



HEIDENHAIN



Centering with Two Scanning Heads

Mounting Instructions
GAGE-CHEK 2000, ND 287

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1 Basic information

This chapter contains information about the product and the Mounting Instructions.

1.1 Applicability of the documentation

These Mounting Instructions are valid for centering with two scanning heads.

This method can be used with the following evaluation electronics:

- ND 287
- GC 2000

You can use this centering method with all HEIDENHAIN modular angle encoders with 1 VPP, TTL or EnDat interfaces.

- ▶ Prior to using the documentation, check whether the documentation and encoder model match

The encoder designation is printed on the ID label.

1.2 Target groups for the Mounting Instructions

The Mounting Instructions must be read and observed by every person who performs any of the following tasks:

- Mounting
- Removal

1.3 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 following table lists the various parts of the documentation in their order of reading priority.

You need the documentation of all devices you are using. For centering with two scanning heads, the documentation on the following products is required:

- Evaluation unit
- Encoder

Further information: "Applicability of the documentation", Page 3

Further information: "Overview of encoders", Page 7

Documentation	Description
Addendum	An Addendum supplements or supersedes the corresponding contents of the Operating Instructions. If an Addendum is included in the shipment, it has the highest reading priority. All other documentation content retains its validity.
Operating Instructions	The Operating Instructions contain all the information and safety precautions needed for the proper mounting and installation of the product. The Operating Instructions are included in delivery. The Operating Instructions have the second highest reading priority.

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 suggestions to the following e-mail address:

userdoc@heidenhain.de

1.4 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: ▶ 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

1.5 Notes in this documentation

Safety precautions

Precautionary statements warn of hazards in handling the device 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 device. Informational notes are divided into the following groups:



The information symbol indicates a **tip**.
A tip provides important additional or supplementary information.



The book symbol indicates a **cross reference**.
A cross reference leads to external documentation, for example: further documentation from HEIDENHAIN or another supplier.

1.6 Centering of graduation carriers with two scanning heads

Centering with two scanning heads is considered to be the most accurate centering method for the graduation carriers (circular scale or scale drum) of modular angle encoders. With this centering method, the angle position is directly used for centering; there is no need for any mechanical or optical auxiliary geometry.

You can use this centering method with all HEIDENHAIN modular angle encoders with 1 V_{PP}, TTL or EnDat interfaces.



For more information, you can download an instructional video from the download area at www.heidenhain.com

1.7 Aids and requirements

The following aids are required for centering with two scanning heads:

- Two scanning heads of the same design with the corresponding adapter cables. One scanning head is needed only for the centering process.
- **Evaluation unit**
 - GAGE-CHEK 2000
or
 - ND 287 and an encoder module for connection of a second HEIDENHAIN encoder to the X2 axis
- **Product software**
 - GAGE-CHEK 2000: >V1.6.0
 - ND 287: >V1.09 or >V0.36 (for centering with the EnDat interface)



The current product software version is available at www.heidenhain.com under Service & Support > Downloads > Software

The following additional requirements must be fulfilled:

- Mounting option (threaded hole and installation space) for the second scanning head directly opposite (180°)
- Accessibility for removal of the second scanning head after centering

1.8 Preparing the graduation carrier of the angle encoder

To perform centering, you have to roughly align the graduation carrier (circular scale or scale drum) and mount the second scanning head.

- ▶ Mount the graduation carrier according to the mounting instructions
- ▶ Pre-center the graduation carrier mechanically or optically to a radial runout of less than approx. 50 µm
- ▶ Mount the scanning heads approximately directly opposite ($180^\circ \pm 5^\circ$) from each other and align them as follows:
 - Rough alignment using a spacer shim or mounting aid
 - No fine adjustment necessary (signal amplitudes of approx. 0.7 V_{PP} are sufficient)
 - No adjustment of the reference mark signals required
- ▶ Connect the scanning heads by means of the adapter cables to the encoder inputs of the evaluation unit

