting depend on the printer type
Type of paper	Designation of the paper type ■ The setting range and default setting depend on the printer type
Duplex printing	Options for duplex printing ■ The setting range and default setting depend on the printer type
Color/Black and white	Specification of the printing mode ■ The setting range and default setting depend on the printer type

15.2.8 Add printer

Path: **Settings ▶ General ▶ Printers ▶ Add printer**

The following parameters are available for **USB printer** and **Network printer**.

Parameters	Explanation
Located printers	Printers detected automatically on the (USB or network) port of the product
Name	Arbitrary printer name for easy identification ℹ The text must not contain slashes ("/"), hash characters ("#") or spaces.
Description	General printer description (optional, arbitrary)
Location	General location description (optional, arbitrary)
Connection	Type of printer connection
Select the driver	Selection of the appropriate driver for the printer

15.2.9 Remove printer

Path: **Settings** ► **General** ► **Printers** ► **Remove printer**

Parameters	Explanation
Printers	List of printers configured on the product
Type	Shows the type of the configured printer
Location	Shows the location of the configured printer
Connection	Shows the connection of the configured printer
Remove the selected printer	Deletes the configured printer from the product

15.2.10 Date and time

Path: **Settings** ► **General** ► **Date and time**

Parameter	Explanation
Date and time	Current date and time of the product ■ Settings: **Year**, **Month**, **Day**, **Hour**, **Minute** ■ Default setting: **Current system time**
Date format	Format in which the date is displayed Settings: ■ **MM-DD-YYYY**: month, day, year ■ **DD-MM-YYYY**: day, month, year ■ **YYYY-MM-DD**: year, month, day ■ Default setting: **YYYY-MM-DD** (e.g. "2016-01-31")

15.2.11 Units

Path: **Settings** ► **General** ► **Units**

Parameter	Explanation
Unit for linear values	Unit of measure for linear values ■ Settings: **Millimeters** or **Inch** ■ Default setting: **Millimeters**

<table>
<tr><th>Parameter</th><th>Explanation</th></tr>
<tr><td>Rounding method for linear values</td><td>Rounding method for linear values
Settings:
Commercial: Decimal digits from 1 to 4 are rounded down, decimal digits from 5 to 9 are rounded up
Round off: Decimal digits from 1 to 9 are rounded down
Round up: Decimal digits from 1 to 9 are rounded up
Truncate: Decimal digits are truncated without rounding up or down
Round to 0 and 5: Decimal digits ≤ 24 or ≥ 75 are rounded to 0, decimal digits ≥ 25 or ≤ 74 are rounded to 5
Default setting: Commercial</td></tr>
<tr><td>Decimal places for linear values</td><td>Number of decimal places for linear values
Setting range:
Millimeters: 0 ... 5
Inch: 0 ... 7
Default value:
Millimeters: 4
Inch: 6</td></tr>
<tr><td>Unit for angular values</td><td>Unit for angular values
Settings:
Radian: angles in radian (rad)
Decimal degrees: angles in degrees (°) with decimal places
Deg-Min-Sec: angles in degrees (°), minutes ['] and seconds ["]
Default setting: Decimal degrees</td></tr>
<tr><td>Rounding method for angular values</td><td>Rounding method for decimal angular values
Settings:
Commercial: Decimal digits from 1 to 4 are rounded down, decimal digits from 5 to 9 are rounded up
Round off: Decimal digits from 1 to 9 are rounded down
Round up: Decimal digits from 1 to 9 are rounded up
Truncate: Decimal digits are truncated without rounding up or down
Round to 0 and 5: Decimal digits ≤ 24 or ≥ 75 are rounded to 0, decimal digits ≥ 25 or ≤ 74 are rounded to 5
Default setting: Commercial</td></tr>
<tr><td>Decimal places for angular values</td><td>Number of decimal places for angular values
Setting range:
Radian: 0 ... 7
Decimal degrees: 0 ... 5
Deg-Min-Sec: 0 ... 2
Default value:
Radian: 5
Decimal degrees: 3
Deg-Min-Sec: 0</td></tr>
</table>

Parameter	Explanation
Decimal separator	Separator for the display of values ■ Settings: **Point** or **Comma** ■ Default setting: **Point**

15.2.12 Copyrights

Path: **Settings** ► **General** ► **Copyrights**

Parameter	Meaning and function
Open source software	Display of the licenses of the software used

15.2.13 Service info

Path: **Settings** ► **General** ► **Service info**

Parameter	Meaning and function
HEIDENHAIN - Customer service	Display of a document containing HEIDENHAIN service addresses
OEM service info	Display of a document containing service information from the machine manufacturer ■ Default: document containing HEIDENHAIN service addresses **Further information:** "Adding documentation", Page 195

15.2.14 Documentation

Path: **Settings** ► **General** ► **Documentation**

Parameter	Meaning and function
Operating Instructions	Display of the operating instructions stored on the product ■ Default: no document; the document in the desired language can be added **Further information:** "Documentation", Page 522

15.3 Sensors

This chapter describes settings for configuring the sensors.

Depending on the software options that have been activated on the product, various parameters are available for configuring the sensors.

Software option	Sensor
QUADRA-CHEK 3000 VED software option	**Video edge detection (VED)**: The product supports the use of a VED sensor (sensor for video edge detection). A VED sensor is a USB camera or network camera connected to the product. **Further information:** "Video edge detection (VED)", Page 469
QUADRA-CHEK 3000 OED software option	**Optical edge detection (OED)**: The product supports the use of an OED sensor (sensor for optical edge detection). An OED sensor is a fiber-optic cable connected to the product, enabling changes in contrast to be detected on the shield of a profile projector. **Further information:** "Optical edge detection (OED)", Page 482
QUADRA-CHEK 3000 3D software option	**Touch probe** The product supports the use of a touch probe for measuring 3-D objects. **Further information:** "Touch probe (TP)", Page 484

15.3.1 Video edge detection (VED)

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)**

Parameter	Explanation
Camera	List of selectable virtual cameras and cameras connected to the product
Magnifications	Definition of the magnifications available on the measuring machine
Lighting	Configuration of the lighting in accordance with the lighting variant used
Contrast settings	Edge algorithm and contrast threshold for defining from when a light-to-dark transition is recognized as an edge
Field of view compensation	Adjusts deviations caused by the properties of the lens
Pixel sizes	Pixel size of the live image compared to the actual size of the object of measurement
Parcentric and parfocal error compensation	Adjusts deviations caused by the mechanical setting of the magnifications
Camera orientation	Compensation of camera orientation
Image scaling in workspace	Scaling of the live image by a defined factor in the workspace
Measuring tools	Configuration of the measuring tools

15.3.2 Camera

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Camera**

The **Camera** menu lists the virtual cameras as well as the camera that is connected to the product.

The displayed information relates to the respective camera; the values specified by the respective manufacturer apply to the settings.

15.3.3 Virtual camera or hardware camera

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Camera** ► **Camera designation**

> The available parameters and settings depend on the camera model connected and may differ from the list given below.

Parameter	Explanation
Camera	Shows the name of the camera
Serial number	Shows the serial number of the camera
Sensor resolution	Shows the resolution of the camera sensor
Frames per second	Shows the number of camera images per second
Frames (successful/faulty)	Shows the number of successful and faulty images taken since the last time the product was powered up
Pixel format	Displayable color range of the camera image Settings: ■ **8 Bit**: 256 colors ■ **16 Bit**: 65 536 colors ■ **24 Bit**: 16.78 million colors ■ **32 Bit**: 16.78 million colors with accelerated rendering
Image directory	Location in which the demo image is stored on the product (can only be set for virtual cameras) ■ Default setting: **Internal/System/Camera**
Network settings	Network address and subnet mask of the network connection (can only be set for connected **(GigE)** camera) **DHCP** ■ Settings: **ON** or **OFF** ■ Default setting: **OFF** The camera must be in the same subnet as the product.

Parameter	Explanation
Mirroring of the image	Depending on the mechanical mounting of the camera, the image can be mirrored in the camera (can only be set for connected cameras) Settings: ■ **None**: Image is not mirrored ■ **Horizontal**: Image is mirrored horizontally ■ **Vertical**: Image is mirrored vertically ■ **Horizontal and vertical**: Image is mirrored horizontally and vertically ■ Default setting: **None**
Pixel clock (MHz)	Rate at which the image data are read from the camera sensor ■ Setting range: Depending on connected camera
Frame rate (fps)	Number of single images acquired per second ■ Setting range: Depending on connected camera For image evaluation, the field of view of the camera can be reduced to the relevant image section. This enables you to increase e.g. the **Frame rate (fps)**, if required. The zero point for determining the size and position of the image section is located in the upper left corner of the camera's field of view. The width and height as well as the X and Y positions are set with respect to the zero point.
Detail: Width	Width of the image section relevant to image evaluation ■ Setting range: depending on connected camera
Detail: Height	Height of the image section relevant to image evaluation ■ Setting range: depending on connected camera
Detail: X position	X position of the image section relevant to image evaluation ■ Setting range: depending on connected camera
Detail: Y position	Y position of the image section relevant to image evaluation ■ Setting range: depending on connected camera
Master gain	The camera sensor outputs a voltage in proportion to the amount of incident light. If you want to increase image brightness and contrast, you can use analog gain to increase this voltage before digitizing. The **Master gain** leads to an increase in the overall brightness of the resulting image and improves the contrast. Master gain for increasing brightness and contrast ■ Setting range: **1 % ... 100 %**

Parameter	Explanation
Red gain	Comparable with **Master gain**, **Red gain** can be used for setting the gain for this color value. **Red gain** for increasing brightness and contrast ■ Setting range: **1 % ... 100 %**
Green gain	Comparable with **Master gain**, **Green gain** can be used for setting the gain for this color value. **Green gain** for increasing brightness and contrast ■ Setting range: **1 % ... 100 %**
Blue gain	Comparable with **Master gain**, **Blue gain** can be used for setting the gain for this color value. **Blue gain** for increasing brightness and contrast ■ Setting range: **1 % ... 100 %**
Exposure time (µs)	Length of time during which the light for image acquisition can reach the sensor ■ Setting range: depending on connected camera
Deactivate camera	Deactivates the camera and live image

15.3.4 Magnifications

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Magnification**

If an optical sensor is active you can configure one or more magnifications. For each optical magnification available on the measuring machine, a **Magnification** must be set up on the product. During measurement the optical magnification must match the magnification set on the product.

Parameter	Explanation
Magnifications Default magnification: **VED Zoom 1**	Definition of the respective magnifications ■ Input for **Description** and **Acronym for quick access menu**: At least one character ■ Default setting: **VED Zoom 1** and **VZ1**
+	Adding a new magnification

15.3.5 Lighting

Path: **Settings ► Sensors ► Video edge detection (VED) ► Lighting**

Parameter	Explanation
General settings	Global settings for lighting
A transmitted light + 4 x AD reflected light	Configuration of lighting using transmitted light and reflected light
A trans.light + 4 x A refl.light + D laser pointer	Configuration of lighting using transmitted light, reflected light and laser pointer
AD trans.light + 4 x AD refl.light + AD coaxial light + exposure time	Configuration of lighting using transmitted light, reflected light, coaxial light and camera exposure time

15.3.6 General settings (Lighting)

Path: **Settings ► Sensors ► Video edge detection (VED) ► Lighting ► General settings**

Parameter	Explanation
Linking with magnifications	Setting of reflected light and transmitted light depending on the magnification Settings: ■ **ON**:When selecting a magnification, the last selected setting for this magnification is set for the lighting ■ **OFF**: When selecting a magnification, no changes are made to the lighting ■ Default setting: **OFF**

15.3.7 A transmitted light + 4 x AD reflected light

Path: **Settings ► Sensors ► Video edge detection (VED) ► Lighting ► A transmitted light + 4 x AD reflected light**

Parameter	Explanation
Analog output for transmitted light	Assignment of the analog outputs for reflected light and transmitted light according to pin layout Default value: **Not connected**
Analog output for reflected light	
Digital output for front segment	Assignment of the digital outputs for reflected-light segments according to pin layout Default value: **Not connected**
Digital output for rear segment	
Digital output for left segment	
Digital output for right segment	

15.3.8 A trans.light + 4 x A refl.light + D laser pointer

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Lighting** ► **A trans.light + 4 x A refl.light + D laser pointer**

Parameter	Explanation
Analog output for transmitted light	Assignment of the analog outputs for reflected-light segments and transmitted light according to pin layout Default value: **Not connected**
Analog output for front segment	
Analog output for rear segment	
Analog output for left segment	
Analog output for right segment	
Digital output for laser pointer	Assignment of the digital outputs for laser pointer according to pin layout Default value: **Not connected**

15.3.9 AD trans.light + 4 x AD refl.light + AD coaxial light + exposure time

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Lighting** ► **AD trans.light + 4 x AD refl.light + AD coaxial light + exposure time**

Parameter	Explanation
Transmitted light	Configuration of the transmitted light
Reflected light	Configuration of the reflected light
Coaxial light	Configuration of the coaxial light
Camera exposure time	Configuration of the camera's exposure time

Transmitted light

Parameter	Explanation
Function	Use of transmitted light ■ Settings: **ON** or **OFF** ■ Default setting: **ON**
Digital output	Assignment of the digital output for lighting according to pin layout Default value: **Not connected**
Analog output	Assignment of the analog output for lighting according to pin layout Default value: **Not connected**
Minimum selectable voltage	Minimum output voltage at the analog output ■ Setting range: **0 mV ... 9900 mV** ■ Default value: **0**
Maximum selectable voltage	Maximum output voltage at the analog output ■ Setting range: **100 mV ... 10000 mV** ■ Default value: **10000**
Slider threshold for "light off"	Threshold value for the slider in % in the control range, starting from which the light is activated or deactivated ■ Setting range: **0 ... 100** ■ Default value: **5**

