

DRO100

Operating Instructions

Digital Readout

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1

Fundamentals

1.1 About these instructions

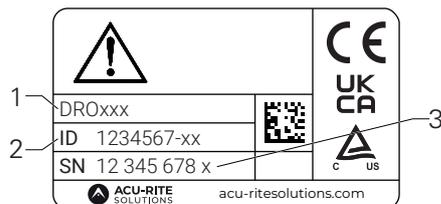
These instructions provide all the information and safety precautions needed for the safe operation of the product.

1.2 Information on the product

Product designation	Part number
DRO101 1 axis	1197252-xx
DRO102 2 axes	1197252-xx
DRO103 3 axes	1197252-xx

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

Example:



- 1 Product designation
- 2 Part number
- 3 Index

Validity of the documentation

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

- ▶ Compare the part number and the index indicated in the documentation with the corresponding data given on the ID label of the product
- > If the part numbers and indexes match, the documentation is valid



If the part numbers and indexes do not match so that the documentation is not valid, you will find the current documentation for the product at **www.acu-ritesolutions.com**.

1.3 Notes on reading the documentation

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

⚠ 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

Documentation	Description
Addendum	An addendum supplements or supersedes the corresponding contents of the Operating Instructions and, if applicable, of the Installation Instructions. If this document is included in the shipment, read it first before you proceed. All other contents of the documentation retain their validity.
Installation Instructions	The Installation Instructions contain all the information and safety precautions needed for the proper mounting and installation of the product. They are an excerpt from the Operating Instructions and are included in every shipment. This document has the second highest 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. This document has the third highest priority for reading. This documentation can be downloaded from the download area at www.acu-ritesolutions.com . The Operating Instructions must be printed prior to commissioning the product.
Documentation of connected measuring devices and other peripherals	These documents are not included in delivery. They are shipped with the respective measuring devices and peripherals.

Would you like any changes, or have you found any errors?

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

acu-ritesolutions@heidenhain.com

1.4 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 replacement 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 Target group for the instructions

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

- Mounting
- Installation
- Commissioning
- Setup, programming and operation
- Service, cleaning and maintenance
- Troubleshooting
- Removal and disposal

1.6 Notes in this documentation

Safety precautions

Comply with all safety precautions indicated in these instructions and in your machine tool builder's documentation!

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 things other than personal injury, like property damage .

Informational notes

Observe the informational notes provided in these instructions to ensure reliable and efficient operation of the product.

In these instructions, you will find the following informational notes:



The information symbol indicates a **tip**.
A tip provides important 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 function 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.

1.7 Symbols and fonts used for marking text

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

Format	Meaning
▶ ... > ...	Identifies an action and the result of this action Example: ▶ Press the enter key > The parameters are saved and the Job Setup menu is displayed
■ ... ■ ...	Identifies an item of a list Example: ■ Installation Setup ■ Job Setup
Bold	Identifies menus, screens, displays, keys, and soft keys Example: ▶ Press the Menu key > The Configuration Menu is displayed.

2

Safety

2.1 Overview

This chapter provides important safety information needed for the proper mounting, installation and operation of the product.

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 DRO100 series are advanced digital readouts for use on manually operated machine tools. In combination with linear and angle encoders, digital readouts of the DRO100 series display the position of the tool in more than one axis and provide further functions for operating the machine tool.

The products of the DRO100 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 of the DRO100 series support the use of a wide variety 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 associated documentations, must be observed.

2.4 Improper use

When the product is used it must be ensured that no hazard to persons can result. If any such hazard exists, appropriate measures must be taken by the operating company.

In particular, the product must not be used in the following applications:

- Use and storage outside the specifications
- Outdoor use
- Use in potentially explosive atmospheres
- Use of the product 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 that are responsible for mounting, installation, operation, maintenance and removal have different qualifications and tasks, which are specified as follows.

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 product and the peripherals. It is responsible that the intended use is complied with at all times.

The operating company must:

- Assign the different tasks to be performed on the product to appropriate, qualified, and authorized personnel
- Verifiably train personnel in the tasks they are allowed to perform and how to perform them
- Provide all materials and means necessary in order for personnel to complete the assigned tasks
- Ensure that the product is operated only when in perfect technical condition
- Ensure that the product 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 documentations must be observed. If no such information has been supplied, 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 in the instructions

The following safety symbols are used in this manual:

Symbol	Meaning
	Identifies information that warns of personal injury
	Identifies electrostatic sensitive devices (ESD)
	ESD wristband for personal grounding

2.7.2 Symbols on the product

The following symbols are used to identify the product:

Symbol	Meaning
	Observe the safety precautions regarding electricity and power connection before you connect the product
	Earth (ground) terminal as per IEC 60417 - 5017. Observe the information on installation.

2.7.3 Electrical safety instructions

WARNING

Hazard of contact with live parts when opening the product.

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!

Opening the product will result in forfeiture of warranty and guarantee.

- ▶ 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 all of the information necessary for the transportation and storage of the product and provides an overview of the items supplied and the available accessories for the product.

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

Items supplied

The following items are included in the shipment:

- Product
- Power cord (in 1197252-0x)
- Installation instructions
- Addendum (optional)

Further information: "Notes on reading the documentation", Page 11

Accessories

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

Accessories	Part number
Single-Pos stand For rigid mounting, inclination angle 20°	1197273-01
Multi-Pos holder For fastening on an arm, continuously tiltable and swivelable	1197273-02
Cover For protection from dirt and debris	1197275-01

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



In case of damage in 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.

Repackaging

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

- ▶ Attach all mounting parts and dust protection caps to the product or repackage them in the same way they were originally shipped from the factory.
- ▶ Repackage the product such that it is protected from impact and vibration during transit
- ▶ Repackage the product such that 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 24

- ▶ Include the Addendum (if it was included in the items supplied), the Installation Instructions and the Operating Instructions

Further information: "Storage and distribution of the documentation", Page 12



If you return the product for repair to a service agency:

- ▶ Ship the product without accessories, without measuring devices and without peripherals

Storage of the product

- ▶ Package the product as described above
- ▶ Observe the specified ambient conditions
- ▶ Inspect the product for damage after any transport or longer storage times

4

Mounting

4.1 Overview

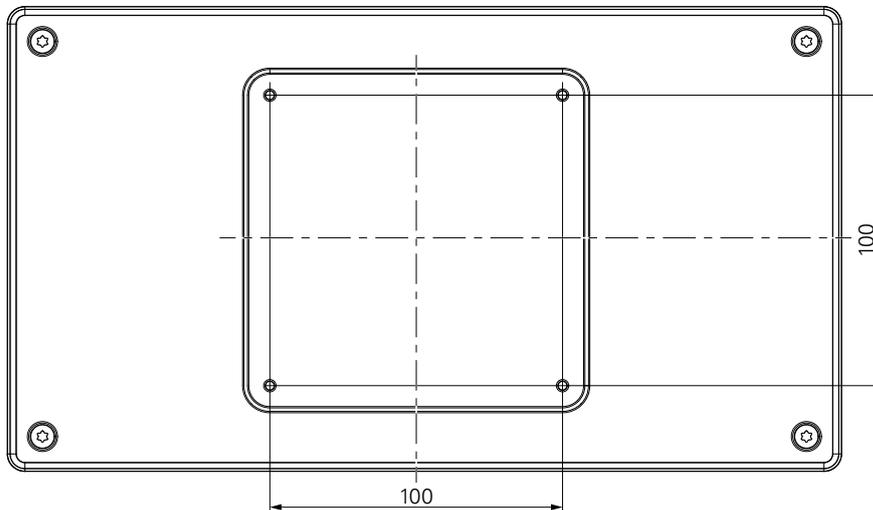
This chapter contains all of the information necessary for mounting the product.

i The following steps are only to be performed by qualified personnel.
Further information: "Personnel qualification", Page 19

4.2 Assembly

General mounting information

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



The material for attaching the mounting variants on the device is included in the accessories to the product.

You will also need the following:

- Torx T20 screwdriver
- Material for mounting on supporting surface

i The product must be mounted on a stand or holder to ensure the correct and intended operation of the product.

Routing the cables

i In the figures showing the stand and holder, you will find suggestions for routing the cables after mounting.

If mounting to a stand:

- ▶ Bring the cables together
- ▶ Route the cables together through the opening in the stand from behind
- ▶ Route the cables laterally to the connections

4.3 Mounting on Single-Pos stand

The Single-Pos stand allows you to place the product on a surface at an inclination angle of 20° and secure the product to a surface.

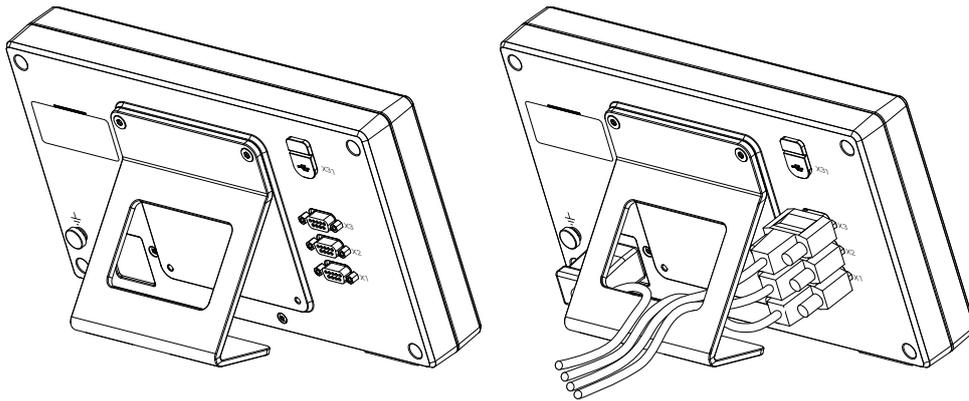
Mount the stand to the upper VESA 100 tapped holes on the rear panel of the product

- ▶ Use a Torx T20 screwdriver to tighten the countersunk head screws M4 x 8 ISO 14581 included in delivery
- ▶ Comply with the permissible tightening torque of 2.6 Nm

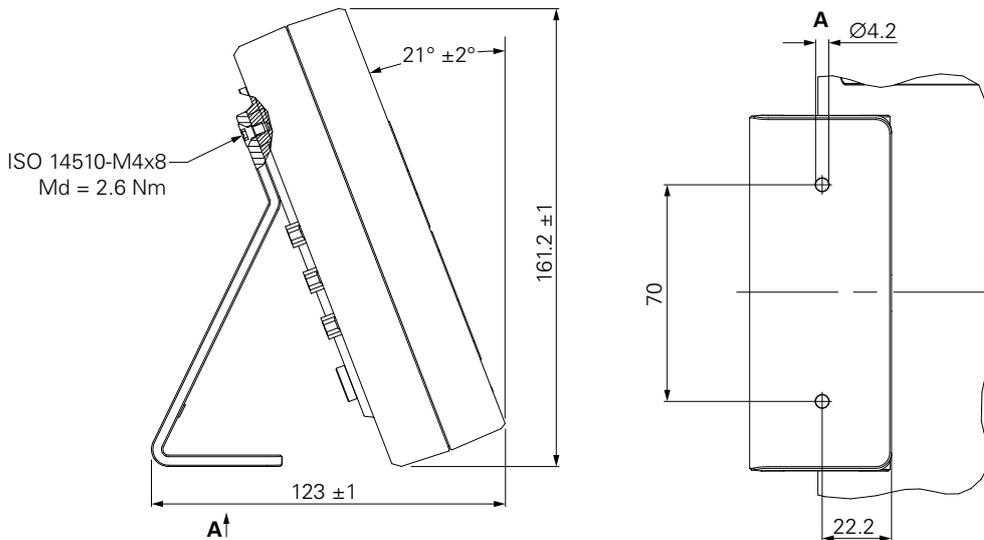
Secure the product against movement during operation

- ▶ Attach the supplied self-adhesive rubber pads to the bottom of the product
- ▶ If you do not screw the product to a surface, attach self-adhesive rubber pads to the bottom of the stand

i Attach the rubber pads to the stand only if you do not screw the product to a surface.