1.9 Overview of encoders

Signal period settings


Encoder	Line count	Signal period (µm) for 1 V _{PP}	Signal period (µm) for TTL
ERP 1000	23000	7.2	7.2 / interpolation
ERP 1000	30000	7.4	7.4 / interpolation
ERP 1000	50000	6.6	6.6 / interpolation
ERP 1000	63000	7.3	7.3 / interpolation
ERO 2000	2500	20.5	20.5 / interpolation
ERO 2000	4096	20.5	20.5 / interpolation
ERO 2900	4400	17.8	17.8 / interpolation
ERA 4400	-	40	40 / interpolation
ERA 4200	-	20	20 / interpolation
ERA 4800	-	80	80 / interpolation
ERM 2200	-	200	200 / interpolation
ERM 200	-	400	400 / interpolation
ERM 2400	-	400	400 / interpolation
ERM 2900	-	1000	1000 / interpolation


2

GAGE-CHEK 2000

2.1 Preparing the evaluation electronics (1 V_{PP} interface)

To perform centering, you have to configure the settings for the scanning heads and the display on the GAGE-CHEK 2000 evaluation unit.

 At least firmware version 1248580.1.6.0 is required for centering.

 For additional operating information, please refer to the Operating Instructions for the GAGE-CHEK 2000. They are available at www.heidenhain.com.

Requirement: Previous signal adjustment performed with the PWM 21 and ATS software.

Basic settings



- ▶ Switch on the product
- ▶ Select the OEM user
- ▶ Enter the password "oem"
- ▶ Tap **Log in**
- ▶ The user is logged in and the **Measure** menu is displayed.
- ▶ Tap **Settings**



- ▶ Tap **General**
- ▶ Tap **Units**
- ▶ Set **Unit for linear values** to **Millimeters**
- ▶ Set **Decimal places for linear values** to four with the plus and minus buttons



- ▶ Tap **Axes**
- ▶ Tap **General settings**
- ▶ Tap **Alias assignment for axis names**
- ▶ Enter the following names:
 - C1: A1
 - C2: A2

Configuring encoders












- ▶ Tap **Settings**



- ▶ Tap **Axes**
- ▶ Tap **A1**
- ▶ Tap **Encoder**
- ▶ Define the following settings:
 - **Encoder model:** **Linear encoder**
 - **Signal period:** see "Signal period settings", Page 7
 - **Counting direction:** **Positive**
- ▶ Tap **Reference marks**
- ▶ Under **Reference mark**, select **None**
- ▶ Repeat the settings for the A2 axis


Entering the formula for centering


- 
 - ▶ Tap **Measure** in the main menu
 - ▶ Drag an empty function bar field to the left into the workspace
- 
 - ▶ Tap the **Formula** function element
 - > The **Formula** function element is now available.
 - ▶ Drag the **Formula** function to the left into the working space
 - ▶ Tap the eye at the third axis to hide this channel
- 
 - > When the function is active, the channel is hidden.
- 
 - > When the function is active, the channel is hidden.
- 
 - ▶ Tap **Add**
 - > An input field for the new, calculated axis is added.
- 
 - ▶ Tap the formula label and enter the name **ZE**
 - ▶ Tap the formula input field
 - ▶ Enter the following formula:
 - $(A1 - A2) \div 2$
 - ▶ Confirm your input with **RET**
 - ▶ Tap **Close**
- 
 - ▶ Tap **Close**
- 
 - ▶ Tap **Formula**
 - > The function is activated.
 - > Centering can be started.

 Now perform centering as described in the Centering chapter.
Further information: "Performing Centering", Page 21

2.2 Preparing the evaluation electronics (TTL interface)

To perform centering, you have to configure the settings for the scanning heads and the display on the GAGE-CHEK 2000 evaluation unit.

 At least firmware version 1248580.1.6.0 is required for centering.

 For additional operating information, please refer to the Operating Instructions for the GAGE-CHEK 2000. They are available at www.heidenhain.com.