Reflected light

Parameter	Explanation
Function	Use of reflected light ▪ Settings: **ON** or **OFF** ▪ Default setting: **ON**
Digital output for front segment **Digital output for rear segment** **Digital output for left segment** **Digital output for right segment**	Assignment of the digital outputs for the reflected-light segments according to pin layout Default value: **Not connected**
Analog output for front segment **Analog output for rear segment** **Analog output for left segment** **Analog output for right segment**	Assignment of the analog outputs for the reflected-light segments according to pin layout Default value: **Not connected**
Minimum selectable voltage	Minimum output voltage at the analog output ▪ Setting range: **0 mV ... 9900 mV** ▪ Default value: **0**
Maximum selectable voltage	Maximum output voltage at the analog output ▪ Setting range: **100 mV ... 10000 mV** ▪ Default value: **10000**
Slider threshold for "light off"	Threshold value for the slider in % in the control range, starting from which the light is activated or deactivated ▪ Setting range: **0 ... 100** ▪ Default value: **5**

Coaxial light

Parameter	Explanation
Function	Use of the coaxial light ■ Settings: **ON** or **OFF** ■ Default setting: **ON**
Digital output	Assignment of the digital output for lighting according to pin layout Default value: **Not connected**
Analog output	Assignment of the analog output for lighting according to pin layout Default value: **Not connected**
Minimum selectable voltage	Minimum output voltage at the analog output ■ Setting range: **0 mV ... 9900 mV** ■ Default value: **0**
Maximum selectable voltage	Maximum output voltage at the analog output ■ Setting range: **100 mV ... 10000 mV** ■ Default value: **10000**
Slider threshold for “light off”	Threshold value for the slider in % in the control range, starting from which the light is activated or deactivated ■ Setting range: **0 ... 100** ■ Default value: **5**

Camera exposure time

Parameter	Explanation
Function	Use of the camera exposure time ■ Settings: **ON** or **OFF** ■ Default setting: **ON**
Minimum exposure time	Minimum length of time during which the light for image acquisition can reach the sensor ■ Setting range: Depending on connected camera
Maximum exposure time	Maximum length of time during which the light for image acquisition can reach the sensor ■ Setting range: Depending on connected camera

Minimum exposure time and **Maximum exposure time** define the setting range of the slider for the exposure time in the lighting.

15.3.10 Contrast settings

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Contrast settings**

Parameter	Explanation
Contrast bar	Displays the **Contrast bar** slider in the workspace for continuously adjusting the contrast threshold Settings: ■ **ON**: Contrast bar is displayed ■ **OFF**: Contrast bar is not displayed ■ Default value: **OFF** **Further information:** "Contrast bar", Page 105
All users can alter the contrast threshold value	Defines which users can adjust the contrast threshold via the contrast bar. If there is no permission the contrast bar is displayed but cannot be adjusted Settings: ■ **ON**: All users can adjust the contrast threshold via the contrast bar ■ **OFF**: Only users of the **OEM** or **Setup** type can adjust the contrast threshold via the contrast bar ■ Default value: **ON**
Orientation of contrast bar	Defines how the contrast bar is displayed in the workspace Settings: ■ **Vertical**: Contrast bar oriented vertically ■ **Horizontal**: Contrast bar oriented horizontally ■ Default value: **Horizontal**
Edge algorithm	Contrast definition for edge detection Settings: ■ **First edge**: The first detected contrast transition that is equal to or greater than the contrast threshold value is defined as the edge ■ **Strongest edge**: The strongest contrast transition that is equal to or greater than the contrast threshold value is defined as the edge ■ **Automatic**: The contrast threshold is determined automatically during each measurement. The edge calculation is implemented with the **First edge** edge algorithm ■ Default value: **First edge**
Contrast	Display of the minimum and maximum contrast determined in the teach sequence. The search area of the VED measuring tool in the live image is evaluated
Contrast threshold value for edge detection	Threshold value for the contrast starting from which a transition is recognized as an edge ■ Setting range: **0 ... 255** ■ Default value: **0**

Parameter	Explanation
Contrast threshold value for measuring tool auto contour	Threshold value for the contrast from which on the Auto contour measuring tool recognizes a transition as an edge ■ Setting range: **0 ... 255** ■ Default value: **0**
Teach sequence	Teach sequence for determining the contrast threshold value for edge detection and for the Auto contour measuring tool

15.3.11 Field of view compensation

Path: **Settings** ▶ **Sensors** ▶ **Video edge detection (VED)** ▶ **Field of view compensation**

The **Field of view compensation** adjusts deviations caused by the properties of the lens (lens curvature).

Parameter	Explanation
Compensation	Field of view compensations are adjusted Settings: ■ **ON**: Compensation is active ■ **OFF**: Compensation is not active ■ Default value: **OFF**
Magnification	List of available magnifications **Further information:** "Magnifications", Page 472
Number of supporting points	Number of measuring points for error compensation on both axes (X and Y) of the encoder ■ Setting range: **3 ... 11** (X and Y) ■ Default value: **5** (X and Y)
Table of supporting points	Opens the table of supporting points for manual editing
Teach sequence	The teach sequence for determining the compensation values is started

15.3.12 Pixel sizes

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Pixel sizes**

Parameter	Explanation
Magnification	List of available magnifications **Further information:** "Magnifications", Page 472
Calibration standard diameter	Circle diameter specified in the calibration chart for the calibration standard Setting range ■ **Millimeters**: **0.00001 mm ... 50 mm** ■ **Inch**: **0.0000004" ... 2"** Default value: ■ **Millimeters**: **1.0000** ■ **Inch**: **0.039370**
Pixel size	Determined system pixel size Setting range ■ **Millimeters**: **0.00001 mm ... 5 mm** ■ **Inch**: **0.0000004" ... 0.2"** Default value: ■ **Millimeters**: **1.0000** ■ **Inch**: **0.0393700787**
Teach sequence	Teach sequence for determining the **Pixel size** for the selected **Magnification**

15.3.13 Parcentric and parfocal error compensation

Path: **Settings** ► **Sensors** ► **Video edge detection (VED)** ► **Parcentric and parfocal error compensation**

Parcentric and parfocal error compensation compensates for position deviations caused by errors in a lens with magnification settings. Parcentric error compensation compensates for deviations in the X and Y axes. Parfocal error compensation compensates for deviations in the Z axis.

Parameter	Explanation
Compensation	Mechanical factors of influence are compensated with the adjustment of magnifications Settings: ■ **ON**: Compensation is active ■ **OFF**: Compensation is not active ■ Default value: **OFF**
Reference magnification	Selection of reference magnification **Further information:** "Magnifications", Page 472
Magnification offsets	Display of the deviations per axis determined in the teach sequence for each available magnification
Teach sequence	Teach sequence for determining the compensation factor for all available magnifications

15.3.14 Camera orientation

Path: **Settings ► Sensors ► Video edge detection (VED) ► Camera orientation**

Parameter	Explanation
Camera skew	Compensation of the camera skew caused by the mechanical mounting ■ Setting range: **-5° ... +5°** ■ Default value: **0°**
Teach sequence	Teach sequence for determining the **Camera orientation**

15.3.15 Image scaling in workspace

Path: **Settings ► Sensors ► Video edge detection (VED) ► Image scaling in workspace**

Parameter	Explanation
Scaling	Activation of image scaling in the workspace: The camera image in the workspace is reduced by the scaling factor ■ Settings: **ON** or **OFF** ■ Default setting: **OFF**
Scaling factor	Factor by which the camera image is reduced in the workspace ■ Setting range: **0.00001 ... 1.00000** ■ Default value: **1.00000**

15.3.16 General settings (Measuring tools)

Path: **Settings ► Sensors ► Video edge detection (VED) ► Measuring tools ► General settings**

Parameter	Explanation
All users can alter measuring tool settings	Determines for which users the **Measuring tool settings** dialog is visible in which the measuring tool settings can be modified Settings: ■ **ON**: All users can see the operating element ■ **OFF**: Only **OEM**-type or **Setup**-type users can see the operating element ■ Default value: **ON** **Further information:** "Controls for measuring with a VED sensor", Page 89

15.3.17 Optical edge detection (OED)

Path: **Settings** ► **Sensors** ► **Optical edge detection (OED)**

Parameter	Explanation
Magnifications	Definition of the magnifications available on the measuring machine **Further information:** "Magnifications", Page 482
Contrast settings	Settings and measured values to determine the light intensity **Further information:** "Contrast settings", Page 483
Threshold settings	Defines from when a light-to-dark transition is recognized as an edge **Further information:** "Threshold settings", Page 483
Offset settings	Defines which offset between the crosshairs and OED sensor must be calculated in with point acquisition **Further information:** "Offset settings", Page 484

15.3.18 Magnifications

Path: **Settings** ► **Sensors** ► **Optical edge detection (OED)** ► **Magnifications**

If an optical sensor is active you can configure one or more magnifications. For each optical magnification available on the measuring machine, a **Magnification** must be set up on the product. During measurement the optical magnification must match the magnification set on the product.

Parameter	Explanation
Magnifications Default magnification: **OED Zoom 1**	Definition of the respective magnifications ■ Input for **Description** and **Acronym for quick access menu**: At least one character ■ Default setting: **OED Zoom 1** and **OZ1**
+	Adding a new magnification

15.3.19 Contrast settings

Path: **Settings ▶ Sensors ▶ Optical edge detection (OED) ▶ Contrast settings**

Parameter	Explanation
Intensity	Display of the measured light intensity of reference (R) and shield (S) ■ Setting range: **0 ... 4095**
Settling time	Measurement duration for detecting the light intensity values for reference (R) and shield (S) ■ Setting range: **0 ms ... 300 ms**
Magnifications	Selecting the magnification that the subsequent settings and the teach sequence refer to
Target intensity	Target light intensity of reference (R) and shield (S) ■ Setting range: **0 ... 4095**
Gain	Gain for reference (R) and shield (S) ■ Setting range: **0 ... 255**
Teach sequence	**Start** begins the teach sequence for determining the optimum compensation values

15.3.20 Threshold settings

Path: **Settings ▶ Sensors ▶ Optical edge detection (OED) ▶ Threshold settings**

Parameter	Explanation
Threshold settling time	Delay time during modification of the threshold value ■ Setting range: **0 ms ... 300 ms**
Magnification	Selecting the magnification that the subsequent setting and the teach sequence refer to
Threshold	Switching threshold ■ Setting range: **0 ... 1023** ■ Default value: Mean value between the light value (target intensity) and dark value (measured value in the dark range)
Teach sequence	**Start** begins the teach sequence for determining the optimum threshold value for edge detection

15.3.21 Offset settings

Path: **Settings** ► **Sensors** ► **Optical edge detection (OED)** ► **Offset settings**

Parameter	Explanation
Current offset	Display of the position error determined in the teach sequence between the OED sensor and crosshairs for both X and Y axes.
Magnification	List of the available magnifications for selecting the magnification that the **Current offset** value refers to **Further information:** "Magnifications", Page 482
Tolerance of circle diameter	Permissible deviation between the two circle diameters measured in the teach sequence ■ Setting range: **0.001 ... 1.000** ■ Default value: **0,200** An error message is output if the diameter of the circles measured in the teach sequence exceeds the specified tolerance.
Teach sequence	**Start** begins the teach sequence for determining the offset between the OED sensor and the crosshair.

15.3.22 Touch probe (TP)

Path: **Settings** ► **Sensors** ► **Touch probe (TP)**

Parameter	Explanation
Calibration	Configuration of the calibration **Further information:** "Calibration", Page 485
Probe head	Configuration of the touch probe head **Further information:** "Probe head", Page 486
Probe body	Definition of the touch probe body **Further information:** "Probe body", Page 487
Styli	Definition of the styli **Further information:** "Styli", Page 487

15.3.23 Calibration

Path: **Settings ▶ Sensors ▶ Touch probe (TP) ▶ Calibration**

Parameter	Explanation
Diameter of calibration sphere	Recorded sphere diameter Setting range ■ **Millimeters**: **0.00001 mm ... 50 mm** ■ **Inch**: **0.0000004" ... 2"** Default value: ■ **Millimeters**: **1.0000** ■ **Inch**: **0.039370**
Reset calibration data for all touch probes	The settings are reset to factory default settings

15.3.24 Probe head

Path: **Settings** ► **Sensors** ► **Touch probe (TP)** ► **Probe head**

Parameter	Explanation
Probe head	Settings: ■ **Fixed**: Touch probe head with fixed angle ■ **Indexed swiveling**: The touch probe head can be swiveled in angle increments ■ **Non-indexed swiveling**: The touch probe head can be swiveled freely ■ Default value: **Fixed** When **Indexed swiveling** is selected, the following additional settings are displayed.
Axis A Adjustment range (°)	Range of adjustment of the touch probe head in the A axis Setting range: ■ Lower limit (**L**): **-360° ... 18°** ■ Upper limit (**U**): **180° ... 360°** Default setting: ■ **L**: **0°** ■ **U**: **180°**
Axis A Step size (°)	Step size of the touch probe head in the A axis Setting range: **1° ... 360°** Default setting: **15°**
Axis B Adjustment range (°)	Range of adjustment of the touch probe head in the B axis Setting range: ■ Lower limit (**L**): **-360° ... 180°** ■ Upper limit (**U**): **180° ... 360°** Default setting: ■ **L**: **-180°** ■ **U**: **180°**
Axis B Step size	Step size of the touch probe head in the B axis Setting range: **1 ... 360°** Default setting: **15°**

15.3.25 Probe body

Path: **Settings** ► **Sensors** ► **Touch probe (TP)** ► **Probe body**

Parameter	Explanation
Type	Settings: ■ **Triggered**: Touch probe body with signal triggering upon deflection ■ **Hard**: Rigid touch probe body ■ Default value: **Triggered**
Evaluation of the ready signal	Evaluates the ready signal of the touch probe body Settings: ■ **ON**: Evaluation is active ■ **OFF**: Evaluation is inactive ■ Default value: **ON**

15.3.26 Styli

Path: **Settings** ► **Sensors** ► **Touch probe (TP)** ► **Styli**

Parameter	Explanation
+	Adds a new stylus
Name	Freely selectable stylus name
Type	Geometry of the stylus Settings: ■ **Straight** ■ **Star** ■ Default value: **Straight**

15.4 Features

This chapter describes settings for configuring the measuring point acquisition.