Dimensions of the Single-Pos stand

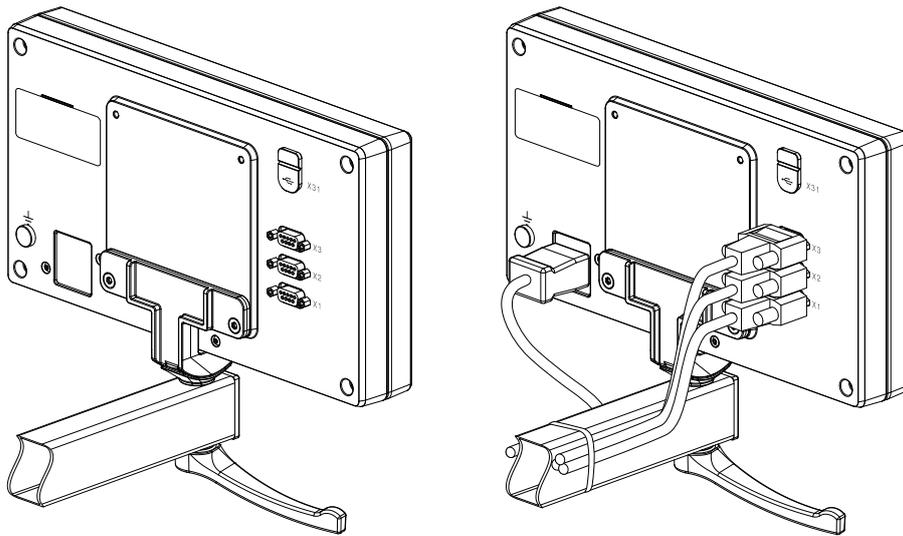


4.4 Mounting on Multi-Pos holder

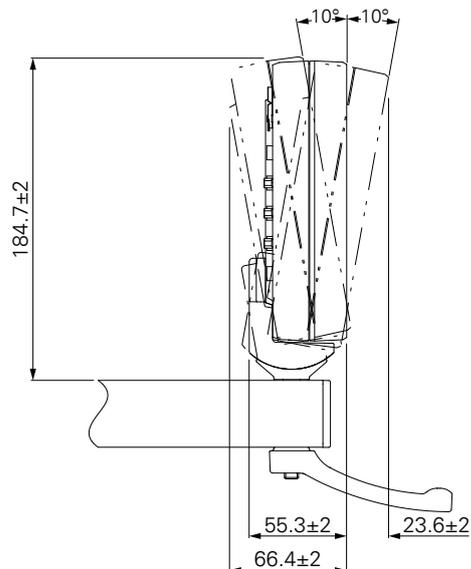
Mount the holder to the bottom VESA 100 tapped holes on the rear panel of the product

- ▶ Use a Torx T20 screwdriver to tighten the countersunk head screws M4 x 10 ISO 14581 (black) included in delivery
- ▶ Comply with the permissible tightening torque of 2.5 Nm

You can tilt and swivel the holder to an angle that allows you to comfortably view the readout.



Dimensions of the Multi-Pos holder

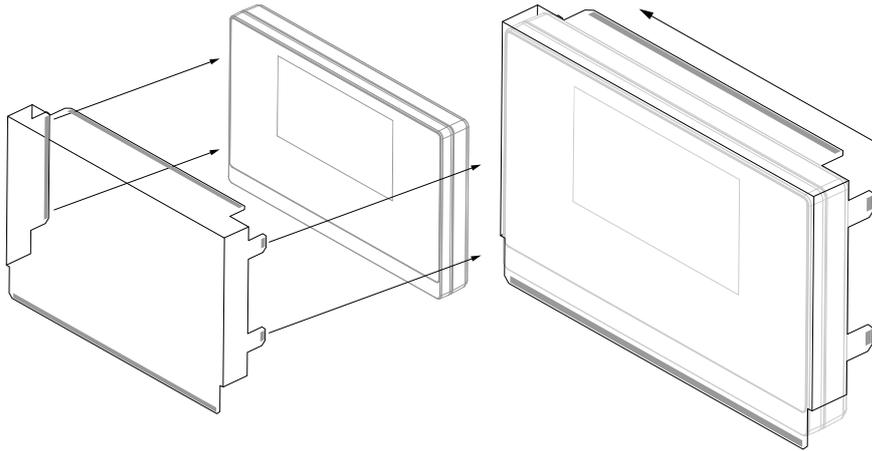


4.5 Mounting a cover

The cover protects the product from dirt and debris.

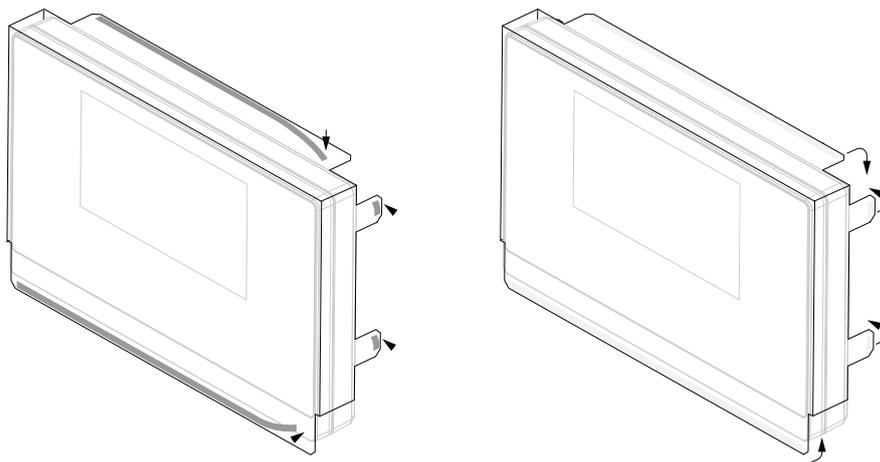
Place the cover on the product

- ▶ Place the cover over the product
- ▶ Align the cover and product on the right hand side, when viewing the front of the product



Mount the cover to the product

- ▶ Remove the adhesive strip protectors from the adhesive tabs
- ▶ Fold the adhesive tabs toward the product
- ▶ Press the adhesive tabs against the product securing the tab to the product



5

Installation

5.1 Overview

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

i The following steps must be performed only by qualified personnel.

Further information: "Personnel qualification", Page 19

5.2 General information

NOTICE

Engaging and disengaging connecting elements!

Risk of damage to internal components.

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

NOTICE

Electrostatic discharge (ESD)!

This product 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 product connections

NOTICE

Incorrect pin assignment!

This may cause product malfunctions or damage to the product.

- ▶ Only assign pins or wires that are used

5.3 Product overview

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

NOTICE

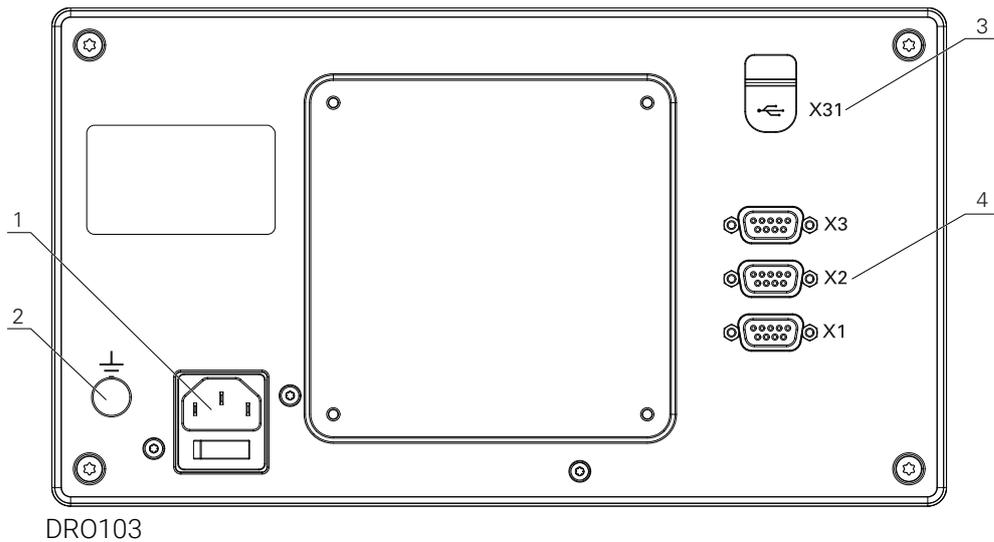
Contamination or damage may result if the dust protection caps are missing!

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, reattach the dust protection cap to the connection

i The type and number of connections may vary depending on the product version.

Rear panel without dust protection caps



Rear panel

- 1 Power switch and power connection
- 2 Earth (ground) terminal as per IEC 60471 - 5017
- 3 **X31**: USB 2.0 Hi-Speed connection (Type C) for USB mass storage device and PC connection (beneath protective cover)
- 4 **X1 to X3**: Device variant with 9-pin D-sub connections for encoders with TTL interface

5.4 Connecting an encoder

- ▶ Remove and save the dust protection caps
- ▶ Route the cables depending on the mounting variant

Further information: "Assembly", Page 28

- ▶ Connect the encoder cable tightly to the respective connection

Further information: "Product overview", Page 35

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

Pin layout of X1 to X3

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}

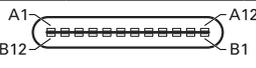
5.5 Connecting a USB device

i A USB device driver is required for communication with a PC.
Download the device driver from the **Support** section at www.acu-ritesolutions.com.

- ▶ Open the dust protection cap
- ▶ Connect the USB device to the respective connection

Further information: "Product overview", Page 35

Pin layout of X31

											
A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1 +	TX1 -	VBUS	CC1	D +	D -	SBU1	VBUS	RX2 -	RX2 +	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
GND	TX2 +	TX2 -	VBUS	CC2	D +	D -	SBU2	VBUS	RX1 -	RX1 +	GND

5.6 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 from the use of power cables that do not meet the national requirements of the respective country in which the product is mounted.

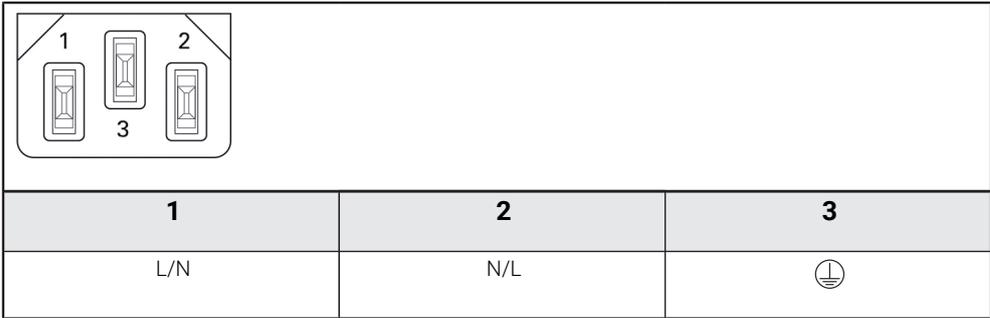
Improper grounding of electrical devices may result in serious personal injury or death by electric shock.