Requirement: Previous signal adjustment performed with the PWM 21 and ATS software.

Basic settings



- ▶ Switch on the product
- ▶ Select the OEM user
- ▶ Enter the password "oem"
- ▶ Tap **Log in**
- The user is logged in and the **Measure** menu is displayed.



- ▶ Tap **Settings**



- ▶ Tap **General**
- ▶ Tap **Units**
- ▶ Set **Unit for linear values** to **Millimeters**
- ▶ Set **Decimal places for linear values** to four with the plus and minus buttons



- ▶ Tap **Axes**
- ▶ Tap **General settings**
- ▶ Tap **Alias assignment for axis names**
- ▶ Enter the following names:
 - C1: A1
 - C2: A2

Configuring encoders



- ▶ Tap **Settings**



- ▶ Tap **Axes**
- ▶ Tap **A1**
- ▶ Tap **Encoder**
- ▶ Define the following settings:
 - **Encoder model:** **Linear encoder**
 - **Signal period:** see "Signal period settings", Page 7
 - **Counting direction:** **Positive**
- ▶ Tap **Reference marks**
- ▶ Under **Reference mark**, select **None**
- ▶ Repeat the settings for the A2 axis

Entering the formula for centering



- ▶ Tap **Measure** in the main menu
- ▶ Drag an empty function bar field to the left into the workspace



- ▶ Tap the **Formula** function element
- > The **Formula** function element is now available.
- ▶ Drag the **Formula** function to the left into the working space
- ▶ Tap the eye at the third axis to hide this channel



- > When the function is active, the channel is hidden.



- ▶ Tap **Add**
- > An input field for the new, calculated axis is added.



- ▶ Tap the formula label and enter the name **ZE**
- ▶ Tap the formula input field
- ▶ Enter the following formula:

- $(A1 - A2) \div 2$

- ▶ Confirm your input with **RET**
- ▶ Tap **Close**



- ▶ Tap **Formula**
- > The function is activated.
- > Centering can be started.




Now perform centering as described in the Centering chapter.
Further information: "Performing Centering", Page 21

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ND 287

3.1 Preparing the evaluation electronics (1 V_{PP} interface)

To perform centering, you have to configure the settings for the scanning heads and the screen display on the ND 287 evaluation unit.

 Product software V1.09 is required for centering via the 1 V_{PP} interface.

- ▶ Switch on the product
- ▶ Press the **C** key
- ▶ Press the **SETUP ▶ INSTALLATION SETUP** soft key
- ▶ Enter the code number **95148**, if required.
- ▶ Make the following settings in the submenus:
 - In **COUNTER SETTINGS**, select the **2 AXES** mode by pressing the **1 AXIS / 2 AXES** soft key
 - In **ENCODER SETUP ▶ INPUT X1 ▶ ENCODER TYPE**, select **LINEAR** by pressing the **TYPE** soft key
 - The **ENCODER SETUP (X1)** form allows you to define the following settings:
 - In the **SIGNAL PERIOD** field, press the **COARSER** or **FINER** soft keys to select the corresponding value for the encoder (see "Signal period settings", Page 7)
 - In the **REFERENCE MARK** field, select **NONE** by pressing the **REF MARK** soft key
 - In the **COUNT DIRECTION** field, select the **POSITIVE** mode by pressing the **POSITIVE/ NEGATIVE** soft key
 - Repeat the encoder settings for **INPUT X2**
 - In **DISPLAY CONFIGURATION ▶ INPUT X1 ▶ DISPL. RESOLUTION**, set the display resolution to **0.0005** by pressing the **COARSER** or **FINER** soft keys
 - Repeat the display settings for **INPUT X2**
 - In **COUNTER SETTINGS**, open the **FORMULA FOR FUNCTION f(X1,X2)** form by pressing the **FUNCTION f(X1,X2)** soft key
 - Enter the formula **f(X1,X2)=(X1-X2)/2** in the **FORMULA FOR FUNCTION f(X1,X2)** form and confirm with the ENTER key
 - In **ERROR COMPENSATION ▶ INPUT X1**, select the **OFF** mode by pressing the **ERROR COMP.** soft key
 - Repeat the error compensation settings for **INPUT X2**
- ▶ Press the **SETUP ▶ JOB SETUP** soft key
- ▶ Make the following settings in the submenus:
 - In **UNIT OF MEASURE**, select **mm** by pressing the **mm/inch** soft key
 - In **SCALING FACTOR**, select **OFF** by pressing the **ON/OFF** soft key
- ▶ Use the NAVIGATION key to switch to soft-key level 3
- ▶ Press and hold the **X1** soft key until the display value **f(X1,X2)** is shown
- > The evaluation unit's display shows the radial runout of the graduation carrier in μm.
- > The algebraic sign shows the direction of the radial runout.