15.4.1 General settings (Features)

Path: **Settings** ▶ **Features** ▶ **General settings**

Parameter	Explanation
Number of measuring points	Specifies whether the number of measuring points is fixed or freely selectable for each feature Settings: ■ **Free**: Number of measuring points is freely selectable ■ **Fixed**: Number of measuring points is fixed ■ Default setting: **Free**
Distances	Display of the measuring point distance Settings: ■ **Signed**: Distances are displayed with a positive or negative algebraic sign, depending on the relative direction ■ **Absolute**: Distances are displayed without an algebraic sign, independently of the relative direction ■ Default setting: **Signed**
Measurement result preview	A window is displayed with detailed information about the measured feature ■ Settings: **ON** or **OFF** ■ Default setting: **ON** **Further information:** "Controls of the Inspector", Page 121 The parameters displayed in the measurement result preview can be defined individually for each geometry type **Further information:** "Geometry types", Page 494
Traverse for closing the measurement result preview	Definition of the traverse path after which the measurement result preview closes automatically Default setting: **0.5000** Unit: millimeters or inches (depending on the setting in the quick access menu **Further information:** "Controls of the Inspector", Page 121
Coordinate systems	Creation of coordinate systems

15.4.2 Coordinate systems

Path: **Settings** ▶ **Features** ▶ **General settings** ▶ **Coordinate systems**

Parameter	Explanation
Create coordinate system automatically	Defines whether a new coordinate system is created automatically upon each definition of a new zero point. In this case, the naming convention **COS[x]** is used; the value **[x]** is incremented sequentially (COS1, COS2, ...). This option can also be activated in the quick access menu. ■ Settings: **ON** or **OFF** ■ Default setting: **OFF**

15.4.3 Measuring point filter

Path: **Settings** ► **Features** ► **Measuring point filter**

Information about the measuring point filter

The measuring point filter enables automatic filtering and prevents contamination on the object of measurement or encoder optic from distorting the measurement result.

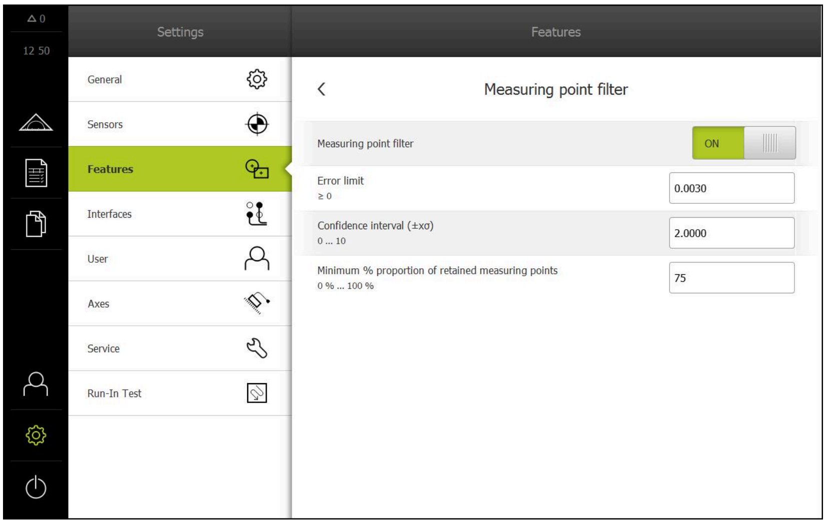


Figure 124: Settings of the measuring point filter

The measuring point filter identifies runaway values in the measuring point cloud based on the following filter criteria:

- **Error limit**
- **Confidence interval (±xσ)**
- **Minimum % proportion of retained measuring points**

Filtered-out measuring points are not included in the calculation of a feature.

The measuring point filter can be used for the following feature types:

- **Even**
- **Circle**
- **Cone**
- **Cylinder**
- **Sphere**
- **Plane**
- **Arc**
- **Ellipse**
- **Slot**
- **Rectangle**

Error limit filter

The **Error limit** filter specifies the maximum permitted deviation per measuring point.

Deviation = orthogonal distance to the feature

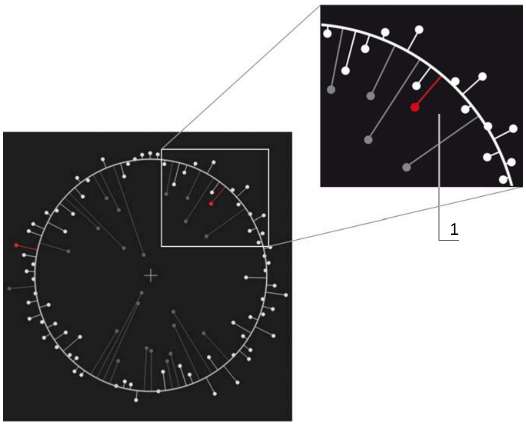


Figure 125: Schematic representation of the form with point cloud and deviations

1 Maximum permissible deviation

Confidence interval (±xσ) filter

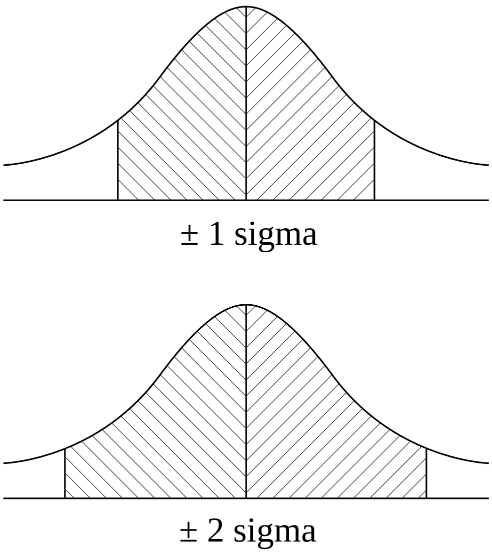


Figure 126: Schematic representation of the confidence interval

Normal distribution is assumed with dispersion of the deviations. The mean value corresponds to the average of all deviations.

The **Confidence interval (±xσ)** filter limits a range that must be included in the calculation. The limits of the confidence interval correspond to the standard deviation (Sigma) multiplied by the Sigma factor:

Confidence interval = Sigma factor * Sigma

Entering the Sigma factor into the **Confidence interval (±xσ)** field influences the width of the confidence interval.

Example: If you select Sigma factor 2, the confidence interval includes almost 95 % of all values.

Minimum % proportion of retained measuring points filter

To prevent the measuring result from becoming obsolete, the majority of measuring points should be kept. The **Minimum % proportion of retained measuring points** filter enables you to define the percentage of all measuring points that must be included in the calculation.

Filter procedure: least-square-best-fit procedure in accordance with Gauß

Runaway values are determined according to the least-square-best-fit procedure and filtered out:

1. Feature is calculated from all measuring points. The Gauß compensation is applied independently of the compensation process you selected for the feature
2. Measuring point with the greatest deviation is checked with filter criteria:
   - Deviation is greater than the value in the **Error limit** field
   - Deviation is outside the confidence interval—if the point is filtered out, **Minimum % proportion of retained measuring points** is not fallen below
   - If the deviation fulfills all criteria the point is filtered out
3. The feature and confidence interval are recalculated (Gauß compensation) based on the remaining points
4. The process is repeated for each point, always based on the greatest deviation
5. The process stops as soon as a deviation falls below the **Error limit**, or is inside the confidence interval, or as soon as **Minimum % proportion of retained measuring points** is fallen below
6. The previously checked point is kept
7. The feature is recalculated with the compensation process you selected for the feature. No more points are filtered out

Bar chart display

Display	Explanation	
	**White**	The measuring point is taken into account in the calculation. Deviation is less than the error limit and is inside the confidence interval.
	Red	The measuring point is taken into account in the calculation. Deviation is greater than the error limit or is outside the confidence interval.
	Gray	The measuring point was filtered out and is not taken into account in the calculation.

> The measuring point filter always uses the Gauß compensation independently of the selected compensation process. Observe that runaway values are determined differently according to the compensation process—this may lead to different results.

Further information: "Fitting algorithm", Page 382

Settings of the measurement point filter

Parameter	Explanation
Measuring point filter	Automatic identification of runaway values in the measuring point cloud under consideration of the following filter criteria ■ Settings: **ON** or **OFF** ■ Default setting: **ON**
Error limit	Filter precondition Input of the maximum permitted deviation per measuring point from the calculated feature ■ Setting range: ≥ **0** (**Millimeters** or **Inch**) ■ Default setting: **0.0030 mm or 0.0001181"**
Confidence interval (±xσ)	Filter precondition Input of the Sigma factor for calculating the confidence interval ■ Setting range: **0 ... 10** ■ Default value: **2.0000**
Minimum % proportion of retained measuring points	Filter precondition Input of the minimum amount of all measuring points needed for calculating the feature ■ Setting range: **0 % ... 100 %** ■ Default value: **75 %**

15.4.4 Measure Magic

Path: **Settings** ► **Features** ► **Measure Magic**

Parameter	Explanation
Maximum form deviation ratio	Maximum permissible ratio of form error to main dimension for recognizing a feature ■ Setting range: ≥ **0** ■ Default value: **0.0500**
Minimum angle for an arc	Minimum angle for recognizing a circular arc ■ Setting range: **0° ... 360°** ■ Default value: **15,000**
Maximum angle for an arc	Maximum angle for recognizing a circular arc ■ Setting range: **0° ... 360°** ■ Default value: **195,000**
Minimum line length	Minimum length for recognizing a line ■ Setting range: ≥ **0** ■ Default value: **0.0010**
Minimum numeric ellipse eccentricity	Ratio of the two reference axes for recognizing an ellipse ■ Setting range: ≥ **0** ■ Default value: **0.5000**

15.4.5 Geometry types

Path: **Settings ► Features ► Point, straight line ...**

Parameter	Explanation
Minimum number of points for a measurement	Minimum number of points to be acquired for measuring the specific feature **Further information:** "Overview of the minimum number of points for a measurement", Page 494
Measurement result preview	List of parameters that can be displayed in the measurement result preview for the specific feature ■ Settings for each parameter: **ON** or **OFF** ■ Default setting: **ON** (exception: **Display of coordinate value Z**) **Further information:** "Overview of parameters in the measurement result preview", Page 495

Overview of the minimum number of points for a measurement

Geometry type	Settings
Point	■ Setting range: **1 ... 100** ■ Default value: **1**
Even	■ Setting range: **2 ... 100** ■ Default value: **2**
Circle	■ Setting range: **3 ... 100** ■ Default value: **3**
Cone	■ Setting range: **6 ... 100** ■ Default value: **6**
Cylinder	■ Setting range: **6 ... 100** ■ Default value: **6**
Sphere	■ Setting range: **4 ... 100** ■ Default value: **4**
Plane	■ Setting range: **3 ... 100** ■ Default value: **3**
Arc	■ Setting range: **3 ... 100** ■ Default value: **3**
Ellipse	■ Setting range: **5 ... 100** ■ Default value: **5**
Slot	■ Setting range: **5 ... 100** ■ Default value: **5**
Rectangle	■ Setting range: **5 ... 100** ■ Default value: **5**
Blob	■ Setting range: **3 ... 100** ■ Default value: **3**

Geometry type	Settings
Reference plane	■ Setting range: **3 ... 100** ■ Default value: **3**
Reference cone	■ Setting range: **6 ... 100** ■ Default value: **6**
Reference cylinder	■ Setting range: **6 ... 100** ■ Default value: **6**
Alignment	■ Setting range: **2 ... 100** ■ Default value: **2**
Distance	■ Setting range: **2 ... 100** ■ Default value: **2**
Angle	■ Setting range: **4 ... 100** ■ Default value: **4**

Overview of parameters in the measurement result preview

For each geometry type it can be defined which parameters are displayed in the measurement result preview. Which parameters are available depends on the specific geometry type.

The measurement result preview can contain the following parameters:

Parameter	Explanation
X	**Display of coordinate value X** Default setting: **ON**
Y	**Display of coordinate value Y** Default setting: **ON**
Z	**Display of coordinate value Z** Default setting: **OFF**
	**Display of form deviation** Default setting: **ON**
Θ	**Display of angle** Default setting: **ON**
R	**Display of radius** Default setting: **ON**
D	**Display of diameter** Default setting: **ON**
Θ_S	**Display of start angle** Default setting: **ON**
Θ_E	**Display of end angle** Default setting: **ON**
L	**Display of length** Default setting: **ON**
W	**Display of width** Default setting: **ON**

Parameter	Explanation
A	**Display of area** Default setting: **ON**
C	**Display of circumference** Default setting: **ON**
	**Number of measuring points** (measuring points for calculating the feature / acquired measuring points) Cannot be configured, is displayed by default
	**Coordinate system** Cannot be configured, is displayed by default
	**Fitting algorithm** Cannot be configured, is displayed by default
Θ	**Align** Cannot be configured, is displayed by default
	**Align** Cannot be configured, is displayed by default
	**Align** Cannot be configured, is displayed by default

15.5 Interfaces

This chapter describes settings for configuring networks, network drives, and USB mass storage devices.

15.5.1 Network

Path: **Settings** ► **Interfaces** ► **Network** ► **X116** or **X117**

> Contact your network administrator for the correct network settings for configuring the product.