- ▶ Use only a power cable that meets at least the national requirements of the respective country in which the product is mounted

- ▶ Use a power cable that meets the requirements to connect the power connection to a 3-wire grounded power outlet

Further information: "Product overview", Page 35

Pin layout of the power connection



6

**Fundamentals of
positioning**

6.1 Overview

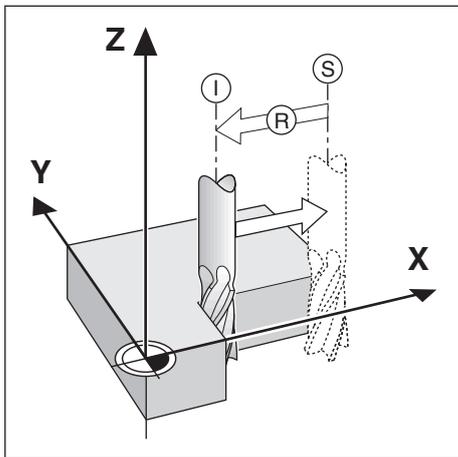
This chapter describes basic positioning information.

6.2 Datums

The workpiece drawing identifies a certain point on the workpiece (example: “a corner”) as the absolute datum, and perhaps one, or more other points as relative datums.

The datum setting procedure establishes these points as the origin of the absolute, or relative coordinate systems. The workpiece, which is aligned with the machine axes, is moved to a certain position relative to the tool. The display is set to zero.

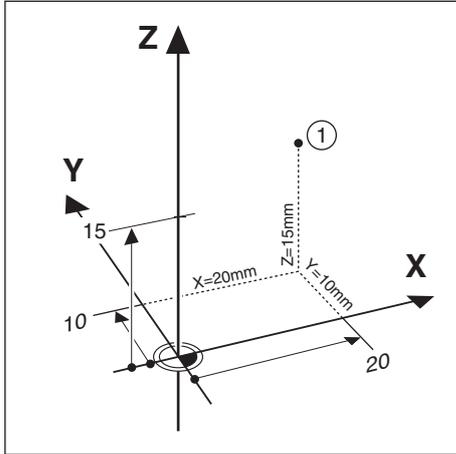
6.3 Actual position, nominal position, and Distance-To-Go



The position of the tool at any given moment is called the Actual Position **I**, while the position that the tool is to move to is called the Nominal Position **S**. The distance from the nominal position to the actual position is called the Distance-To-Go **R**.

6.4 Absolute workpiece positions

Each position on the workpiece is uniquely identified by its absolute coordinates.



Example: Absolute coordinates of position **1**:

X = 20 mm

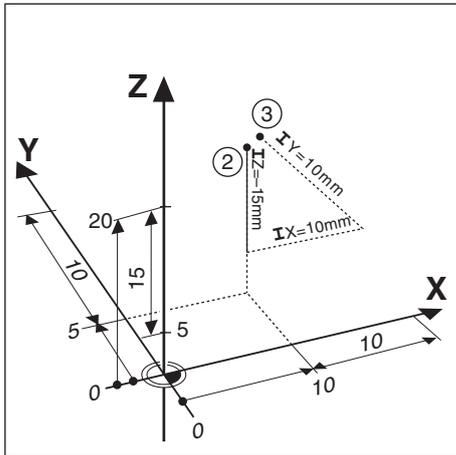
Y = 10 mm

Z = 15 mm

If you are drilling, or milling a workpiece according to a workpiece drawing with absolute coordinates, the tool is moving to the value of the coordinates.

6.5 Incremental workpiece positions

A position can also be referenced to the preceding nominal position. In this case the relative datum is always the last nominal position. Such coordinates are referred to as Incremental Coordinates. They are also called incremental, or chain dimensions, since the positions are defined as a chain of dimensions. Incremental coordinates are designated with the prefix **I**.



Example: Incremental coordinates of position **3** referenced to position **2**.

Absolute coordinates of position **2**:

X = 10 mm

Y = 5 mm

Z = 20 mm

Incremental coordinates of position **3**:

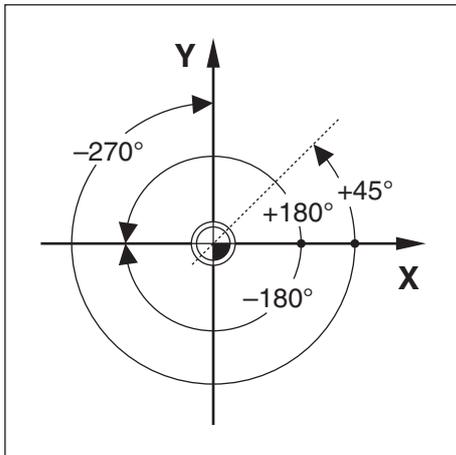
IX = 10 mm

IY = 10 mm

IZ = 15 mm

If you are drilling, or milling a workpiece according to a drawing with incremental coordinates, you are moving the tool by the value of the coordinates.

6.6 Zero angle reference axis



The Zero Angle Reference Axis is the 0.0° position. It is defined as one of the two axes in the plane of rotation. The following table defines the Zero Angle where the position of the angle is zero for the three possible planes of rotation.

For angular positions, the following reference axes are defined:

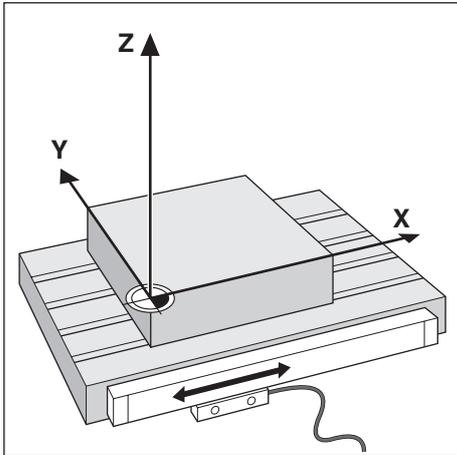
Plane	Zero Angle Reference Axis
XY	+X
YZ	+Y
ZX	+Z

Positive direction of rotation is counterclockwise if the working plane is viewed in the negative tool axis direction.

Example: Angle in the working plane X / Y

Plane	Zero Angle Reference Axis
$+45^\circ$... bisecting line between +X and +Y
$\pm 180^\circ$... negative X axis
-270°	... positive Y axis

6.7 Reading head position



The reading head position provides feedback to the product that converts the movement of the machine axes into electrical signals. The product constantly evaluates these signals, calculates the actual positions of the machine axes, and displays the positions as a numerical value on the display.

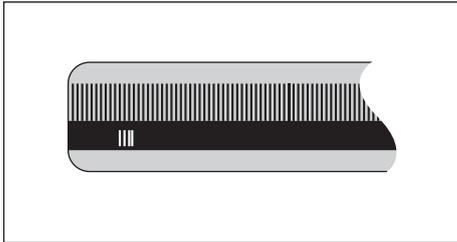
If there is an interruption in power, the calculated position will no longer correspond to the actual position. When power is restored, you can re-establish this relationship by using the reference marks on the encoder. This product provides the Reference Mark Evaluation Feature (REF).

6.8 Encoder reference marks

Encoders normally contain one or more reference marks which the Reference Mark Evaluation feature uses to re-establish datum positions after a power interruption. There are two main options available for reference marks:

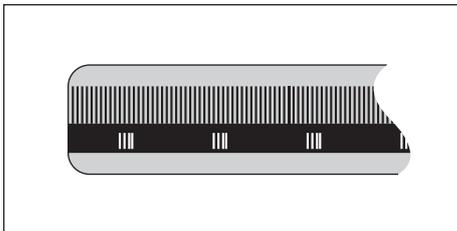
- Fixed reference marks
- Distance-coded reference marks

Fixed reference marks



Encoders that have one or more marks on fixed intervals have to re-establish the datums correctly. It is necessary to use the same exact reference mark, during the Reference Mark Evaluation routine, that was used when the datum was first established.

Position Trac (Distance-coded reference marks)



Encoders that have marks separated by a specific encryption pattern allow the product to use any two pair of marks along the length of the encoder to re-establish the prior datums. This configuration means that you only have to travel less than 20 mm anywhere along the encoder to re-establish the datums when the product is switched back on.



The established datums cannot be restored from one power cycle to the next if the reference marks were not crossed before the datums were set.

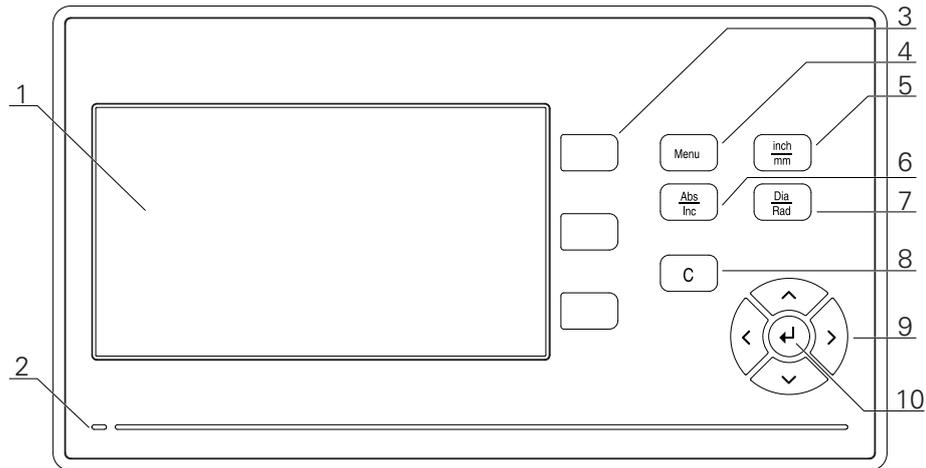
7

Basic operation

7.1 Overview

This chapter describes the product's operating elements and user interface as well as its basic functions.