Settings for the 1 V_{PP} interface

Press the SETUP ► INSTALLATION SETUP soft key

COUNTER SETTINGS	APPLICATION	2 AXES			
		FUNCTION f(X1,X2)	f(X1,X2)= (X1-X2)/2		
ENCODER SETUP	INPUT X1 INPUT X2	ENCODER TYPE	LINEAR	SIGNAL PERIOD	see "Signal period settings", Page 7
				REFERENCE MARK	NONE
				COUNTING DIRECTION	POSITIVE
DISPLAY CONFIGURATION	INPUT X1 INPUT X2	DISPLAY RESOLUTION	0.0005		
ERROR COMPENSATION	INPUT X1 INPUT X2	OFF			

SETUP ► JOB SETUP soft key

UNIT OF MEASURE	LINEAR	mm
SCALING FACTOR	INPUT X1 INPUT X2	OFF

3.2 Preparing the evaluation electronics (EnDat interface)

To perform centering, you have to configure the settings for the scanning heads and the screen display on the ND 287 evaluation unit.



Product software V0.36 (special version) is required for centering via the EnDat interface.

- ▶ Switch on the product
- ▶ Press the **C** key
- ▶ Press the **SETUP ▶ INSTALLATION SETUP** soft key
- ▶ Enter the code number **95148**, if required
- ▶ Make the following settings in the submenus:
 - In **COUNTER SETTINGS**, select the **2 AXES** mode by pressing the **1 AXIS / 2 AXES** soft key
 - In **DISPLAY CONFIGURATION ▶ INPUT X1 ▶ DISPL. RESOLUTION**, set the display resolution to **0.0001** by pressing the **COARSER** or **FINER** soft keys
 - In **DISPLAY CONFIGURATION ▶ INPUT X1 ▶ ANGLE DISPLAY**, set the value to **+/-180°**
 - Repeat the display settings for **INPUT X2**
 - In **ERROR COMPENSATION ▶ INPUT X1**, select the **OFF** mode by pressing the **ERROR COMP.** soft key
 - Repeat the error compensation settings for **INPUT X2**
- ▶ Press the **SETUP ▶ JOB SETUP** soft key
- ▶ Make the following settings in the submenus:
 - In **UNIT OF MEASURE ▶ ANGLE**, select the value **RADIAN MEASURE** by pressing the **ANGLE** soft key
 - In **SCALING FACTOR ▶ INPUT X1** enter the value calculated by means of the formula **SCALING FACTOR = 4 / drum diameter [mm]** using the keyboard
Example: Outside diameter of scale drum 127 mm → scaling factor = 4 / 127 = 0.031
 - Repeat the scaling factor settings for **INPUT X2**
- ▶ Use the **NAVIGATION** key to switch to soft-key level 3
- ▶ Press and hold the **X1** soft key until the display value **X1 - X2** is shown
- ▶ Use the **NAVIGATION** key to switch to soft-key level 2
- ▶ Check whether the values are displayed in **rad** and change them, if necessary
- > The evaluation unit's display shows the radial runout of the graduation carrier in mm.
- > The algebraic sign shows the direction of the radial runout.