Parameter	Explanation
MAC address	Unique hardware address of the network adapter
DHCP	Dynamically assigned network address of the product ■ Settings: **ON** or **OFF** ■ Default value: **ON**
IPv4 address	Network address consisting of four octets The network address is automatically assigned if DHCP is active, or it can be entered manually ■ Setting range: **0.0.0.1 ... 255.255.255.255**
IPv4 subnet mask	Identifier within the network, consisting of four octets The subnet mask is automatically assigned if DHCP is active, or it can be entered manually. ■ Setting range: **0.0.0.0 ... 255.255.255.255**
IPv4 standard gateway	Network address of the router connecting a network The network address is automatically assigned if DHCP is active, or it can be entered manually. ■ Setting range: **0.0.0.1 ... 255.255.255.255**
IPv6 SLAAC	Network address with extended namespace Only required if supported in the network ■ Settings: **ON** or **OFF** ■ Default value: **OFF**
IPv6 address	Automatically assigned if **IPv6 SLAAC** is active
IPv6 subnet prefix length	Subnet prefix in IPv6 networks
IPv6 standard gateway	Network address of the router connecting a network
Preferred DNS server	Primary server for mapping the IP address
Alternative DNS server	Optional server for mapping the IP address

15.5.2 Network drive

Path: **Settings** ► **Interfaces** ► **Network drive**

> Contact your network administrator for the correct network settings for configuring the product.

Parameter	Explanation
Name	Folder name displayed in the file management Default value: **Share** (cannot be changed)
Server IP address or host name	Name or network address of the server
Shared folder	Name of the shared folder
User name	Name of the authorized user
Password	Password of the authorized user
Show password	Display of the password in plain text ■ Settings: **ON** or **OFF** ■ Default value: **OFF**
Network drive options	Configuration of the **Authentication** for encrypting the password in the network Settings: ■ **None** ■ **Kerberos V5 authentication** ■ **Kerberos V5 authentication and packet signing** ■ **NTLM password hashing** ■ **NTLM password hashing with signing** ■ **NTLMv2 password hashing** ■ **NTLMv2 password hashing with signing** ■ Default value: **None** Configuration of the **Mount options** Settings: ■ Default value: **nounix,noserverino**

15.5.3 USB

Path: **Settings** ► **Interfaces** ► **USB**

Parameter	Explanation
Automatically detect attached USB mass storage devices	Automatic recognition of a USB mass storage device ■ Settings: **ON** or **OFF** ■ Default setting: **ON**

15.5.4 RS-232

Path: **Settings** ► **Interfaces** ► **RS-232** ►**X31**, **X32**, **X33**, **X34**

The parameters of the **RS-232** adapter are output.

Parameter	Explanation
Baud rate	Configuration of the transfer rate Setting range: **1 ... 115200**
Data bits	Selection of the number of data bits Settings: ■ **5 bits** ■ **6 bits** ■ **7 bits** ■ **8 bits**
Parity	Selection of the parity bit for verification Settings: ■ **None** ■ **Even** ■ **Odd** ■ **Space** ■ **Mark**
Stop bits	Selection of the stop bit for synchronization Settings: ■ **1 bit** ■ **2 bits**
Flow control	Selection of the data flow Settings: ■ **None** ■ **Hardware** ■ **Xon/Xoff**

15.5.5 Data transfer

Path: **Settings ► Interfaces ► Data transfer**

Parameter	Explanation
RS-232	Selection of the serial port Settings: ■ **None** ■ **X31** ■ **X32** ■ **X33** ■ **X34** Default value: **None**
Data format for data transfer	Selection of the data format for measured value output Settings: ■ **Standard** ■ **Steinwald** ■ **MyFormat1** (template for copying) ■ Any data formats you have defined yourself Default value: **Standard**

15.5.6 Barcode scanner

Path: **Settings ► Interfaces ► Barcode scanner**

Parameter	Explanation
Device	Activation of the barcode scanner ■ Settings: **ON** or **OFF** ■ Default setting: **OFF**
Filter setting 1	Number of characters truncated at the start of the code ■ Setting range: **0 ... 100** ■ Default value: **21** The first 21 characters of the code are truncated
Filter setting 2	Number of output characters ■ Setting range: **0 ... 100** ■ Default value: **10** A total of ten characters of the code are output; the next characters are truncated
Raw data of test code	Display of all characters of the scanned test code (unfiltered)
User data of test code	Display of filtered characters of the scanned test code according to **Filter setting 1** and **Filter setting 2**
Test area	Text field and test code, enabling settings of the barcode scanner to be checked

15.5.7 Wireless LAN hotspot

Path: **Settings** ► **Interfaces** ► **Wireless LAN hotspot**

> The current firmware of the units in this series does not support this function.

15.5.8 Switching functions

Path: **Settings** ► **Interfaces** ► **Switching functions**

Parameter	Explanation
Axes	Configuration of the inputs for the purpose of setting all of the axes, or individual axes, to zero
Magnifications	Configuration of the inputs to select magnifications on the product
Switch the unit for linear values	Assignment of the digital input in accordance with the pin layout in order to execute the respective function Default setting: **Not connected**
Switch the unit for angular values	
Switch the coordinate system to "World"	
Switch the number of measuring points	
Create a new program	
Run the program	
Delete all features	
Tap the "Enter" button	
Tap the "Undo" button	
Delete the unconcluded feature	
Conclude the measuring point acquisition	
Send measurement results of last feature	
Switch the OED mode	
Switch the measuring tools	

15.6 User

This chapter describes settings for configuring users and user groups.

15.6.1 OEM

Path: **Settings** ▶ **User** ▶ **OEM**

The **OEM** (Original Equipment Manufacturer) user has the highest level of permissions. This user is allowed to configure the product's hardware (e.g. connection of encoders and sensors). He can create **Setup** and **Operator**-type users, and configure the **Setup** and **Operator** users. The **OEM** user cannot be duplicated or deleted. This user cannot be logged in automatically.

Parameters	Explanation	Edit permission
Name	Name of the user ■ Default value: **OEM**	–
First name	First name of the user ■ Default value: –	–
Department	Department of the user ■ Default value: –	–
Group	Group of the user ■ Default value: **oem**	–
Password	Password of the user ■ Default value: **oem**	**OEM**
Language	Language of the user	**OEM**
Auto login	On restart of the product: Automatic login of the last logged-in user ■ Default value: **OFF**	–
Remove user account	Removal of the user account	–

15.6.2 Setup

Path: **Settings** ► **User** ► **Setup**

The **Setup** user configures the product for use at the place of operation. This user can create **Operator**-type users. The **Setup** user cannot be duplicated or deleted. This user cannot be logged in automatically.

Parameters	Explanation	Edit permission
Name	Name of the user ■ Default value: **Setup**	–
First name	First name of the user ■ Default value: –	–
Department	Department of the user ■ Default value: –	–
Group	Group of the user ■ Default value: **setup**	–
Password	Password of the user ■ Default value: **setup**	**Setup**, **OEM**
Language	Language of the user	**Setup**, **OEM**
Auto login	On restart of the product: Automatic login of the last logged-in user ■ Default value: **OFF**	–
Remove user account	Removal of the user account	–

15.6.3 Operator

Path: **Settings** ► **User** ► **Operator**

The **Operator** user is permitted to use the basic functions of the product. An **Operator**-type user cannot create additional users, but is allowed to edit various operator-specific settings, such as his name or the language. A user of the **Operator** group can be logged in automatically as soon as the product is switched on.

Parameters	Explanation	Edit permission
Name	Name of the user ■ Default value: **Operator**	**Operator**, **Setup**, **OEM**
First name	First name of the user	**Operator**, **Setup**, **OEM**
Department	Department of the user ■ Default value: –	**Operator**, **Setup**, **OEM**
Group	Group of the user ■ Default value: **operator**	–
Password	Password of the user ■ Default value: **operator**	**Operator**, **Setup**, **OEM**
Language	Language of the user	**Operator**, **Setup**, **OEM**
Auto login	On restart of the product: Automatic login of the last logged-in user ■ Settings: **ON** or **OFF** ■ Default value: **OFF**	**Operator**, **Setup**, **OEM**
Remove user account	Removal of the user account	**Setup**, **OEM**

15.6.4 Adding a User

Path: **Settings** ► **User** ► **+**

Parameter	Explanation
+	Adds a new user of the type **Operator** **Further information:** "Entering and configuring users", Page 206 It is not possible to add further **OEM** and **Setup**-type users.

15.7 Axes

This chapter describes settings for configuring the axes and assigned devices.

> Not all of the described parameters and options may be available, depending on the product version, configuration and the connected encoders.

15.7.1 Reference marks

Path: **Settings** ► **Axes** ► **General settings** ► **Reference marks**

Parameters	Explanation
Reference mark search after unit start	Setting for the reference mark search after unit start Settings: ■ **ON**: The reference mark search must be performed after startup ■ **OFF**: No prompt for a mandatory reference mark search is displayed after startup of the product ■ Default value: **ON**
All users can cancel reference mark search	Specifies whether the reference mark search can be canceled by all user types Settings ■ **ON**: The reference mark search can be canceled by users of any type ■ **OFF**: The reference mark search can only be canceled by users of the **OEM** or **Setup** type ■ Default value: **OFF**
Reference mark search	**Start** starts the reference mark search and opens the workspace
Reference mark search status	Indicates whether the reference mark search was successful Display: ■ **Successful** ■ **Unsuccessful**
Stop of reference mark search	Indicates whether the reference mark search was canceled Display: ■ **Yes** ■ **No**

15.7.2 Information

Path: **Settings ► Axes ► General settings ► Information**

Parameters	Explanation
Assignment of the encoder inputs to the axes	Shows the assignment of the encoder inputs to the axes
Assignment of the analog outputs to the axes	Shows the assignment of the analog outputs to the axes
Assignment of the analog inputs to the axes	Shows the assignment of the analog inputs to the axes
Assignment of the digital outputs to the axes	Shows the assignment of the digital outputs to the axes
Assignment of the digital inputs to the axes	Shows the assignment of the digital inputs to the axes

> With the **Reset** buttons, the assignments for the inputs and outputs can be reset.

15.7.3 Switching functions

Path: **Settings ► Axes ► General settings ► Switching functions**

> The switching functions must not be used as a part of a safety function.

Parameters	Explanation
Inputs	Assignment of the digital input for the respective switching function according to the pin layout **Further information:** "Inputs (Switching functions)", Page 507
Outputs	Assignment of the digital output for the respective switching function according to the pin layout **Further information:** "Outputs (Switching functions)", Page 507

15.7.4 Inputs (Switching functions)

> The switching functions are available only for units with ID number .

> The switching functions must not be used as a part of a safety function.

Path: **Settings** ▶ **Axes** ▶ **General settings** ▶ **Switching functions** ▶ **Inputs**

Parameter	Explanation
Control voltage on	Assignment of the digital input for querying the external control voltage (e.g. for the machine to be controlled) ■ Default value: **Not connected**
Emergency stop active	Assignment of the digital input for querying whether an externally connected emergency stop switch was activated ■ Default value: **Not connected**

15.7.5 Outputs (Switching functions)

> The switching functions are available only for units with ID number .

> The switching functions must not be used as a part of a safety function.

Path: **Settings** ▶ **Axes** ▶ **General settings** ▶ **Switching functions** ▶ **Outputs**

Parameter	Explanation
Operational readiness	Assignment of the relay output set if an error (e.g. positioning error or standstill error) occurs on an axis. The error results in interruption of the axis control and power disconnection of the configured analog outputs of the axis. ■ Default value: **Not connected**
User-defined switching function	Assignment of the relay output that activates for some seconds after shutdown of the product. The relay is connected to a circuit with self-retaining function that disconnects the product and machine tool from power if this signal is applied. The circuit can couple the switch-on/off of the product to the switch-on/off of the machine tool to be controlled. ■ Default value: **Not connected**

15.7.6 Error compensation

Path: **Settings ▶ Axes ▶ General settings ▶ Error compensation**

Parameter	Explanation
Nonlinear error compensation (NLEC)	Mechanical influences on the **X** and **Y** axes are compensated
Squareness error compensation (SEC)	Mechanical influences on the squareness of the **X**, **Y** and **Z** axes relative to each other are compensated
3-D error compensation (VEC)	Mechanical influences on the **X**, **Y** and **Z** axes and on their squareness are compensated

15.7.7 Nonlinear error compensation (NLEC)

Path: **Settings ▶ Axes ▶ General settings ▶ Error compensation ▶ Nonlinear error compensation (NLEC)**

Parameter	Explanation
Compensation	Mechanical influences on the axes of the machine are compensated Settings: ■ **ON**: Compensation is active ■ **OFF**: Compensation is not active ■ Default value: **OFF**
Number of supporting points	Number of measuring points for error compensation on both axes (**X** and **Y**) of the encoder ■ Setting range: **1 ... 99** (**X** and **Y**) ■ Default value: **2** (**X** and **Y**)
Spacing of the supporting points	Spacing of the compensation points on the axes (**X** and **Y**) ■ Setting range: **0.00001 mm ... 100.00000 mm** (**X** and **Y**) ■ Default value: **1.00000 mm** (**X** and **Y**)
Read deviations of calibration standard	A file containing the deviations of the calibration standard is read
Import table of supporting points	Uploading a file ■ in .txt-format with position information regarding the supporting points ■ in .xml format with position information regarding the supporting points and the deviations of the calibration standard
Export table of supporting points	A file containing the position indications of the supporting points and the deviations of the calibration standard is saved
Table of supporting points	Opens the table of supporting points for manual editing
Teach sequence	**Start** begins the teach sequence for determining the compensation values