7.2 Front panel and keys



- 1 Display
- 2 Power indicator LED
- 3 Axis keys
- 4 Menu key
- 5 inch/mm key
- 6 Abs/Inc key
- 7 Dia/Rad key
- 8 C key
- 9 Arrow keys
- 10 Enter key

Key	Function
Axis	Press an axis key to zero the axis
Menu	Press the Menu key to access the Configuration menu
inch/mm	Press the inch/mm key to toggle between inch and millimeter units of measure
Abs/Inc	Press the Abs/Inc key to toggle between Actual Value (Absolute) and Distance-To-Go (Incremental) modes
Dia/Rad	Press the Dia/Rad key to toggle between diameter and radius measurements
C	Press the C key to clear entries and error messages, or return back to the previous screen
Arrow	Press the arrow keys to navigate the Configuration Menu
Enter	Press the enter key to confirm a selection, and return to the previous screen

7.3 User interface

7.3.1 Display layout



- 1 Unit of measure
- 2 Operating mode
- 3 Display area
- 4 Reference mark indicator
- 5 Axis labels

Feature	Function
Status bar	Displays the current operating mode and unit of measure
Display area	Indicates the current position of each axis. Also shows forms, fields, instruction boxes, error messages and help topics
Axis labels	Indicates axis for corresponding axis key
Reference mark indicator	Indicates current reference mark status <ul style="list-style-type: none">  Reference marks are enabled  Reference marks are disabled

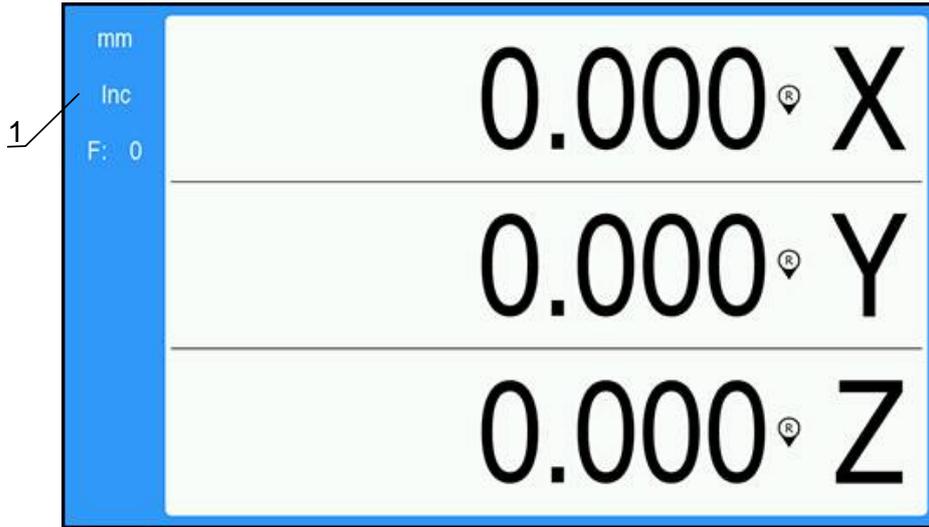
7.3.2 Operating modes

The product has two operating modes:

- Distance-To-Go (Incremental)
- Actual Value (Absolute)

Distance-To-Go mode (Incremental)

The Distance-To-Go mode enables you to approach nominal positions by zeroing the axes and traversing to a position based on its distance from the zeroed position.



1 Distance-To-Go mode (Inc)

Actual Value mode (Absolute)

The Actual Value mode always displays the current actual position of the tool, relative to the active datum. In this mode, all moves are done by traveling until the display matches the nominal position that is required.



1 Actual Value mode (Abs)

Changing the operating mode

To change the operating mode:

- ▶ Press the **Abs/Inc** key to toggle between operating modes

7.3.3 Reference mark evaluation

The Reference Mark Evaluation feature automatically re-establishes the relationship between axis slide positions and display values that was last defined by setting the datum.

The reference mark indicator will flash for each axis with an encoder that has reference marks. The indicator will stop flashing after crossing over the reference marks.

Activating reference marks



1 Reference marks enabled

To activate reference marks:

- ▶ Cross over the reference marks for each axis to activate the reference
- > After a successful reference mark evaluation, the indicator will stop flashing

Working without reference marks

The product can also be used without crossing over the reference marks.



1 Reference marks disabled

To work without reference marks:

- ▶ Press the **C** key to exit the reference mark evaluation routine, and continue
- > After disabling reference marks the indicator will have a forward slash through it, signifying that the reference marks have been disabled

Re-enabling reference marks

Reference marks can be enabled any time after they have been disabled

To re-enable reference marks:

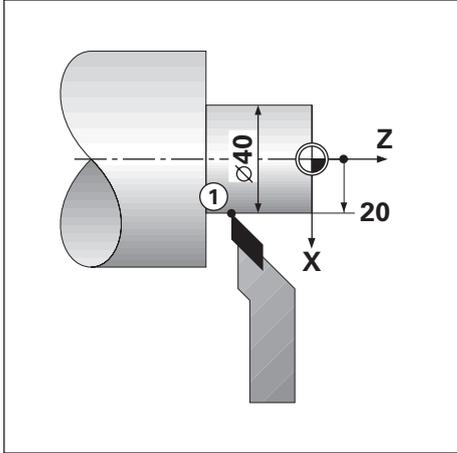
- ▶ Press and hold the **Abs/Inc** key for two seconds to re-enable reference marks



If an encoder is setup without reference marks the reference indicator will not be displayed. A datum set from the axis will be lost once power is turned off.

7.3.4 Diameter and radius measurements

Drawings for lathe parts usually give diameter values. The product can display either the diameter or the radius. When the diameter is being displayed, the diameter symbol \emptyset is shown next to the position value.



Example:

- Radius display, position 1, X = 20
- Diameter display, position 1, X = $\emptyset 40$

Activating diameter and radius measurements for an axis

Further information: "Diameter Axes", Page 73

Switching between diameter and radius measurements

To toggle between diameter and radius measurements:

- ▶ Press the **Dia/Rad** key

7.3.5 Help

Integrated operating instructions provide context-sensitive **Help** when operating the product.

 The operating instructions may take a moment to load the first time they are opened:

- After uploading a new operating instructions file
- After changing the user interface language

The message **Loading file. Please wait ...** will display while the operating instructions load.

To open the operating instructions:

- ▶ Press and hold the **Menu** key for two seconds
- The operating instructions will open to the section that covers the current feature or function being used on the product.

The following key functions are available in **Help**:

Key	Function
First axis	Press the First axis key to open the table of contents
Up arrow	Press the Up arrow key to navigate back in the operating instructions
Down arrow	Press the Down arrow key to navigate forward in the operating instructions
Right arrow	Press the Right arrow key to highlight the first link on a page If a link is already highlighted: Press the Right arrow key to highlight the next link on a page
Left arrow	Press the Left arrow key to highlight the last link on a page If a link is already highlighted: Press the Left arrow key to highlight the previous link on a page
enter	Press the enter key to navigate to a link that is highlighted
C	Press the C key to remove a highlight from a link If no links are highlighted: Press the C key to exit Help

7.4 Switch-on/Switch-off

7.4.1 Switch-on

 Before using the product, you need to perform the commissioning steps. Depending on the purpose of use, you may have to configure additional setup parameters.

Further information: "Commissioning", Page 57

To switch-on the product:

- ▶ Turn the power switch on
The power switch is on the rear side of the unit
- > The unit powers up. This can take a moment.
- > The first-time configuration screen will appear if this is the first time turning on the product or after resetting factory default settings
- ▶ Press the **Menu** key to go to the **Installation Guide**
or
- ▶ Press any key to continue to the display

7.4.2 Switch-off

To switch-off the product:

- ▶ Turn the power switch off
The power switch is on the rear side of the unit
- > The unit powers down

7.5 Error messages

If an error occurs while working with the product, a message will appear on the display, and provide an explanation of what caused the error.

Further information: "What to do if...", Page 107

To clear an error message:

- ▶ Press the **C** key
- > The error message will be cleared and normal operation can continue

8

Commissioning

8.1 Overview

i Make sure that you have read and understood the "Basic Operation" chapter before performing the activities described in this section.
Further information: "Basic operation", Page 47

i The following steps are only to be performed by qualified personnel.
Further information: "Personnel qualification", Page 19

During the commissioning process the product is configured for use. Parameters that are changed during the commissioning process can be reset to the factory defaults.

Further information: "Factory Defaults", Page 70

Backing up the configuration

Configuration data can be backed up after commissioning. The configuration data can be reused for equivalent products.

Further information: "Configuration Parameters", Page 61

8.2 Installation Guide

An **Installation Guide** is provided the first time you switch-on the product. This guide will step you through common commissioning parameters. Information about specific parameters included in the **Installation Guide** can be found in the Settings section of these instructions.

Further information: "Settings", Page 97



The **Installation Guide** provides configuration options for the following parameters:

- **Language**
- **Encoder Setup**
- **Display Configuration**
- **Readout Settings**
 - **Encoder Type**
 - **Display Resolution**
 - **Number of Axes**
 - **Resolution**
 - **Label**
 - **Count Direction**
 - **Display Color Scheme**
 - **Error Monitor**
 - **Color Mode**

Opening the Installation Guide

To access the **Installation Guide** from the first-time startup screen:

- ▶ Press the **Menu** key
- > The **Installation Guide** opens

Navigating the Installation Guide

- ▶ Press the **right arrow** key to open a parameter drop-down menu
- ▶ Press the **up** or **down arrow** key to highlight a parameter option
- ▶ Press the **enter** key to select an option
- ▶ Press the **down arrow** key to advance to the next parameter
- or
- ▶ Press the **up arrow** key to go back to a previous parameter
- ▶ Repeat these steps until all parameters have been set

8.3 Installation Setup

Installation Setup parameters are used to establish encoder, display, and communication parameters.

Further information: "Settings", Page 97



Installation Setup parameters must be configured only by qualified personnel.

Further information: "Personnel qualification", Page 19



To access the **Installation Setup** menu:

- ▶ Press the **Menu** key
- ▶ Use the **up** or **down arrow** key to highlight **Installation Setup**
- ▶ Press the **right arrow** key
- > The **Installation Setup** menu is displayed

8.3.1 File Management

Configuration Parameters

The configuration of the product can be backed up as a file to make it available after a reset to the factory default settings or for installation on multiple products. A file with the following properties needs to be stored on the product for this purpose:

- File format: DAT
- File name: config.dat

Importing Configuration Parameters

To import **Configuration Parameters**:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**
 - **Configuration Parameters**
- ▶ Select **Import**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate importing the configuration parameters
- > A pop-up warning informs you that the current parameter settings will be overwritten
- ▶ Press the **enter** key to import the configuration parameters and return to the **File Management** menu
- or
- ▶ Press the **C** key to cancel

Exporting Configuration Parameters

To export configuration parameters:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**
 - **Configuration Parameters**
- ▶ Select **Export**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate exporting the configuration parameters
- > A pop-up warning informs you that the current parameter settings will be exported to the attached USB memory device
- ▶ Press the **enter** key to export the configuration parameters and return to the **File Management** menu
- or
- ▶ Press the **C** key to cancel

Operating instructions

The product's **Operating Instructions** can be loaded onto the product and viewed using the **Help** function.

Operating Instructions can be loaded to the product in multiple languages. The product will look for the operating instructions in the **Language** selected in the **Job Setup** menu when loading the file from a USB memory device.



An error will be displayed if the operating instructions are not found on the USB memory device in the selected **Language**.

The **Operating Instructions** can be downloaded from the download area at www.acu-ritesolutions.com.

A file with the following properties needs to be loaded onto the product:

- File format: mPub
 - File name: DRO100_xx.mpub¹⁾
- 1) xx: corresponds to the ISO 639-1 two-letter code

To load the **Operating Instructions**:

- ▶ Select the desired **Language** if it is different than the currently selected language
Further information: "Language", Page 75
- ▶ Insert a USB memory device containing the **Operating Instructions** mPub file into the USB connection
- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**
 - **Operating Instructions**
- ▶ Select **Load**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate loading the **Operating Instructions**
- > A pop-up warning informs you that the **Operating Instructions** will be loaded
- ▶ Press the **enter** key to load the **Operating Instructions**
- or
- ▶ Press the **C** key to cancel

Power-up Screen

You can define an OEM-specific **Power-up 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 format: 24-Bit Bitmap
- Image size: 800 x 480 px
- File name: OEM_SplashScreen.bmp

Importing a power-up screen

To import a power-up screen:

- ▶ Connect a USB mass storage device containing the OEM_SplashScreen.bmp file to the USB port of the product
- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**
 - **Power-up Screen**
- ▶ Select **Import**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate loading the power-up screen
- ▶ A pop-up warning informs you that the power-up screen will be loaded
- ▶ Press the **enter** key to load the power-up screen and return to the **File Management** menu
- or
- ▶ Press the **C** key to cancel

Exporting a power-up screen

To export a power-up screen:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**
 - **Power-up Screen**
- ▶ Select **Export**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate exporting the power-up screen
- ▶ A pop-up warning informs you that the current power-up screen will be exported to the attached USB memory device



The OEM_SplashScreen.bmp file on the USB memory device will be overwritten.

- ▶ Press the **enter** key to export the power-up screen and return to the **File Management** menu
- or
- ▶ Press the **C** key to cancel

Service File

The product saves event data that may be used for analysis at a later time. You may be asked to provide this data, by exporting a **Service File**, in the event that your product requires service.

Exporting a Service File

To export a **Service File**:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**
 - **Service File**
- ▶ Select **Export**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate exporting the file
- > A pop-up warning informs you that the file will be written to the USB mass storage device
- ▶ Press the **enter** key to export the file and return to the **File Management** menu
 - or
- ▶ Press the **C** key to cancel

Clearing the Service File data

HEIDENHAIN recommends maintaining the maximum amount of free space available in the internal memory, by clearing the saved data, after exporting a **Service File**.

To clear the service file data:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**
 - **Service File**
- ▶ Select **Clear**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate clearing the history
- > A pop-up warning informs you that the history will be lost
- ▶ Press the **enter** key to clear the data and return to the **File Management** menu
 - or
- ▶ Press the **C** key to cancel

Product Software

When a **Product Software** update is available it can be uploaded to the product from a USB mass storage device.

To install a product software update:

- ▶ Connect a USB mass storage device containing the **Product Software** update file to the USB port of the product
- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **File Management**File Management
 - **Product Software**
- ▶ Select **Install**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to initiate installing the software update
- > A pop-up warning informs you that the software update will be installed
- ▶ Press the **enter** key to install the software update
- > The product will restart
- or
- ▶ Press the **C** key to cancel

8.3.2 Encoder Setup

Encoder Setup parameters are used to configure each encoder input.

 The adjustment procedure is the same for each axis. The following section describes the configuration of one axis. Repeat the procedure for each axis.

To set up an encoder:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **Encoder Setup**
- ▶ Select the encoder to set up:
 - **X1**
 - **X2**
 - **X3**
- ▶ The **Encoder Setup** parameters are displayed for the selected axis
- ▶ Select the desired **Resolution**:
 - **0.5** μm
 - **1.0** μm
 - **2.0** μm
 - **5.0** μm
 - **10.0** μm

 The **Resolution** can also be established by moving the axis in either direction.

- ▶ Press the **enter** key to confirm the selection
- ▶ Select the desired **Reference Mark** type:
 - **None**: no reference signal
 - **Single**: single reference mark
 - **Position Trac**: an encoder with the Position-Trac feature
 - **P-Trac (ENC 250)**: an ENC 250 encoder with the Position-Trac feature
 - **P-Trac (LB 382C)**: an LB 382C encoder with the Position-Trac feature
 - **EverTrack**: an encoder with the EverTrack feature
 - **LMF**: an LMF encoder with reference marks
- ▶ Press the **enter** key to confirm the selection
- ▶ Select the desired **Count Direction**:
 - **Negative**
 - **Positive**

When the encoder's count direction matches the operators count direction, select **Positive**. When they do not match, select **Negative**.

 The **Count Direction** can also be established by moving the axis in the positive direction.

- ▶ Press the **enter** key to confirm the selection
- ▶ Select **On** or **Off** in the **Error Monitor** parameter to enable or disable error monitoring

On allows the DRO to monitor counting errors. The types of counting errors are contamination errors (when the signal to the encoder falls below a set limit), and frequency error (when the signal frequency exceeds the set limit).
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to save the **Encoder Setup** parameter changes and return to the **Installation Setup** menu

or
- ▶ Press the **C** key to cancel

8.3.3 Display Configuration

Display Configuration parameters are used to configure the way axes information is shown on the display.

 The adjustment procedure is the same for each axis display. The following section describes the configuration of one axis display. Repeat the procedure for each axis display.

To configure an axis display:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **Display Configuration**
- ▶ Select the axis display to set up:
 - **Display 1**
 - **Display 2**
 - **Display 3**
- ▶ The **Display Configuration** parameters are displayed for the selected axis display
- ▶ Select the desired **Display Resolution**

Display Resolution options vary based on the encoders connected to the product.
- ▶ Press the **enter** key to confirm the selection
- ▶ Select a **Label** for the axis display or **Off** to turn off the selected axis display:

■ Off	■ A
■ X	■ B
■ Y	■ C
■ Z	■ S
■ U	■ T
■ V	■ Q
■ W	
- ▶ Press the **enter** key to confirm the selection

- ▶ Select **Off** or **On** to enable or disable a **Subscript** zero being displayed after the axis label
- ▶ Press the **enter** key to confirm the selection
- ▶ Select the desired input for the axis display in the **Input 1** parameter:
 - **X1**
 - **X2**
 - **X3**
- ▶ Press the **enter** key to confirm the selection
- ▶ Select **+** or **-** in the **Couple Operation** parameter to couple a second input with the first:
 - **+**
 - **-**
 - **Off**
- ▶ Press the **enter** key to confirm the selection
- ▶ Select the desired input to couple with **Input 1** in the **Input 2** parameter:
 - **Not Defined**
 - **X1**
 - **X2**
 - **X3**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to save the **Display Configuration** parameter changes and return to the **Installation Setup** menu
- or
- ▶ Press the **C** key to cancel

8.3.4 Readout Settings

Readout Settings parameters are used to set axes, and position recall requirements.

To configure the readout:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **Readout Settings**
- ▶ Select the **Number of Axes**:
 - **1**
 - **2**
 - **3**
- ▶ Press the **enter** key to confirm the selection
- ▶ Select **On** or **Off** to enable or disable **Position Recall**

Position Recall will store the last position of each axis when power was turned off, and then redisplay that position once power is turned back on.

 Any movement that occurs while power is off will be lost. Whenever power has been off it is recommended to re-establish workpiece datums using the reference mark evaluation procedure.
Further information: "Reference mark evaluation", Page 52

- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to save the **Readout Settings** parameter changes and return to the **Installation Setup** menu
- or
- ▶ Press the **C** key to cancel

8.3.5 Diagnostics

The **Diagnostics** feature provides a way to test the keypad and display.

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **Diagnostics**

Keypad Test

An image of the keypad provides an indication when a key is pressed and released.

To test the keypad:

- ▶ Press each key to test
- > A key that is operating properly will turn green in the **Diagnostics** screen when pressed on the keypad, and change to gray when released.
- ▶ Press the **C** key two times to exit the **Keypad Test**

Display Test

The **Display Test** cycles through the five available pixel colors; red, green, blue, black, and white. Cycling through the pixel colors allows you to more easily see if there is a color problem with the display.

To test the display:

- ▶ Press the **enter** key to cycle through the pixel colors

8.3.6 Display Color Scheme

Display Color Scheme parameters are used to set the color scheme of the product. Select the color scheme that makes the display easiest to view in your workspace lighting conditions.

To select a color scheme:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **Display Color Scheme**
- ▶ Select the **Color Mode**:
 - **Day**: the color scheme is set to **Day** mode and cannot be selected by the user
 - **Night**: the color scheme is set to **Night** mode and cannot be selected by the user
 - **User Selectable**: the color mode can be selected by the user from the **Job Setup** menu
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to save the **Display Color Scheme** parameter changes and return to the **Installation Setup** menu
- or
- ▶ Press the **C** key to cancel

8.3.7 Factory Defaults

Parameter changes made in the **Job Setup** and **Installation Setup** menus can be reset to the factory default settings. All parameters will be reset.

Further information: "Settings", Page 97

To reset parameters to factory default settings:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **Factory Defaults**
 - **Reset Settings**
- ▶ Select **Yes**
- ▶ Press the **enter** key to accept the selection
- ▶ Press the **enter** key to initiate resetting the product to the factory default settings
- > A warning window will appear to confirm the reset
- ▶ Press the **enter** key to reset parameters to the factory default settings
- > The product will restart.
- or
- ▶ Press the **C** key to cancel the reset

8.3.8 Error Compensation

The distance a cutting tool travels, measured by an encoder, can in certain cases differ from the actual tool travel. This error can occur due to ball screw pitch error, or deflection and tilting of axes. Errors can be determined with a reference measurement system, such as gauge blocks.

The product provides the ability to compensate for linear errors, and each axis can be programmed separately with the appropriate compensation.

Linear Error Compensation (LEC) can be applied, if the results of a comparison with a reference standard shows a linear deviation over the whole measuring length. In this case the error can be compensated by the calculation of a single correction factor.

The correction factor may be calculated automatically using a standard gauge block.



The adjustment procedure is the same for each axis. The following section describes the configuration of one axis. Repeat the procedure for each axis.

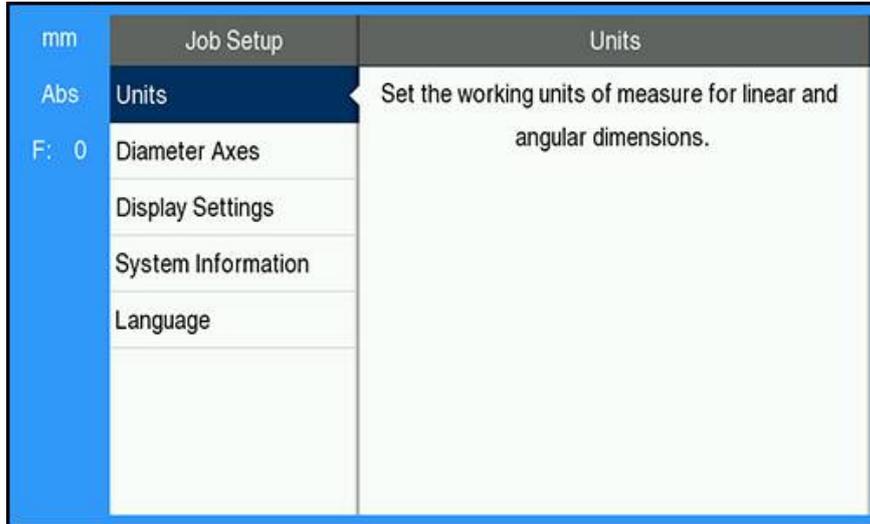
To configure LEC:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Installation Setup**
 - **Error Compensation**
- ▶ Select the input to configure:
 - **X1**
 - **X2**
 - **X3**
- ▶ Select **Linear** to configure LEC for the input
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **Menu** key to begin teaching the LEC factor
- ▶ Touch one edge of the standard with the tool
- ▶ Press the **enter** key
- ▶ Touch the opposite edge of the standard with the tool
- ▶ Press the **enter** key to confirm the **Measured** value
- ▶ Move the encoder until the **Actual** field shows the actual size of the standard plus the diameter of the probe.
- ▶ The **Calculated Factor** field shows the calculated correction factor based on the **Measured** and **Actual** values.
- ▶ Press the **enter** key to confirm the value
- ▶ Press the **enter** key to save the **Error Compensation** parameter changes and return to the **Installation Setup** menu
- or
- ▶ Press the **C** key to cancel

8.4 Job Setup

Job Setup parameters are used to accommodate specific machining requirements for each job. These parameters can be set by a system installer, supervisor, or operator.

Further information: "Settings", Page 97



To access the **Job Setup** menu:

- ▶ Press the **Menu** key
- ▶ Use the **up** or **down arrow** key to highlight **Job Setup**
- ▶ Press the **right arrow** key
- > The **Job Setup** menu is displayed

8.4.1 Units

Units parameters are used to specify the preferred display units and format. You can also select the unit of measure by pressing the **inch/mm** key in either operating mode.