Parameter	Explanation
Delete table of supporting points	**Reset** deletes all deviations from the nominal values, including the deviations of the calibration standard The following settings are retained: ■ **Number of supporting points** ■ **Spacing of the supporting points**

15.7.8 Squareness error compensation (SEC)

Path: **Settings** ► **Axes** ► **General settings** ► **Error compensation** ► **Squareness error compensation (SEC)**

Parameter	Explanation
XY plane **XZ Plane** **YZ plane**	Mechanical influences on the squareness of the axes relative to each other are compensated ■ Setting range: **85 ° ... 95 °** ■ Default value: **90**

15.7.9 3-D error compensation (VEC)

Path: **Settings** ► **Axes** ► **General settings** ► **Error compensation** ► **3-D error compensation (VEC)**

Parameter	Explanation
Compensation	Mechanical influences on the axes of the machine and their squareness are compensated Settings: ■ **ON**: Compensation is active ■ **OFF**: Compensation is not active ■ Default value: **OFF**
Import table of supporting points	Importing a file with the compensation values (file type: TXT)

Stacking order	Adapts the compensation of rotational errors to the machine setup
	Settings:
	■ **XYZ**:
	  ■ X axis is basis of the setup
	  ■ Y axis is based on the X axis
	  ■ Z axis is based on the Y axis
	■ **YXZ**:
	  ■ Y axis is basis of the setup
	  ■ X axis is based on the Y axis
	  ■ Z axis is based on the X axis
	■ Default value: **XYZ**

X offset	Shifts the compensation range defined in the compensation-value table on the X axis Default value: **0.00000 mm**

Parameter	Explanation
Y offset	Shifts the compensation range defined in the compensation-value table on the Y axis Default value: **0.00000 mm**
Z offset	Shifts the compensation range defined in the compensation-value table on the Z axis Default value: **0.00000 mm**

15.7.10 <Axis name> (settings of the axis)

Path: **Settings** ► **Axes** ► **<Axis name>**

Parameters	Explanation
Axis name	Selection of the axis name displayed in the position preview
Encoder	Configuration of the connected encoder **Further information:** "Encoder", Page 511
Error compensation	Configuration of the linear error compensation **LEC** or segmented linear error compensation **SLEC** **Further information:** "Linear error compensation (LEC)", Page 517 **Further information:** "Segmented linear error compensation (SLEC)", Page 517 Error compensation is only available if you have configured a **Linear encoder** under **Encoder model**. If an **Angle encoder** or **Angle encoder as linear encoder** has been configured, error compensation is disabled automatically.

15.7.11 Q axis

Path: **Settings** ► **Axes** ► **Q**

Parameter	Explanation
Axis name	Definition of the axis name displayed in the position preview Settings: ■ **Not defined** ■ **Q** ■ Default setting: **Q**
Encoder	Configuration of the connected encoder **Further information:** "Encoder", Page 511

The Q axis is the manual rotary axis of the measuring plate and is used for angle measurement. If the Q axis is configured in the product, then the position of the Q axis can be seen in the position display or position preview.

> The Q axis values are not processed by the product and do not flow into the measurement and the calculation of features. For this reason the values are not displayed in the features view and cannot be output in the measurement report.

15.7.12 Encoder

Path: **Settings ► Axes ► <Axis name> ► Encoder**

Settings for encoders with interfaces of the EnDat 2.2 type

Parameter	Explanation
Encoder input	Assignment of the encoder input to the axis of the product Settings: ■ **Not connected** ■ **X1** ■ **X2** ■ **X3** ■ **X4** **Further information:** "Device overview", Page 51
Interface	Automatically detected **EnDat** interface type
ID label	Information about the encoder that was read out from the electronic ID label
Diagnosis	Results of encoder diagnostics
Encoder model	Connected encoder model Settings: ■ **Linear encoder**: Linear axis ■ **Angle encoder**: Rotary axis ■ **Angle encoder as linear encoder**: Rotary axis is displayed as linear axis ■ Default value: Depending on the connected encoder
Mechanical ratio	For display of a rotary axis as a linear axis: traverse path in mm per revolution ■ Setting range: **0.1 mm ... 1000 mm** ■ Default value: **1.0**
Reference point displacement	Configuration of the offset between the reference mark and the zero point **Further information:** "Reference point displacement", Page 516

Settings for encoders with interfaces of the type 1 V_{PP} or 11 μA_{PP}

Parameter	Explanation
Encoder input	Assignment of the encoder input to the axis of the product Settings: ■ **Not connected** ■ **X1** ■ **X2** ■ **X3** ■ **X4** **Further information:** "Device overview", Page 51
Incremental signal	Signal of the connected encoder Settings: ■ **1 Vpp**: Sinusoidal voltage signal ■ **11 µApp**: Sinusoidal current signal ■ Default value: **1 Vpp**
Encoder model	Connected encoder model Settings: ■ **Linear encoder**: Linear axis ■ **Angle encoder**: Rotary axis ■ **Angle encoder as linear encoder**: Rotary axis is displayed as linear axis ■ Default value: Depending on the connected encoder
Signal period	For linear encoders Length of a signal period ■ Setting range: **0.001 µm ... 1000000.000 µm** ■ Default value: **20.000**
Line count	For angle encoders and for display of a rotary axis as a linear axis. Number of lines ■ Setting range: **1 ... 1000000** ■ Default value: **1000**
Teach sequence	Starts the teach sequence for determining the **Line count** for an angle encoder based on a specified angle of rotation.
Display mode	For angle encoders and for the display of a rotary axis as a linear axis. Settings: ■ **- ∞ ... ∞** ■ **0° ... 360°** ■ **-180° ... 180°** ■ Default value: **- ∞ ... ∞**
Mechanical ratio	For display of a rotary axis as a linear axis: traverse path in mm per revolution ■ Setting range: **0.1 mm ... 1000 mm** ■ Default value: **1.0**

Parameter	Explanation
Reference marks	Configuration of the **Reference marks** **Further information:** "Reference marks (Encoder)", Page 515
Analog filter frequency	Frequency value of the analog low-pass filter Settings: ■ **33 kHz**: Suppression of interference frequencies above 33 kHz ■ **400 kHz**: Suppression of interference frequencies above 400 kHz ■ Default value: **400 kHz**
Terminating resistor	Dummy load to avoid reflections ■ Settings: **ON** or **OFF** ■ Default value: **ON**

Error monitor	Monitoring of signal errors
	Settings:
	■ **Off**: Error monitoring not active
	■ **Amplitude**: Error monitoring of the signal amplitude
	■ **Frequency**: Error monitoring of the signal frequency
	■ **Frequency & amplitude**: Error monitoring of both signal amplitude and signal frequency
	■ Default value: **Frequency & amplitude**
	
	A warning or error message is displayed if one of the limit values for error monitoring is exceeded.
	
	The limit values depend on the signal of the connected encoder:
	■ Signal: **1 Vpp**, setting: **Amplitude**
	  ■ Warning with voltage ≤ 0.45 V
	  ■ Error message with voltage ≤ 0.18 V or ≥ 1.34 V
	■ Signal: **1 Vpp**, setting: **Frequency**
	  ■ Error message with frequency ≥ 400 kHz
	■ Signal: **11 µApp**, setting: **Amplitude**
	  ■ Warning with current ≤ 5.76 µA
	  ■ Error message with current ≤ 2.32 µA or ≥ 17.27 µA
	■ Signal: **11 µApp**, setting: **Frequency**
	  ■ Error message with frequency ≥ 150 kHz

Counting direction	Signal detection during axis movement Settings: ■ **Positive**: The direction of traverse corresponds to the counting direction of the encoder ■ **Negative**: The direction of traverse does not correspond to the counting direction of the encoder ■ Default value: **Positive**

Settings for encoders with interfaces of the TTL type

Parameter	Explanation
Encoder input	Assignment of the encoder input to the axis of the product Settings: ■ **X21** ■ **X22** ■ **X23** ■ **X24** **Further information:** "Device overview", Page 51
Interface	Automatically detected **TTL** interface type
Encoder model	Connected encoder model Settings: ■ **Linear encoder**: Linear axis ■ **Angle encoder**: Rotary axis ■ **Angle encoder as linear encoder**: Rotary axis is displayed as linear axis ■ Default value: Depending on the connected encoder
Signal period	For linear encoders Length of a signal period ■ Setting range: **0.001 µm ... 1000000.000 µm** ■ Default value: **20.000**
Output signals per revolution	For angle encoders and for display of a rotary axis as a linear axis Number of output signals ■ Setting range: **1 ... 10000000** ■ Default value: **18000**
Teach sequence	Starts the teach sequence for determining the **Output signals per revolution** for an angle encoder based on a specified angle of rotation.
Display mode	For angle encoders and for the display of a rotary axis as a linear axis. Settings: ■ **- ∞ ... ∞** ■ **0° ... 360°** ■ **-180° ... 180°** ■ Default value: **- ∞ ... ∞**
Mechanical ratio	For display of a rotary axis as a linear axis: traverse path in mm per revolution ■ Setting range: **0.1 mm ... 1000 mm** ■ Default value: **1.0**
Reference marks	Configuration of the **Reference marks** **Further information:** "Reference marks (Encoder)", Page 515
Terminating resistor	Dummy load to avoid reflections ■ Settings: **ON** or **OFF** ■ Default value: **ON**

Parameter	Explanation
Error monitor	Monitoring of signal errors Settings: ■ **Off**: Error monitoring not active ■ **Frequency**: Error monitoring of the signal frequency ■ Default value: **Frequency** ℹ A warning or error message is displayed if one of the limit values for error monitoring is exceeded. The limit values depend on the signal of the connected encoder: ■ Setting **Frequency** ■ Error message with frequency ≥ 5 MHz
Counting direction	Signal detection during axis movement Settings: ■ **Positive**: The direction of traverse corresponds to the counting direction of the encoder ■ **Negative**: The direction of traverse does not correspond to the counting direction of the encoder ■ Default value: **Positive**

15.7.13 Reference marks (Encoder)

Path: **Settings ► Axes ► <Axis name> ► Encoder ► Reference marks**

> ℹ The reference mark search does not need to be performed for serial encoders with EnDat interface, because the axes are automatically homed.

Parameters	Explanation
Reference mark	Definition of the type of reference mark Settings: ■ **None**: There is no reference mark ■ **One**: The encoder has one reference mark ■ **Coded**: The encoder has distance-coded reference marks For encoders with TTL interface: ■ **Reverse coded**: The encoder has inverse-coded reference marks ■ Default value: **One**
Maximum traverse path	For linear encoders with coded reference marks: maximum traverse path for determining the absolute position ■ Setting range: **0.1 mm ... 10000.0 mm** ■ Default value: **20.0**

Parameters	Explanation
Nominal increment	For angle encoders with coded reference marks: maximum nominal increment for determining the absolute position ■ Setting range: **> 0° ... 360°** ■ Default value: **10.0**
Interpolation	For encoders with TTL interface: Interpolation value of the encoders and integrated interpolation for the evaluation of the coded reference marks. Settings: ■ **None** ■ **2-fold** ■ **5-fold** ■ **10-fold** ■ **20-fold** ■ **50-fold** ■ Default value: **None**
Inversion of reference mark pulses	Specifies whether the reference mark pulses are evaluated in inverted form Settings ■ **ON**: Reference pulses are evaluated in inverted form ■ **OFF**: Reference pulses are not evaluated in inverted form ■ Default value: **OFF**
Reference point displacement	Configuration of the offset between the reference mark and the zero point **Further information:** "Reference point displacement", Page 516

15.7.14 Reference point displacement

Path: **Settings** ► **Axes** ► **<Axis name>** ► **Encoder** ► **Reference marks** ► **Reference point displacement**

Parameters	Explanation
Reference point displacement	Activation of offset calculation between reference mark and datum of the machine ■ Setting range: **ON** or **OFF** ■ Default value: **OFF**
Reference point displacement	Manual input of the offset (in mm or degrees according to the selected encoder type) between reference mark and datum Default value: **0.00000**
Current position for reference point shift	**Apply** applies the current position as an offset (in mm or degrees, depending on the selected encoder model) between the reference marks and zero point

15.7.15 Linear error compensation (LEC)

Path: **Settings** ▶ **Axes** ▶ **<Axis name>** ▶ **Error compensation** ▶ **Linear error compensation (LEC)**

Parameter	Explanation
Compensation	Mechanical influences on the axes of the machine are compensated Settings: ■ **ON**: **Compensation** is active ■ **OFF**: **Compensation** is not active ■ Default value: **OFF** If **Compensation** is active, the **Nominal length** and **Actual length** cannot be edited or generated.
Nominal length	Input field for the length of the calibration standard according to the manufacturer's specifications Input: Millimeters or degrees (depending on the encoder)
Actual length	Input field for entering the measured length (actual distance traversed) Input: millimeters or degrees (depending on the encoder)

15.7.16 Segmented linear error compensation (SLEC)

Path: **Settings** ▶ **Axes** ▶ **<Axis name>** ▶ **Error compensation** ▶ **Segmented linear error compensation (SLEC)**

Parameters	Explanation
Compensation	Mechanical influences on the axes of the machine are compensated Settings: ■ **ON**: **Compensation** is active ■ **OFF**: **Compensation** is not active ■ Default value: **OFF** When **Compensation** is active, then the **Table of supporting points** cannot be edited or created.
Table of supporting points	Opens the table of supporting points for manual editing
Create table of supporting points	Opens the menu for creating a new **Table of supporting points** **Further information:** "Create table of supporting points", Page 518

15.7.17 Create table of supporting points

Path: **Settings ► Axes ► <Axis name> ► Error compensation ► Segmented linear error compensation (SLEC) ► Create table of supporting points**

Parameters	Explanation
Number of supporting points	Number of supporting points on the mechanical axis of the machine ■ Setting range: **2 ... 200** ■ Default value: **2**
Spacing of the supporting points	Spacing of the supporting points on the mechanical axis of the machine ■ Default value: **100.00000**
Start point	The start point defines the position starting from which the compensation is applied to the axis ■ Default value: **0.00000**
Create	Creates a new table of supporting points based on the entries

15.8 Service

This chapter describes settings for product configuration, for maintaining the firmware and for enabling software options.