To set the units of measure:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Job Setup**
 - **Units**
- ▶ Select the **Linear** units of measure:
 - **inch**
 - **mm**
- ▶ Press the **enter** key to confirm the selection
- ▶ Select the **Angular** units of measure:
 - **Decimal Degrees**
 - **Radians**
 - **DMS: Degrees, Minutes, Seconds**
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to save the **Units** parameter changes and return to the **Job Setup** menu
- or
- ▶ Press the **C** key to cancel

8.4.2 Diameter Axes

Diameter Axes parameters are used to set which axes can display radius or diameter values.

To setup the display of radius or diameter values:

- ▶ Press the **Menu** key
 - ▶ Open in the sequence
 - **Job Setup**
 - **Diameter Axes**
 - ▶ Select the desired axis to setup
 - ▶ Select **On** or **Off** to enable or disable the display of radius or diameter values for the selected axis
 - ▶ Press the **enter** key to confirm the selection
 - ▶ Press the **enter** key to save the **Diameter Axes** parameter changes and return to the **Job Setup** menu
- or
- ▶ Press the **C** key to cancel

8.4.3 Display Settings

Display Settings parameters are used to adjust the appearance of the display.

To configure **Display Settings**:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Job Setup**
 - **Display Settings**
- ▶ Use the **left** or **right arrow** key to adjust the **Brightness** level of the display
The **Brightness** can also be adjusted using the **up** and **down arrow** keys when the product is in either operating mode.
- ▶ Select the time in minutes that the display is idle before the **Display Saver (min)** is activated and the display is switched off:
 - **Off**
 - **10**
 - **30**
- ▶ Press the **enter** key to confirm the selection
- ▶ Select the desired **Color Mode**:
 - **Night**
 - **Day**
- ▶ Press the **enter** key to confirm the selection
- ▶ Select how the axis that is in motion is displayed:
 - **Normal**: All axes are displayed normal
 - **Dynamic Zoom**: The axis in motion is displayed larger than axes not in motion
 - **Highlight**: The axis in motion is displayed in black, axes not in motion are displayed in gray
- ▶ Press the **enter** key to confirm the selection
- ▶ Select the number of seconds (1-9) for **Zoom Timeout (sec)** that **Dynamic Zoom** or **Highlight** stays active after axis movement has stopped
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to save the **Display Settings** parameter changes and return to the **Job Setup** menu
or
- ▶ Press the **C** key to cancel

8.4.4 System Information

The **System Information** screen provides product and software information.

Available information:

- **Product Name**
- **Product ID**
- **Serial Number**
- **Software Version**
- **Bootloader Version**
- **FPGA Version**
- **Board ID**

To access **System Information**:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Job Setup**
 - **System Information**
- ▶ Press the **enter** key
- > The **System Information** screen is displayed
- ▶ Press the **C** key to exit **System Information**

8.4.5 Language

The **Language** parameter is used to select the language for the user interface. The default language is English.

To change the Language:

- ▶ Press the **Menu** key
- ▶ Open in the sequence
 - **Job Setup**
 - **Language**
- ▶ Select the desired language
- ▶ Press the **enter** key to confirm the selection
- ▶ Press the **enter** key to save the **Language** parameter change and return to the **Job Setup** menu
- or
- ▶ Press the **C** key to cancel

9

Operation

9.1 Overview

This chapter describes the procedure for simple machining operations.

i Make sure that you have read and understood the "Basic Operation" chapter before performing the activities described in this section.

Further information: "Basic operation", Page 47

Short description

By traversing the reference marks on the encoders, you make it possible to define an absolute position. When you have completed the reference mark search, you then set the datums that will be used as the basis for all subsequent measurements.

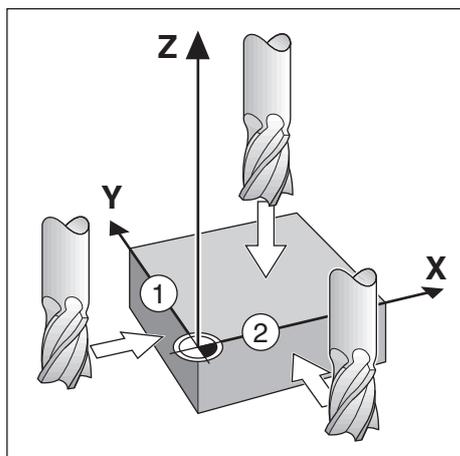
9.2 Probing for datum setting

Probing with a tool

A tool is used to probe and set datum points.

Probing an edge

Datum points can be set by probing the edge of a workpiece with a tool, zeroing the respective axis, and repeating this process for the remaining axes.

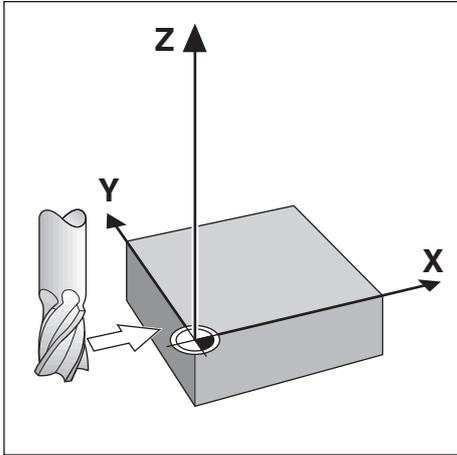


Tool compensation

Tool compensation can be accounted for by moving the distance of the tool radius towards the workpiece and pressing the zero key, after zeroing on an edge.

Example: Probe workpiece edge and set edge as datum

An end mill is shown in this example, along with the product display.



Preparation:

- ▶ Insert the tool that will be used to set the datum
 - Datum axis: X =0
 - Tool diameter D = 0.25"
- ▶ If required, press the Abs/Inc key to select
- ▶ Touch the workpiece edge
- ▶ Press the X axis **Zero** key to zero the current absolute value while the tool is in contact with the workpiece edge

The location for the touched edge will not take into account the diameter of the tool in use.
- ▶ Raise the tool enough to clear the workpiece
- ▶ move the tool the distance of the tool radius towards the workpiece
- ▶ Press the X axis **Zero** key to zero the current absolute value

10

External operation

10.1 External operation

The product can be operated over the USB data interface from a host application. Special commands available: <Ctrl>B 'Send Current Position', <Ctrl>P 'Send Screen Capture'.

The following key commands are available:

Format

<ESC>TXXXX<CR>	Key is pressed
<ESC>AXXXX<CR>	Output of screen contents
<ESC>SXXXX<CR>	Special functions

Sequence of commands

Function

<ESC>T0100<CR>	C key
<ESC>T0104<CR>	enter key
<ESC>T0109<CR>	Axis Key 1
<ESC>T0110<CR>	Axis Key 2
<ESC>T0111<CR>	Axis Key 3
<ESC>T0135<CR>	Left arrow key
<ESC>T0136<CR>	Right arrow key
<ESC>T0137<CR>	Up arrow key
<ESC>T0138<CR>	Down arrow key
<ESC>T0140<CR>	Menu key
<ESC>T0141<CR>	inch/mm key
<ESC>T0142<CR>	Abs/Inc key
<ESC>T0143<CR>	Dia/Rad key
<ESC>T0144<CR>	Access Help feature
<ESC>T0145<CR>	Enable reference marks
<ESC>A0000<CR>	Send device identification
<ESC>A0200<CR>	Send actual position
<ESC>S0000<CR>	Reset device
<ESC>S0001<CR>	Lock keypad
<ESC>S0002<CR>	Release keypad

11

Reference tables

11.1 Drill sizes to decimal inches

Size	Inches
1.00 mm	0.0394
60	0.0400
59	0.0410
1.05 mm	0.0413
58	0.0420
57	0.0430
1.10 mm	0.0433
1.15 mm	0.0453
56	0.0465
3/64	0.0469
1.20 mm	0.0472
1.25 mm	0.0492
1.30 mm	0.0512
55	0.0520
1.35 mm	0.0531
54	0.0550
1.40 mm	0.0551
1.45 mm	0.0571
1.50 mm	0.0591
53	0.0595
1.55 mm	0.0610
1/16	0.0625
1.60 mm	0.0630
52	0.0635
1.65 mm	0.0650
1.70 mm	0.0669
51	0.0670
1.75 mm	0.0689
50	0.0700
1.80 mm	0.0728
49	0.0730
1.90 mm	0.0748
48	0.0760
1.95 mm	0.0768
5/64	0.0781
47	0.0785
2.00 mm	0.0787

Size	Inches
2.05 mm	0.0807
46	0.0810
45	0.0820
2.40 mm	0.0827
2.15 mm	0.0846
44	0.0860
2.20 mm	0.0866
2.25 mm	0.0886
43	0.0890
2.30 mm	0.0906
2.35 mm	0.0925
42	0.0935
3/32	0.0938
2.40 mm	0.0945
41	0.0960
2.45 mm	0.0965
40	0.0980
2.50 mm	0.0984
39	0.0995
38	0.1015
2.60 mm	0.1024
37	0.1040
2.70 mm	0.1063
36	0.1065
2.75 mm	0.1083
7/64	0.1094
35	0.1100
2.80 mm	0.1102
34	0.1110
33	0.1130
2.90 mm	0.1142
32	0.1160
3.00 mm	0.1181
31	0.1200
3.10 mm	0.1220
1/8	0.1250
3.20 mm	0.1260
3.25 mm	0.1280
30	0.1285

Size	Inches
3.30 mm	0.1299
3.40 mm	0.1339
29	0.1360
3.50 mm	0.1378
28	0.1405
9/64	0.1406
3.60 mm	0.1417
27	0.1440
3.70 mm	0.1457
26	0.1470
3.75 mm	0.1476
25	0.1495
3.80 mm	0.1495
24	0.1520
3.90 mm	0.1535
23	0.1540
5/32	0.1562
22	0.1570
4.00 mm	0.1575
21	0.1590
20	0.1610
4.10 mm	0.1614
4.20 mm	0.1654
19	0.1660
4.25 mm	0.1673
4.30 mm	0.1693
18	0.1695
44/64	0.1719
17	0.1730
4.40 mm	0.1732
16	0.1770
4.50 mm	0.1772
15	0.1800
4.60 mm	0.1811
14	0.1820
13	0.1850
4.70 mm	0.1850
4.75 mm	0.1870
3/16	0.1875

Size	Inches
4.80 mm	0.1890
12	0.1890
11	0.1910
4.90 mm	0.1929
10	0.1935
9	0.1960
5.00 mm	0.1969
8	0.1990
5.10 mm	0.2008
7	0.2010
13/64	0.2031
6	0.2040
5.20 mm	0.2047
5	0.2055
5.25 mm	0.2067
5.30 mm	0.2087
4	0.2090
5.40 mm	0.2126
3	0.2130
5.50 mm	0.2165
7/32	0.2188
5.60 mm	0.2205
2	0.2211
5.70 mm	0.2244
5.75 mm	0.2264
1	0.2280
5.80 mm	0.2283
5.90 mm	0.2323
A	0.2340
15/64	0.2344
6.00 mm	0.2362
B	0.2380
6.10 mm	0.2402
C	0.2420
6.20 mm	0.2441
D	0.2460
6.25 mm	0.2461
6.30 mm	0.2480
E	0.2500