This chapter describes the settings for the product configuration and for the maintenance of the firmware.

15.8.1 Firmware information

Path: **Settings ► Service ► Firmware information**

The following information on the individual software modules is displayed for service and maintenance.

Parameter	Explanation
Core version	Version number of the microkernel
Microblaze bootloader version	Version number of the Microblaze bootloader
Microblaze firmware version	Version number of the Microblaze firmware
Extension PCB bootloader version	Version number of the bootloader (expansion board)
Extension PCB firmware version	Version number of the firmware (expansion board)
Boot ID	ID number of the boot process
HW Revision	Revision number of the hardware
C Library Version	Version number of the C library
Compiler Version	Version number of the compiler
Touchscreen Controller version	Version number of the touchscreen controller
Qt build system	Version number of the Qt compilation software
Qt runtime libraries	Version number of the Qt runtime libraries
Kernel	Version number of the Linux kernel
Login status	Information on the logged-in user
SystemInterface	Version number of the system interface module
BackendInterface	Version number of the backend interface module
GuiInterface	Version number of the user interface module
TextDataBank	Version number of the text database module
Optical edge detection	Version number of the optical edge detection module
CameraInterface	Version number of the camera interface module
Imageprocessing	Version number of the image processing module
Metrology	Version number of the metrology module
NetworkInterface	Version number of the network interface module
OSInterface	Version number of the operating system interface module
PrinterInterface	Version number of the printer interface module
Programming	Version number of the programming module
VideoProbes	Version number of the video tools module
system.xml	Version number of the system parameters

Parameter	Explanation
axes.xml	Version number of the axis parameters
encoders.xml	Version number of the encoder parameters
ncParam.xml	Version number of the NC parameters
io.xml	Version number of the parameters for inputs and outputs
opticalEdge.xml	Version number of the parameters for OED
peripherals.xml	Version number of the parameters for peripherals
slec.xml	Version number of the parameters for segmented linear error compensation (SLEC)
lec.xml	Version number of the parameters for linear error compensation (LEC)
nlec.xml	Version number of the parameters for nonlinear error compensation (NLEC)
microBlazePVRegister.xml	Version number of the "Processor Version Register" of MicroBlaze
info.xml	Version number of the information parameters
audio.xml	Version number of the audio parameters
camera.xml	Version number of the camera parameters
lightcontrolRuntime.xml	Version number of the runtime environment parameters of the lighting
metrology.xml	Metrology parameters
network.xml	Version number of the network parameters
os.xml	Version number of the operating system parameters
probeRuntime.xml	Version number of the runtime parameters of the sensors
runtime.xml	Version number of the runtime parameters
users.xml	Version number of the user parameters
ved.xml	Version number of the VED parameters
GI Patch Level	Patch level of the golden image (GI)

15.8.2 Back up and restore

Path: **Settings ► Service ► Back up and restore**

The unit’s settings or user files can be backed up as a file so that they are available after a reset to the factory default settings has been performed or for installation on multiple units.

Parameters	Explanation
Restore settings	Restoring of the backed up settings **Further information:** "Restore settings", Page 530
Back up settings	Backing up of settings of the product **Further information:** "Back up settings", Page 198
Restore user files	Restoring of user files of the product **Further information:** "Restore user files", Page 531
Back up user files	Backing up of user files of the product **Further information:** "Back up user files", Page 199

15.8.3 Firmware update

Path: **Settings ► Service ► Firmware update**

The firmware is the operating system of the product. You can import new versions of the firmware via the product's USB port or the network connection.

> Prior to the firmware update, you must comply with the release notes for the respective software version and the information they contain regarding reverse compatibility.

> In order to be on the safe the side, the current settings must be backed up if the unit’s firmware is going to be updated.

Further information: "Updating the firmware", Page 528

15.8.4 Reset

Path: **Settings ► Service ► Reset**

If necessary, you can reset the unit’s settings to the factory default settings or to the condition at delivery. Software options are deactivated and subsequently need to be reactivated with the available license key.

Parameter	Explanation
Reset all settings	The settings are reset to factory default settings **Further information:** "Reset all settings", Page 532
Reset to shipping conditions	Resetting of the settings to the factory default setting and deletion of the user files from the unit’s memory area **Further information:** "Reset to shipping conditions", Page 532

15.8.5 OEM area

Path: **Settings ▶ Service ▶ OEM area**

Parameters	Explanation
Documentation	Addition of OEM documentation, e.g. service information **Further information:** "Adding documentation", Page 195
Startup screen	Changing the startup screen (e.g., with one's own company logo) **Further information:** "Startup screen", Page 522
Remote access for screenshots	Permitting a network connection with the ScreenshotClient program so that ScreenshotClient can take screenshots of the unit from a computer Settings: ■ **ON**: Remote access is possible ■ **OFF**: Remote access is not possible ■ Default value: **OFF** When the unit is shut down, **Remote access for screenshots** is automatically deactivated.

15.8.6 Startup screen

Path: **Settings ▶ Service ▶ OEM area ▶ Startup screen**

Parameter	Explanation
Add startup screen	Selecting the image file that is to be displayed as opening screen (file type: PNG or JPG) **Further information:** "Adding a startup screen", Page 195
Delete startup screen	**Delete** clears the user-defined opening screen and restores the default view

15.8.7 Documentation

Path: **Settings ▶ Service ▶ Documentation**

The product provides the possibility to upload the corresponding Operating Instructions in the desired language. The Operating Instructions can be copied from the supplied USB mass storage device to the product.

The latest version can be downloaded from the download area at **www.heidenhain.de**.

Parameters	Explanation
Add Operating Instructions	Adding the Operating Instructions in the desired language

15.8.8 Software options

Path: **Settings ► Service ► Software options**

> Software options need to be enabled on the product via a license key. Before you can use the associated hardware components, you need to enable the respective software option.
>
> **Further information:** "Activating the Software options", Page 139

Parameter	Explanation
Overview	Overview of all software options that are active on the product
Request options	Creation of a license key request that can be submitted to a HEIDENHAIN service agency **Further information:** "Requesting license key", Page 139
Request trial options	Creation of a license key request that can be submitted to a HEIDENHAIN service agency **Further information:** "Requesting license key", Page 139
Activate options	Activation of the software options via license key or license file **Further information:** "Activating a license key", Page 140
Reset trial options	Reset of the trial options by entering a license key

16

Servicing and maintenance

16.1 Overview

This chapter describes the general maintenance work on the product.

The following steps must be performed only by qualified personnel.

Further information: "Personnel qualification", Page 31

This chapter contains a description of maintenance work for the product only. Any maintenance work on peripheral devices is not described in this chapter.

Further information: Manufacturer's documentation for the respective peripheral devices

16.2 Cleaning

NOTICE

Cleaning with sharp-edged objects or aggressive cleaning agents

Improper cleaning will cause damage to the product.

- Never use abrasive or aggressive cleaners, and never use strong detergents or solvents
- Do not use sharp-edged objects to remove persistent contamination

Cleaning the housing

- Use only a cloth dampened with water and a mild detergent for cleaning the exterior surfaces

Cleaning the screen

Activate cleaning mode to clean the display. This switches the unit to an inactive state without interrupting the power supply. The screen is switched off in this state.

- Tap **Switch-off** in the main menu to activate the cleaning mode

- Tap **Cleaning mode**
> The screen switches off
- Use a lint-free cloth and a commercially available glass cleaner to clean the screen

- To deactivate the cleaning mode, tap anywhere on the touchscreen
> An arrow appears at the bottom of the screen
- Drag the arrow up
> The screen is switched on and shows the user interface last displayed

16.3 Maintenance plan

The product is largely maintenance-free.

NOTICE

Operating defective devices

Operating defective devices may result in serious consequential damage.

- Do not repair or operate the device if it is damaged
- Replace defective devices immediately or contact a HEIDENHAIN service agency

The following steps are only to be performed by electrical specialists.

Further information: "Personnel qualification", Page 31

Maintenance step	Interval	Corrective action
▶ All labels and symbols provided on the product must be checked for readability	Annually	▶ Contact HEIDENHAIN service agency
▶ Inspect electrical connections for damage and check their function	Annually	▶ Replace defective cables. Contact HEIDENHAIN service agency if required
▶ Check power cables for faulty insulation and weak points	Annually	▶ Replace power cables according to the specification

16.4 Resuming operation

When operation is resumed, e.g. when the product is reinstalled after repair or when it is remounted, the same measures and personnel requirements apply as for mounting and installing the product.

Further information: "Mounting", Page 43

Further information: "Installation", Page 49

When connecting the peripheral devices (e.g. encoders), the operating company must ensure safe resumption of operation and assign authorized and appropriately qualified personnel to the task.

Further information: "Obligations of the operating company", Page 31

16.5 Updating the firmware

The firmware is the operating system of the product. You can import new versions of the firmware via the product's USB port or the network connection.

	Prior to the firmware update, you must comply with the release notes for the respective software version and the information they contain regarding reverse compatibility.

	In order to be on the safe the side, the current settings must be backed up if the unit’s firmware is going to be updated.

Requirement

- The new firmware is available as a *.dro file
- To update the firmware over the USB port, the current firmware must be stored on a USB mass storage device (FAT32 format)
- To update the firmware via the network interface, the current firmware must be available in a folder on the network drive

Starting a firmware update

- ▶ Tap **Settings** in the main menu
- ▶ Tap **Service**
- ▶ Open in the sequence
  - **Firmware update**
  - **Continue**
- > The service application is launched

Updating the firmware

The firmware can be updated from a USB mass storage device (FAT32 format) or via a network drive.

- ▶ Tap **Firmware update**
- ▶ Tap **Select**
- ▶ If required, connect a USB mass storage device to a USB port of the product
- ▶ Navigate to the folder containing the new firmware

> If you have accidentally tapped the wrong folder, you can return to the previous folder.
>
> - ▶ Tap the file name that is displayed above the list

- ▶ Select the firmware
- ▶ Tap **Select** to confirm the selection
- > The firmware version information is displayed
- ▶ Tap **OK** to close the dialog

> The firmware update cannot be canceled once the data transfer has started.

- ▶ Tap **Start** to start the update
- > The screen shows the progress of the update
- ▶ Tap **OK** to confirm successful update
- ▶ Tap **Finish** to terminate the service application
- > The service application is terminated
- > The main application is launched
- > If automatic user login is active, the user interface is displayed in the **Measure** menu
- > If automatic user login is not active, the **User login** menu is displayed

Safely removing a USB mass storage device

- ▶ Tap **File management** in the main menu
- ▶ Navigate to the list of storage locations
- ▶ Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- ▶ Disconnect the USB mass storage device

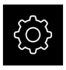
16.6 Restore settings

Backed-up settings can be restored to the product. The current configuration of the product is replaced in the process.

> Software options that were active when the settings were backed up must be activated before restoring the settings.

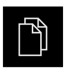
A restore can be necessary in the following cases:

- During commissioning, the settings are set on a product and transferred to all identical products
  Further information: "Steps for commissioning", Page 138
- After a reset, the settings are copied back to the product
  Further information: "Reset all settings", Page 532



- ▶ Tap **Settings** in the main menu
- ▶ Open in the sequence
  - **Service**
  - **Back up and restore**
  - **Restore settings**
- ▶ Tap **Complete restoration**
- ▶ If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- ▶ Navigate to the folder containing the backup file
- ▶ Select the backup file
- ▶ Tap **Select**
- ▶ Confirm the successful transfer with **OK**
- > The system is shut down
- ▶ To restart the product with the transferred configuration data, switch the product off and then back on

Safely removing a USB mass storage device



- ▶ Tap **File management** in the main menu
- ▶ Navigate to the list of storage locations
- ▶ Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- ▶ Disconnect the USB mass storage device

16.7 Restore user files

Backed-up user files of the product can be loaded into the product again. Existing user files will be overwritten. This, together with the restoring of the settings, enables you to restore the complete configuration of a unit.

Further information: "Restore settings", Page 530

If servicing becomes necessary, a replacement unit can be operated with the configuration of the failed unit after restoring. This requires that the version of the old firmware matches that of the new firmware or that the versions are compatible.

> All files from all user groups that are stored in the respective folders are backed up and can be restored as user files.
>
> The files in the **System** folder are not restored.

- Tap **Settings** in the main menu
- Open in the sequence
- Tap **Service**
- Open in the sequence
  - **Back up and restore**
  - **Restore user files**
- Tap **Load as ZIP**
- If required, connect a USB mass storage device (FAT32 format) to a USB port of the product
- Navigate to the folder containing the backup file
- Select the backup file
- Tap **Select**
- Confirm the successful transfer with **OK**
- To restart the product with the transferred user files, switch the product off and then back on

Safely removing a USB mass storage device

- Tap **File management** in the main menu
- Navigate to the list of storage locations
- Tap **Safely remove**
- > The message **The storage medium can be removed now.** appears
- Disconnect the USB mass storage device

16.8 Reset all settings

You can reset the settings of the product to the factory defaults if required. The software options are deactivated and must be subsequently reactivated with the available license key.

- ▶ Tap **Settings** in the main menu
- ▶ Tap **Service**
- ▶ Open in the sequence
  - **Reset**
  - **Reset all settings**
- ▶ Enter password
- ▶ Confirm the entry with **RET**
- ▶ To show the password in plain text, activate **Show password**
- ▶ Tap **OK** to confirm the action
- ▶ Tap **OK** to confirm the reset
- ▶ Tap **OK** to confirm shutdown of the device
- > The product is shut down
- > All settings are reset
- > To restart the product, switch it off and then back on

16.9 Reset to shipping conditions

You can reset the settings of the product to the factory defaults and delete the user files from product's memory area. The software options are deactivated and must be subsequently reactivated with the available license key.