Size	Inches
1/4	0.2500
6.40 mm	0.2520
6.50 mm	0.2559
F	0.2570
6.60 mm	0.2598
G	0.2610
6.70 mm	0.2638
17/64	0.2656
6.75 mm	0.2657
H	0.2660
6.80 mm	0.2677
6.90 mm	0.2717
I	0.2720
7.00 mm	0.2756
J	0.2770
7.10 mm	0.2795
K	0.2810
9/32	0.2812
7.20 mm	0.2835
7.25 mm	0.2854
7.30 mm	0.2874
L	0.2900
7.40 mm	0.2913
M	0.2950
7.50 mm	0.2953
19/64	0.2969
7.60 mm	0.2992
N	0.3020
7.70 mm	0.3031
7.75 mm	0.3051
7.80 mm	0.3071
7.90 mm	0.3110
5/16	0.3125
8.00 mm	0.3150
O	0.3160
8.10 mm	0.3189
8.20 mm	0.3228
P	0.3230
8.25 mm	0.3248

Size	Inches
8.30 mm	0.3268
21/64	0.3281
8.40 mm	0.3307
Q	0.3320
8.50 mm	0.3346
8.60 mm	0.3386
R	0.3390
8.70 mm	0.3425
11/32	0.3438
8.75 mm	0.3445
8.80 mm	0.3465
S	0.3480
8.90 mm	0.3504
9.00 mm	0.3546
T	0.3580
9.10 mm	0.3583
23/64	0.3594
9.20 mm	0.3622
9.25 mm	0.3642
9.30 mm	0.3661
U	0.3680
9.40 mm	0.3740
9.50 mm	0.3740
3/8	0.3750
V	0.3770
9.60 mm	0.3780
9.70 mm	0.3819
9.75 mm	0.3839
9.80 mm	0.3858
W	0.3860
9.90 mm	0.3898
25/64	0.3906
10.00 mm	0.3937
X	0.3970
Y	0.4040
13/32	0.4062
Z	0.4130
10.50 mm	0.4134
27/64	0.4219

Size	Inches
11.00 mm	0.4331
7/16	0.4375
11.50 mm	0.4528
29/64	0.4531
15/32	0.4688
12.00 mm	0.4724
31/64	0.4844
12.50 mm	0.4921
1/2	0.5000
13.00 mm	0.5118
33/64	0.5156
17/32	0.5312
13.50 mm	0.5315
35/64	0.5469
14.00 mm	0.5512
9/16	0.5625
14.50 mm	0.5709
37/64	0.5781
15.00 mm	0.5906
19/32	0.5938
39/64	0.6094
15.50 mm	0.6102
5/8	0.6250
16.00 mm	0.6299
41/64	0.6406
16.50 mm	0.6496
21/32	0.6562
17.00 mm	0.6693
43/64	0.6719
11/16	0.6875
17.50 mm	0.6890
45/64	0.7031
18.00 mm	0.7087
23/32	0.7188
18.50 mm	0.7283
47/64	0.7344
19.00 mm	0.7480
3/4	0.7500
49/64	0.7656

Size	Inches
19.50 mm	0.7677
25/32	0.7812
20.00 mm	0.7874
51/64	0.7969
20.50 mm	0.8071
13/16	0.8125
21.00 mm	0.8268
27/32	0.8438
21.50 mm	0.8465
55/64	0.8594
22.00 mm	0.8661
7/8	0.8750
22.50 mm	0.8858
57/64	0.8906
23.00 mm	0.9055
29/32	0.9062
59/64	0.9219
23.50 mm	0.9252
15/16	0.9375
24.00 mm	0.9449
61/64	0.9531
24.50 mm	0.9646
31/32	0.9688
25.00 mm	0.9843
63/64	0.9844
1	1.0000

11.2 English tap drill sizes

Tap	Drill
2-56	50
2-64	50
4-40	43
4-48	42
6-32	36
6-40	33
8-32	29
8-36	29
10-24	26
10-32	21
1/4-20	7
1/4-28	3
5/16-18	F
5/16-24	I
3/8-16	5/16
3/8-24	Q
1/2-13	27/64
1/2-20	29/64
5/8-11	17/32
5/8-18	37/64
3/4-10	21/32
3/4-16	11/16
1-8	7/8
1-12	59/64

11.3 Metric tap drill sizes

Metric tap	Drill mm	~Drill inches
m1.5	1.25	-
m2	1.60	52
m3	2.50	40
m4	3.30	30
m5	4.20	19
m6	5.00	9
m8	6.70	17/64
m10	8.50	Q
m12	10.20	Y
m16	14.00	35/64
m20	17.50	11/16
m24	21.00	53/64

11.4 English recommended surface speeds

HSS

Material	BHN	ft/min
cast iron		
soft	120-220	100 - 80
medium	190-220	80 - 60
hard	220-260	60 - 30
crs & hrs*	100-275	110 - 65
soft alloy	125-225	100 - 90
hard alloy	225-425	100 - 20
cast stl	125-300	95 - 60
aluminum		800 - 500
brass		500 - 300
bronze		140 - 80
magnesium		-

*most low & medium carbon

Carbide

Material	BHN	ft/min
cast iron		
soft	120-220	400 - 360
medium	190-220	380 - 240
hard	220-260	240 - 120
crs & hrs*	100-275	440 - 260
soft alloy	125-225	400 - 360
hard alloy	225-425	400 - 80
cast stl	125-300	380 - 240
aluminum		1800 - 1000
brass		1000 - 600
bronze		275 - 180
magnesium		3000 - 500

*most low & medium carbon

11.5 Metric recommended surface speeds

HSS

Material	BHN	m/min
cast iron		
soft	120-220	30 - 25
medium	190-220	25 - 20
hard	220-260	20 - 10
crs & hrs*	100-275	35 - 20
soft alloy	125-225	30 - 28
hard alloy	225-425	30 - 6
cast stl	125-300	29 - 18
aluminum		240 - 150
brass		150 - 90
bronze		40 - 25
magnesium		-

*most low & medium carbon

Carbide

Material	BHN	m/min
cast iron		
soft	120-220	120 - 110
medium	190-220	115 - 70
hard	220-260	70 - 40
crs & hrs*	100-275	135 - 80
soft alloy	125-225	120 - 110
hard alloy	225-425	120 - 25
cast stl	125-300	115 - 70
aluminum		545 - 300
brass		300 - 180
bronze		80 - 55
magnesium		910 - 150

*most low & medium carbon

12

Settings

12.1 Overview

This chapter describes the settings options and the associated parameters for the product.

The basic settings options and parameters for commissioning are outlined in the respective chapter:

Further information: "Commissioning", Page 57

Function	Description
Job Setup	Set the individual job properties
Installation Setup	Set the installation setup properties

Activation

- ▶ Press the **Menu** key

12.2 Factory Defaults

If individual settings that were changed during commissioning need to be reset to the default setting, you can look up the default for each adjustment parameter in this chapter.

If all settings need to be reset, you can restore the product to the default settings.

Further information: "Factory Defaults", Page 70

12.3 Job Setup

12.3.1 Units

Units settings are used to set the working units of measure for linear and angular dimensions.

Parameter	Explanation
Linear	The unit of measure used for linear measurements <ul style="list-style-type: none"> ■ inch or mm ■ Default setting: mm:
Angular	The unit of measure used for angular measurements <ul style="list-style-type: none"> ■ Decimal Degrees, Radians, DMS ■ Default setting: DMS

12.3.2 Diameter Axes

Diameter Axes settings are used to set which display positions can be displayed as diameter values.

Parameter	Explanation
X, Y, Z	<ul style="list-style-type: none"> ■ Off or On ■ Default setting: Off

12.3.3 Display Settings

Display Settings are used to adjust the appearance of the display.

Parameter	Explanation
Brightness	Set the brightness of the display <ul style="list-style-type: none"> ■ Setting range: 10 % ... 100 % ■ Default setting: 90 %
Display Saver (min)	Set how long the display can remain inactive, in minutes, before the display saver turns on <ul style="list-style-type: none"> ■ Settings: Off, 10, 30 ■ Default setting: 30
Color Mode	Set the color mode for varying ambient lighting conditions <ul style="list-style-type: none"> ■ Settings: Night or Day ■ Default setting: Day
Axes Displays	Set how the axis that is in motion is displayed. <ul style="list-style-type: none"> ■ Normal ■ Dynamic Zoom: The axis currently in motion is magnified on the display ■ Highlight: The axis currently in motion is highlighted on the display. All other axes are grayed out. ■ Default setting: Off
Zoom Timeout (sec)	Enter the time, in seconds, Dynamic Zoom or Highlight stays active after axis movement stops <ul style="list-style-type: none"> ■ Setting range: 1 ... 9 ■ Default setting: 1

12.3.4 Language

The **Language** setting is used to select the language used for the user interface.

Parameter	Explanation
Language	<ul style="list-style-type: none"> ■ Settings: multiple languages ■ Default setting: English

12.4 Installation Setup

12.4.1 File Management

File Management options are used to import, export, and install files on the product.

Parameter	Explanation
Configuration Parameters	Import or export a Configuration Parameters file <ul style="list-style-type: none"> Options: Import or Export
Operating Instructions	Install an Operating Instructions file <ul style="list-style-type: none"> Options: Load
Power-up Screen	Import or export a Power-up Screen file <ul style="list-style-type: none"> Options: Import or Export
Service File	Clear or export a Service File <ul style="list-style-type: none"> Options: Clear or Export
Product Software	Install a Product Software file <ul style="list-style-type: none"> Options: Install

12.4.2 Encoder Setup

Encoder settings are used to configure parameters for each encoder.

Parameter	Explanation
Encoder Type	<ul style="list-style-type: none"> Settings: Linear Default setting: Linear
Resolution	<ul style="list-style-type: none"> Settings: 0.5, 1.0, 2.0, 5.0, 10.0 Default setting: 5.0
Reference Mark	<ul style="list-style-type: none"> Settings: None, Single, Position Trac, P-Trac (ENC 250), P-Trac (LB 382C), EverTrack, LMF Default setting: Position Trac
Count Direction	<ul style="list-style-type: none"> Settings: Negative or Positive Default setting: Positive
Error Monitor	<ul style="list-style-type: none"> Off or On Default setting: On

12.4.3 Display Configuration

Display settings are used to configure the resolution, labels, and inputs shown on the display.

Parameter	Explanation
Display Resolution	Settings vary based on encoder connected to the product
Label	<ul style="list-style-type: none"> ■ Settings: Off, X, Y, Z, U, V, W, A, B, C, S, T, Q ■ Default Setting: <ul style="list-style-type: none"> ■ Display 1: X ■ Display 2: Y ■ Display 3: Z
Subscript	<ul style="list-style-type: none"> ■ Settings: Off or On ■ Default Setting: Off
Input 1	<ul style="list-style-type: none"> ■ Settings: X1, X2, X3 ■ Default Setting: <ul style="list-style-type: none"> ■ Display 1: X1 ■ Display 2: X2 ■ Display 3: X3
Couple Operation	<ul style="list-style-type: none"> ■ Settings: +, -, Off ■ Default Setting: Off
Input 2	<ul style="list-style-type: none"> ■ Settings: Not Defined, X1, X2, X3 ■ Default Setting: Not Defined

12.4.4 Readout Settings

Readout Settings are used to configure the **Application**, **Number of Axes**, and **Position Recall**.

Parameter	Explanation
Number of Axes	<ul style="list-style-type: none"> ■ Settings: 1, 2, 3 ■ Default Setting: 3
Position Recall	<ul style="list-style-type: none"> ■ Settings: Off or On ■ Default Setting: Off

12.4.5 Diagnostics

Diagnostics are used to test the keypad and the display.

Further information: "Diagnostics", Page 69

12.4.6 Display Color Scheme

The **Display Color Scheme** settings are used to select the **Color Mode** of the display and to set whether users can select the **Color Mode**.

Parameter	Explanation
Color Mode	<ul style="list-style-type: none"> ■ Settings: Day, Night, User Selectable ■ Default Setting: User Selectable

12.4.7 Factory Defaults

The **Factory Defaults** option is used to reset **Job Setup** and **Installation Setup** parameters to the default settings.

Parameter	Explanation
Reset Settings	<ul style="list-style-type: none"> ■ Settings: No or Yes ■ Default Setting: No

12.4.8 Error Compensation

Error Compensation provides a way to configure Linear Error Compensation for each encoder.

Parameter	Explanation
X1, X2, X3	Settings: Off, Linear Default setting: Off

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**Service and
maintenance**

13.1 Overview

This chapter describes the general maintenance work on the product:



This chapter contains a description of maintenance work for the product only.

Further Information: Manufacturer's documentation for the respective peripheral devices

13.2 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

- ▶ Use only a cloth dampened with water and a mild detergent for cleaning the exterior surfaces
- ▶ Use a lint-free cloth and a commercially available glass cleaner to clean the screen

13.3 Maintenance schedule

The product is largely maintenance-free.

NOTICE

Operating defective products

Operating defective products may result in serious consequential damage.

- ▶ Do not operate or repair the product if damaged
- ▶ Replace defective products immediately or contact an authorized service agency



The following steps are only to be performed by electrical specialists.

Further information: "Personnel qualification", Page 19

Personnel requirement

Maintenance step	Interval	Corrective action
▶ Check all labels and symbols provided on the product for readability	Annually	▶ Contact an authorized service agency
▶ Inspect electrical connections for damage and check their function	Annually	▶ Replace defective cables. Contact an authorized service agency if required.
▶ Check power cables for faulty insulation and weak points	Annually	▶ Replace power cables according to the specification

13.4 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 27

Further information: "Installation", Page 33

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 20

13.5 Resetting to the factory defaults

You can reset the settings of the product to the factory defaults, if required.

"Factory Defaults"

14

What to do if...

14.1 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 performing the activities described in this section.

Further information: "Basic operation", Page 47

14.2 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 an authorized service agency.

14.3 Troubleshooting



The following troubleshooting steps must be performed only by the personnel indicated in the table.

Further information: "Personnel qualification", Page 19

Fault	Cause of fault	Correction of fault	Personnel
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 an authorized service agency	Qualified personnel
The position display does not count the axis position even though the encoder is moving.	Incorrect connection of the encoder	▶ Correct the connection ▶ Contact the encoder manufacturer's service agency	Qualified personnel
The position display miscounts the axis position.	Incorrect settings of the encoder	▶ Check the encoder settings Page 100	Qualified personnel
The connected USB mass storage device is not detected.	Defective connection	▶ Check the correct position of the USB mass storage device in the port	Qualified personnel
	The type or formatting of the USB mass storage device is not supported	▶ Use another USB mass storage device	Qualified personnel

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**Removal and
disposal**

15.1 Overview

This chapter provides information about the removal and disposal of the product. This information includes requirements to be complied with in respect of environmental-protection laws.

15.2 Removal



Removal of the product is to be performed only by qualified personnel.
Further information: "Personnel qualification", Page 19

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 33

Further information: "Mounting", Page 27

15.3 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

16

Specifications

16.1 Product specifications

Product

Housing	Die cast aluminum
Housing dimensions	285 mm x 160 mm x 46 mm
Fastener system, mating dimensions	VESA MIS-D, 100 100 mm x 100 mm

Display

Visual display unit	<ul style="list-style-type: none"> ■ LCD Widescreen (15:9) color screen 17.8 cm (7") ■ 800 x 480 pixels
User interface	Graphical user interface (GUI) with keypad

Electrical data

Power supply	<ul style="list-style-type: none"> ■ AC 100 V ... 240 V ($\pm 10\%$) ■ 50 Hz ... 60 Hz ($\pm 5\%$) ■ Input power max. 30 W
Buffer battery	Lithium battery type CR2032; 3.0 V
Overvoltage category	II
Number of encoder inputs	1, 2, or 3
Encoder interfaces	TTL: Max. current 300 mA max. input frequency 500 kHz
Data interface	USB 2.0 Hi-Speed (Type C), max. current 500 mA

Ambient conditions

Operating temperature	0 °C ... 45 °C
Storage temperature	-20 °C ... 70 °C
Relative air humidity	10 % ... 80 % r.H., non-condensing
Altitude	≤ 2000 m

General information

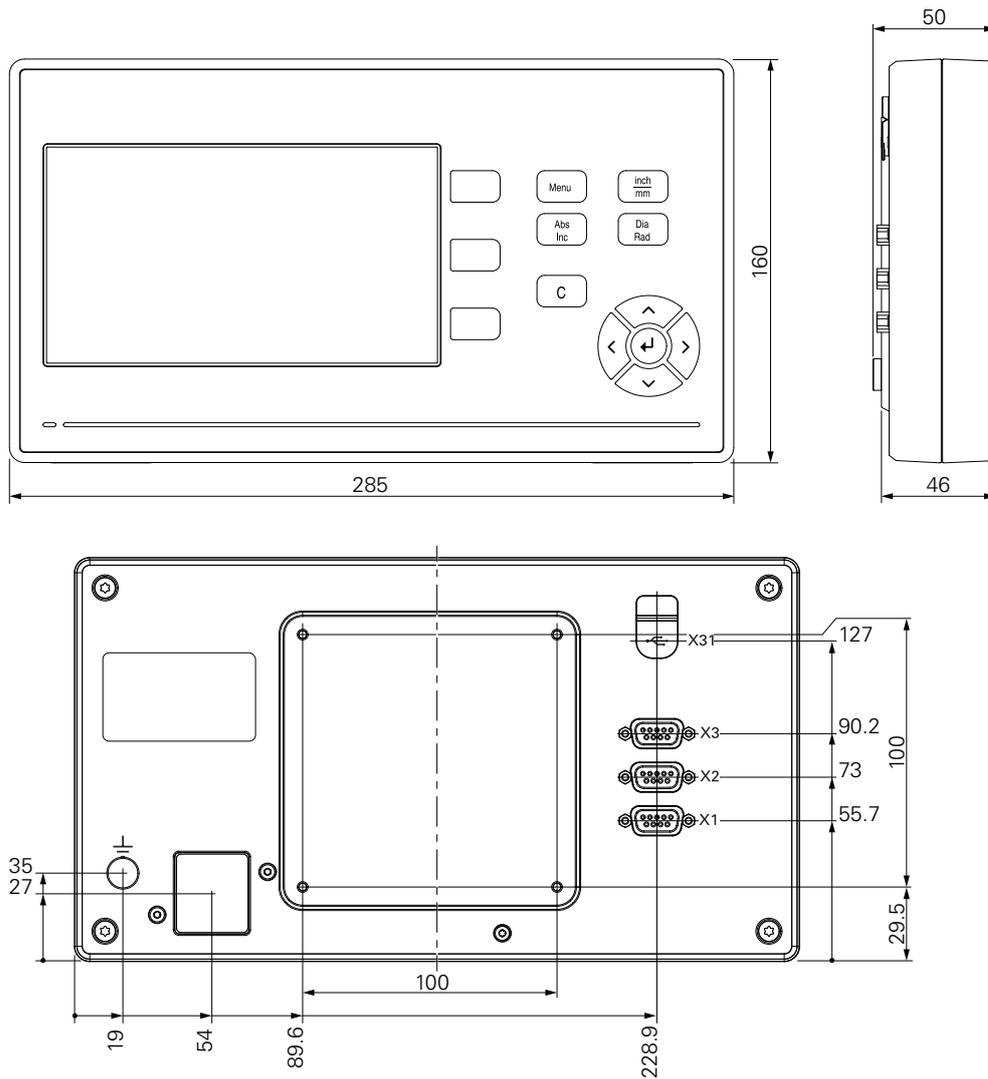
Directives	<ul style="list-style-type: none"> ■ EMC Directive 2014/30/EU ■ Low Voltage Directive 2014/35/EU ■ RoHS Directive 2011/65/EU
Pollution degree	2
Protection EN 60529	<ul style="list-style-type: none"> ■ Front panel and side panels: IP 54 ■ Rear panel: IP 40

General information

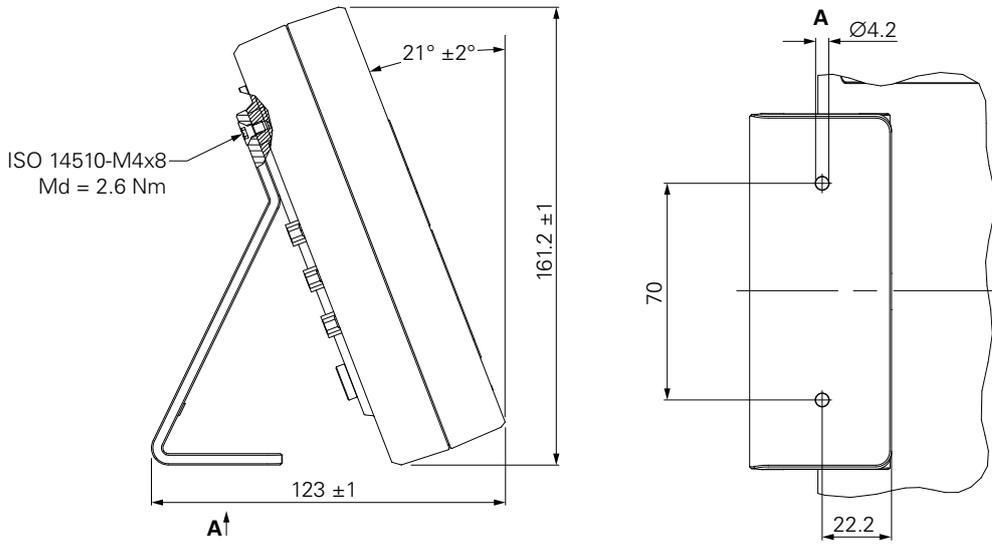
- Mass
- 1.5 kg
 - With Single-Pos stand: 1.6 kg
 - With Multi-Pos holder: 1.9 kg

16.2 Product dimensions and mating dimensions

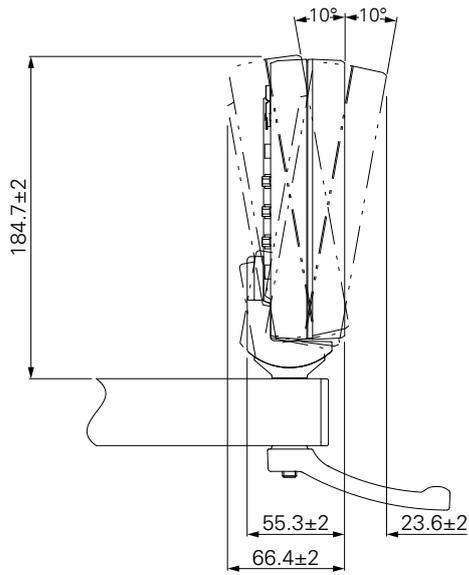
All dimensions in the drawings are in millimeters.



Product dimensions with Single-Pos stand



Product dimensions with Multi-Pos holder



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