- ▶ Tap **Settings** in the main menu
- ▶ Tap **Service**
- ▶ Open in the sequence
  - **Reset**
  - **Reset to shipping conditions**
- ▶ Enter password
- ▶ Confirm the entry with **RET**
- ▶ To show the password in plain text, activate **Show password**
- ▶ Tap **OK** to confirm the action
- ▶ Tap **OK** to confirm the reset
- ▶ Tap **OK** to confirm shutdown of the device
- > The product is shut down
- > All settings are reset and the user files are deleted
- > To restart the product, switch it off and then back on

17

What to do if ...

17.1 Overview

This chapter describes the causes of faults or malfunctions of the product and the appropriate corrective actions.

> Make sure that you have read and understood the "Basic operation" chapter before carrying out the actions described below.
>
> **Further information:** "Basic operation", Page 65

17.2 System or power failure

Operating system data can be corrupted in the following cases:

- System or power failure
- Switching off the product without shutting down the operating system

If the firmware is damaged, the product starts a Recovery System that displays short instructions on the screen.

With restoration, the Recovery System overwrites the damaged firmware with a new firmware previously saved to a USB mass storage device. During this procedure the settings of the product are deleted.

17.2.1 Restoring the firmware

- ▶ On a computer, create the folder "heidenhain" on a USB mass storage device (FAT32 format).
- ▶ In the "heidenhain" folder, create the folder "update"
- ▶ Copy the new firmware to the "update" folder
- ▶ Rename the firmware "recovery.dro"
- ▶ Switch off the product
- ▶ Connect a USB mass storage device to a USB port of the product
- ▶ Switch on the product
- > The product starts the Recovery System
- > The USB mass storage device is detected automatically
- > The firmware is installed automatically
- > After a successful update, the firmware is automatically renamed "recovery.dro.[yyyy.mm.dd.hh.mm]"
- ▶ Restart the product on completion of the installation
- > The product starts up with the factory defaults

17.2.2 Restore settings

Reinstalling the firmware resets the product to the factory defaults. This deletes the setting, including the error compensation values and the activated software options. Not affected by this are user files (e.g., measurement reports and measuring programs) saved in the memory or files that are retained after a firmware reinstallation.

To restore settings, you must either reconfigure them on the unit yourself or restore previously backed up settings on the unit.

> Software options that were active when the settings were backed up must be activated before restoring the settings on the product.

- Activating software options

Further information: "Activating the Software options", Page 139

- Restoring settings

Further information: "Restore settings", Page 530

17.3 Malfunctions

If faults or malfunctions that are not listed in the "Troubleshooting" table below occur during operation, refer to the machine tool builder's documentation or contact a HEIDENHAIN service agency.

17.3.1 Troubleshooting

> The following troubleshooting steps must be performed only by the personnel indicated in the table.
>
> **Further information:** "Personnel qualification", Page 31

Fault	Cause of fault	Correction of fault	Personnel
The status LED remains dark after switch-on	There is no supply voltage	▶ Check the power cable	Electrical specialist
	The product does not function properly	▶ Contact a HEIDENHAIN service agency	Qualified personnel
A blue screen appears when the unit starts up	Firmware error during startup	▶ If this fault occurs for the first time, switch the product off and then on again ▶ If the fault recurs, contact a HEIDENHAIN service agency	Qualified personnel
After startup, the product does not recognize any entries made on the touchscreen	Incorrect hardware initialization	▶ Switch the product off and then on again	Qualified personnel
Axes do not count despite movement of the encoder	Incorrect connection of the encoder	▶ Correct the connection ▶ Contact the encoder manufacturer's service agency	Qualified personnel

Fault	Cause of fault	Correction of fault	Personnel
Axes are miscounting	Incorrect settings of the encoder	▶ Check the encoder settings Page 145	Qualified personnel
The lighting does not work	Defective connection	▶ Check the cable	Electrical specialist
	Incorrect settings of the inputs and outputs	▶ Check the settings for the inputs and outputs Page 180	Qualified personnel
Camera image is not displayed	Wrong camera model connected	▶ Check the camera model	Qualified personnel
	Incorrect camera settings	▶ Check the camera settings Page 175	Qualified personnel
	Defective connection	▶ Check the cable and for correct connection to X32 / X117	Qualified personnel
The camera image flickers.	Incorrect pixel format selected for the camera	▶ Set the pixel format in the camera settings Page 470	Qualified personnel
Connection to the network is not possible	Defective connection	▶ Check the cable and the correct connection to X116	Qualified personnel
	Incorrect settings of the network	▶ Check the network settings Page 210	Qualified personnel
The connected USB mass storage device is not detected	Defective USB connection	▶ Check the correct position of the USB mass storage device in the port ▶ Use another USB port	Qualified personnel
	The type or formatting of the USB mass storage device is not supported	▶ Use another USB mass storage device ▶ Format USB mass storage device with FAT32	Qualified personnel
The unit starts in recovery mode (text only mode)	Firmware error during startup	▶ If this fault occurs for the first time, switch the product off and then on again ▶ If the fault recurs, contact a HEIDENHAIN service agency	Qualified personnel
User login is not possible	Password does not exist	▶ As user with higher permission level, reset the password Page 206 ▶ To reset the OEM password, contact the HEIDENHAIN service agency	Qualified personnel

18

Removal and disposal

18.1 Overview

This chapter contains information and environmental protection specifications that must be observed for correct disassembly and disposal of the device.

18.2 Removal

> Removal of the product must be performed only by qualified personnel.
> **Further information:** "Personnel qualification", Page 31

Depending on the connected peripherals, the removal may need to be performed by an electrical specialist.

In addition, the same safety precautions that apply to the mounting and installation of the respective components must be taken.

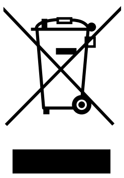
Removing the product

To remove the product, follow the installation and mounting steps in the reverse order.

Further information: "Installation", Page 49

Further information: "Mounting", Page 43

18.3 Disposal



NOTICE

Incorrect disposal of the product!

Incorrect disposal of the product can cause environmental damage.

- Do not dispose of electrical waste and electronic components in domestic waste
- The integrated backup battery must be disposed of separately from the product
- Forward the product and the backup battery to recycling in accordance with the applicable local disposal regulations

- If you have any questions about the disposal of the product, please contact a HEIDENHAIN service agency

19

Specifications

19.1 Overview

This chapter contains an overview of the product data and drawings with the product dimensions and mating dimensions.

19.2 Product data

Device	
Housing	Aluminum milled housing
Housing dimensions	314 mm x 265 mm x 38 mm
Fastener system, mating dimensions	VESA MIS-D, 100 100 mm x 100 mm

Display	
Visual display unit	■ LCD widescreen (16:10) color screen 30.7 cm (12.1") ■ 1280 x 800 pixels
Display step	Selectable, min. 0.00001 mm
User interface	User interface (GUI) with touchscreen

Electrical data	
Supply voltage	■ AC 100 V ... 240 V (±10 %) ■ 50 Hz ... 60 Hz (±5 %) ■ max. input power 79 W
Buffer battery	Lithium battery type CR2032; 3.0 V
Overvoltage category	II
Number of encoder inputs	2 (2 additional inputs can be enabled optionally via software option)
Encoder interfaces	■ 1 V_{PP}: max. current 300 mA; max. input frequency 400 kHz ■ 11 μA_{PP}: Maximum current 300 mA; maximum input frequency: 150 kHz ■ EnDat 2.2: max. current 300 mA ■ TTL: max. current 300 mA, max. input frequency 5 MHz
Interpolation at 1 V_{PP}	4096-fold
Touch probe connection	■ Voltage supply DC 5 V or DC 12 V ■ 5 V or floating switching output ■ Max. cable length with HEIDENHAIN cable 30 m
Camera connection	USB 2.0 Hi-Speed (Type A), max. current 500 mA, Ethernet 1 Gbit (RJ45)
Connection for optical edge detector	2 F-SMA sockets (screw thread designation 1/4-36 UNS-2A)
Digital inputs	TTL DC 0 V ... +5 V

Electrical data	
Digital outputs	TTL DC 0 V ... +5 V Maximum load 1 k Ω
Relay outputs	■ Max. switching voltage AC 30 V / DC 30 V ■ Max. switching current 0.5 A ■ Max. switching capacity 15 W ■ Max. continuous current 0.5 A
Analog inputs	Voltage range DC 0 V ... +5 V Resistance 100 Ω ≤ R ≤ 50 kΩ
Analog outputs	Voltage range DC –10 V ... +10 V Maximum load 1 kΩ
5 V voltage outputs	Voltage tolerance ±5 %, maximum current 100 mA
Data interface	■ 4 USB 2.0 Hi-Speed (Type A), maximum current 500 mA per USB connection ■ 1 Ethernet 10/100 Mbit/1 Gbit (RJ45) ■ 1 Ethernet 1 GBit (RJ45)

Environment	
Operating temperature	0 °C ... +45 °C
Storage temperature	–20 °C ... +70 °C
Relative air humidity	10 % ... 80 % RH, non-condensing
Altitude	≤ 2000 m

General information	
Directives	■ EMC Directive 2014/30/EU ■ Low Voltage Directive 2014/35/EU ■ RoHS Directive 2011/65/EU
Pollution degree	2
Protection EN 60529	■ Front panel and side panels: IP 65 ■ Rear panel: IP 40
Mass	■ 3.5 kg ■ With Duo-Pos stand: 3.8 kg ■ With Multi-Pos stand: 4.5 kg ■ With Multi-Pos holder: 4.1 kg

19.3 Product dimensions and mating dimensions

All dimensions in the drawings are in millimeters.

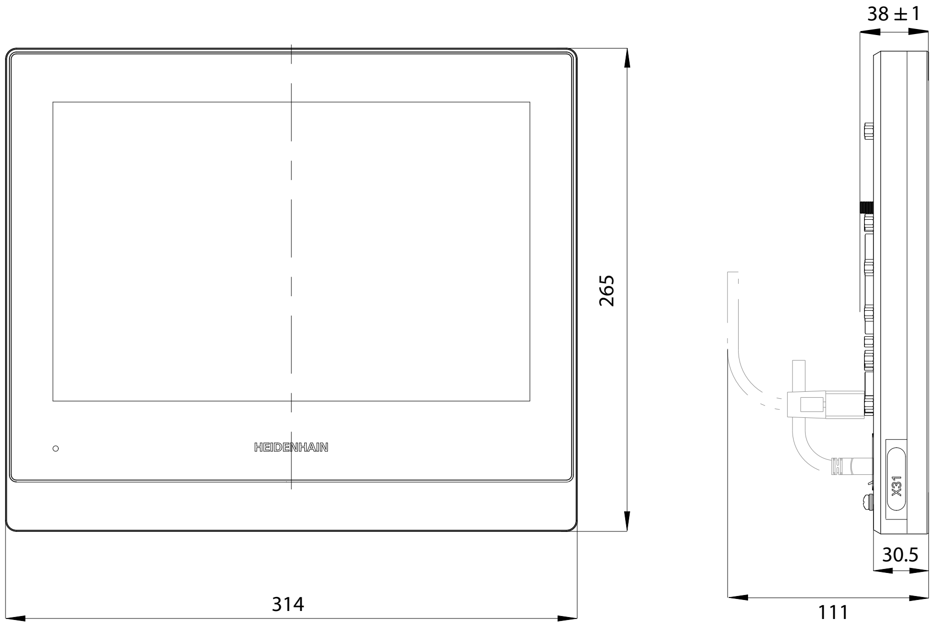


Figure 127: Dimensions of housing

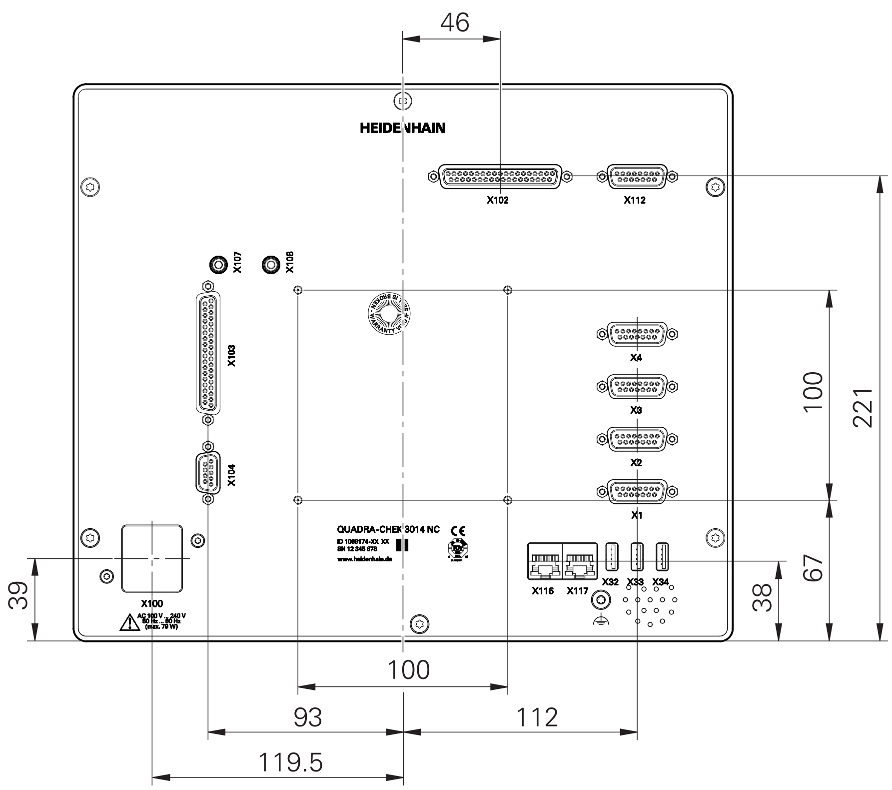


Figure 128: Dimensions of rear panel of the product

19.3.1 Product dimensions with Duo-Pos stand

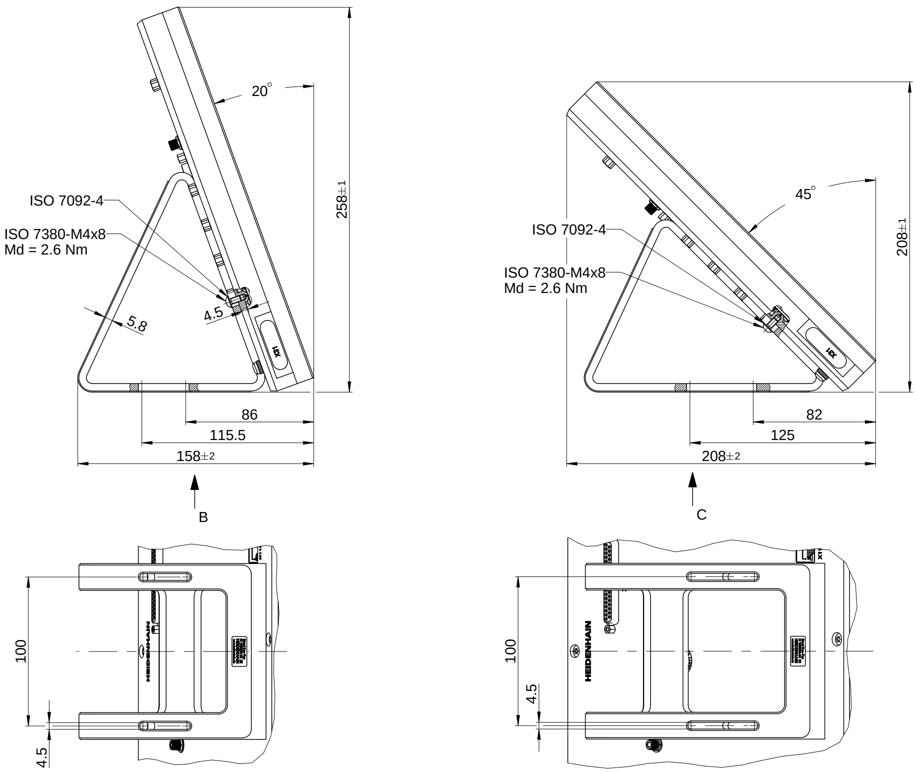


Figure 129: Product dimensions with Duo-Pos stand

19.3.2 Product dimensions with Multi-Pos stand

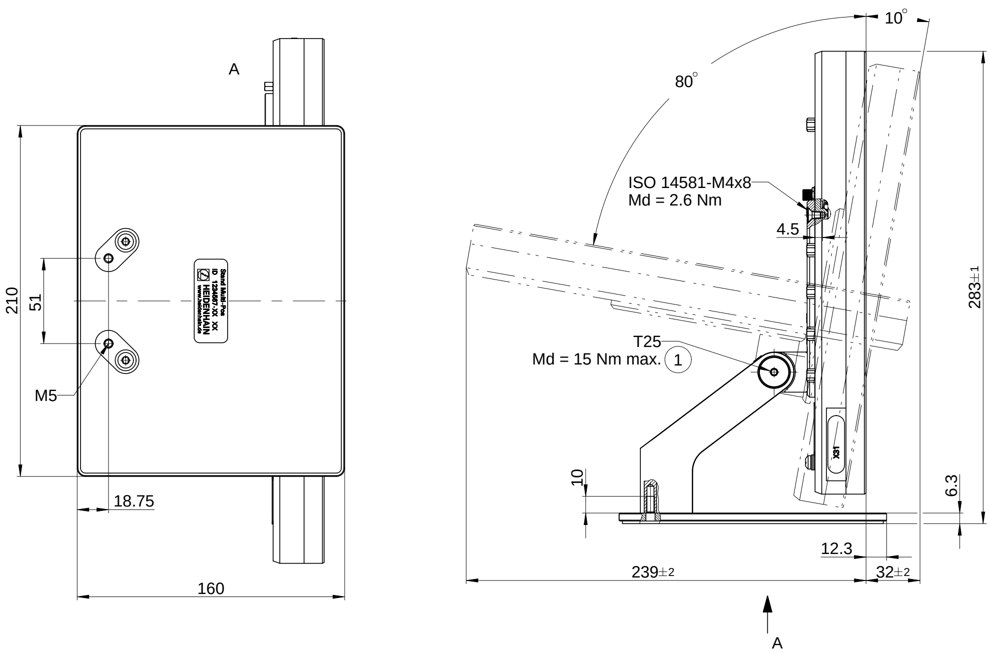


Figure 130: Product dimensions with Multi-Pos stand

19.3.3 Product dimensions with Multi-Pos holder

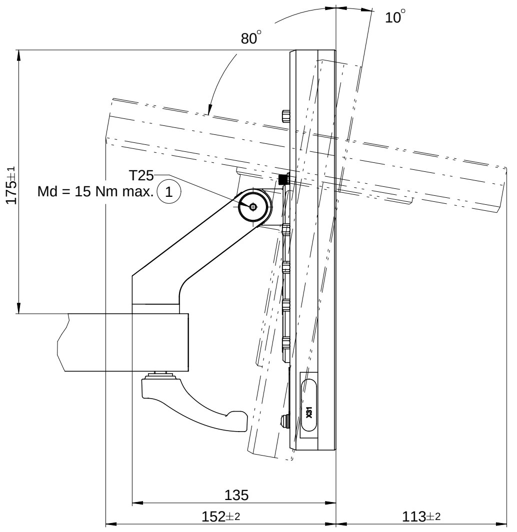
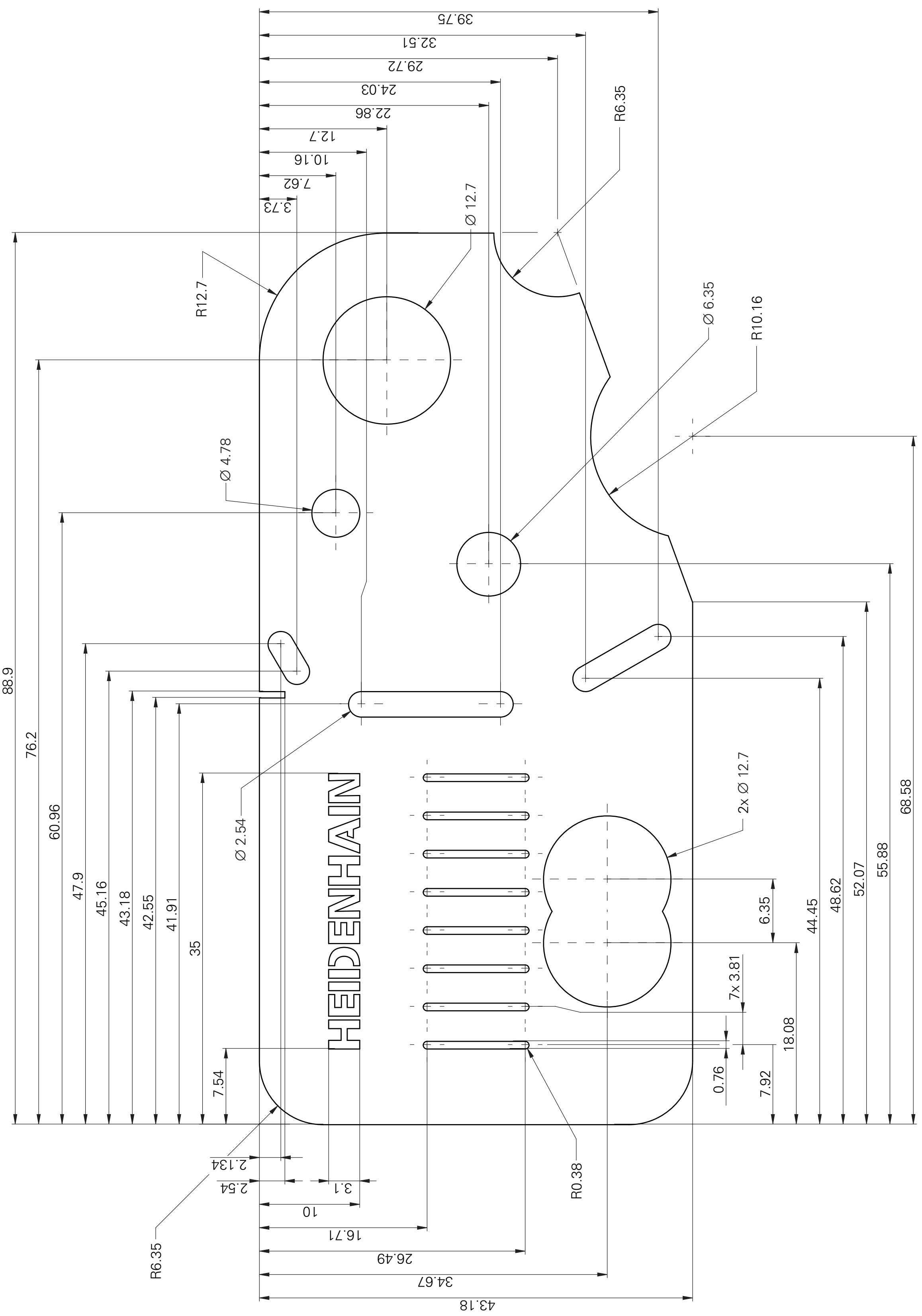


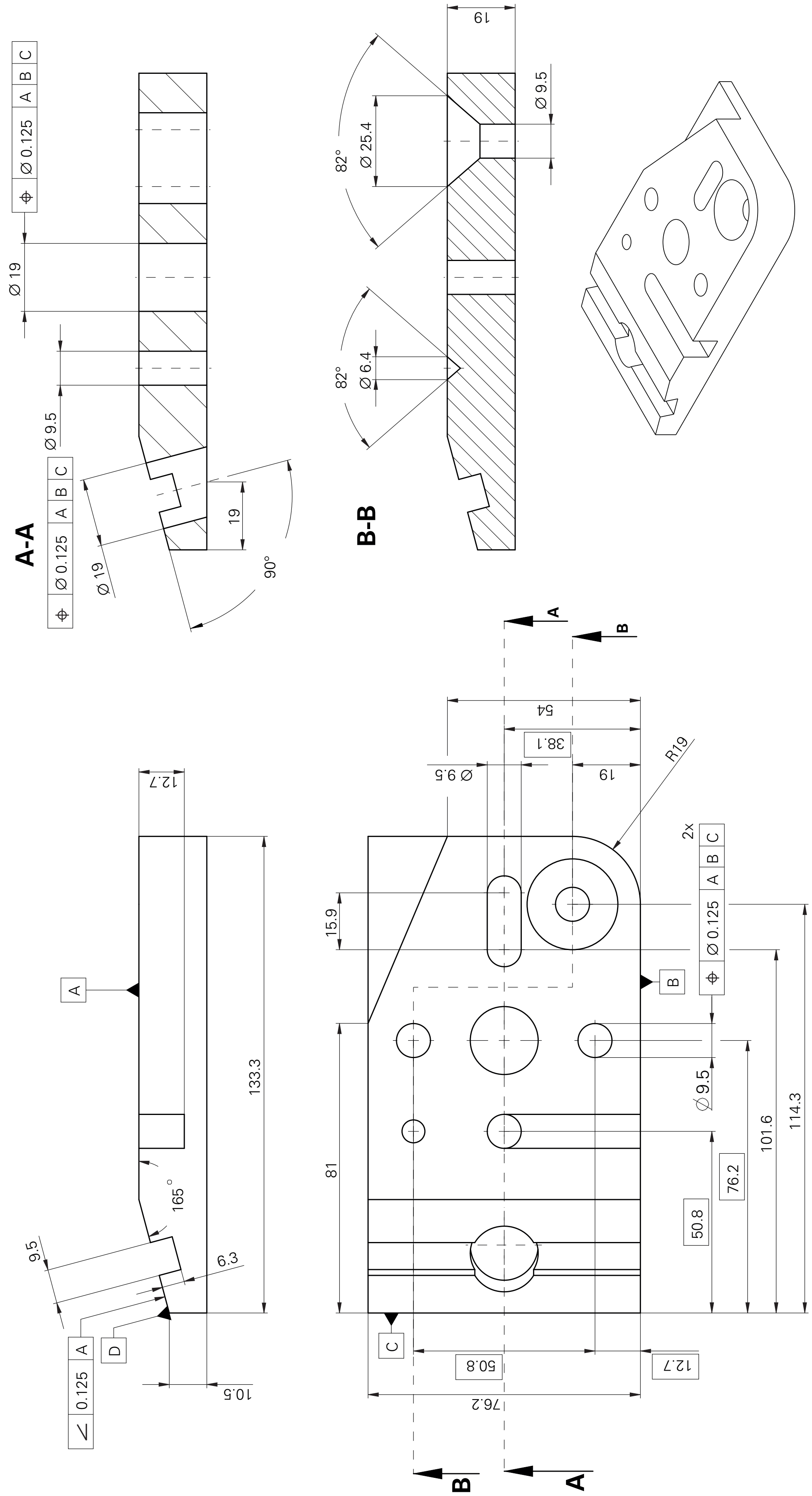
Figure 131: Product dimensions with Multi-Pos holder

19.4 Technical drawings

19.4.1 2-D demo part



19.4.2 3-D demo part



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Original document
1178796 · 04 · A · 02 · 02/2020 · PDF