Settings for the EnDat interface

Press the SETUP ► INSTALLATION SETUP soft key

COUNTER SETTINGS	APPLICATION	2 AXES	
DISPLAY CONFIGURATION	INPUT X1	DISPLAY RESOLUTION	0.0001
	INPUT X2	ANGLE DISPLAY	+/- 180°
ERROR COMPENSATION	INPUT X1	OFF	
	INPUT X2		

SETUP ► JOB SETUP soft key

UNIT OF MEASURE	ANGLE	RADIAN MEASURE
SCALING FACTOR	INPUT X1	4 / drum diameter [mm]
	INPUT X2	

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**Performing
Centering**

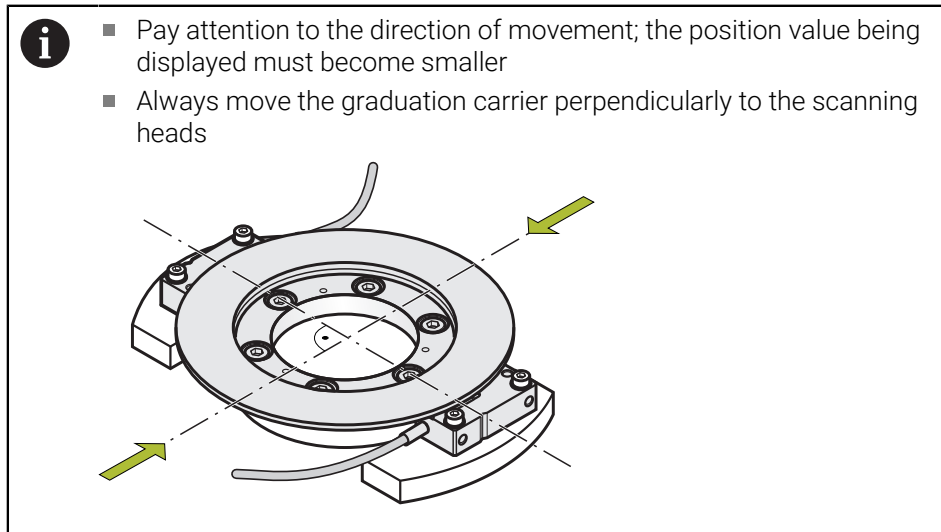
4.1 Centering the graduation carrier

Centering of the graduation carrier (circular scale or scale drum) is performed iteratively in multiple runs and becomes more accurate with every repetition.

- ▶ Check the torque of the mounting screws on the graduation carrier. All screws must be tightened with the same torque
- ▶ Set the position display to zero
 - **GAGE-CHEK 2000**: Press and hold the axis label (tap and hold A1, repeat for A2)
 - **ND 287**: Press **C** to set the product to zero

Performing centering:

- ▶ Rotate the graduation carrier by at least one rotation and define the minimum position value
- ▶ Keep the graduation carrier in this position and set the position display to zero
 - **GAGE-CHEK 2000**: Press and hold the axis label (tap and hold A1, repeat for A2)
 - **ND 287**: Press **C** to set the product to zero
- ▶ Rotate the graduation carrier by at least one rotation and find the maximum position value
- ▶ Keep the graduation carrier in this position and remember the position value
- ▶ By tapping lightly perpendicularly to the scanning heads, move the graduation carrier halfway to the position value displayed before



- ▶ Repeat the centering process until the desired centering accuracy has been reached
- > Centering is completed.
- ▶ Finish mounting of the graduation carrier according to the mounting instructions
- ▶ Verify the centering accuracy again after mounting
- ▶ Remove the second scanning head again
- ▶ Adjust and mount the other scanning head in its final position according to the mounting instructions

HEIDENHAIN

DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

☎ +49 8669 32-5061

info@heidenhain.de

Technical support ☎ +49 8669 32-1000

Measuring systems ☎ +49 8669 31-3104

service.ms-support@heidenhain.de

NC support ☎ +49 8669 31-3101

service.nc-support@heidenhain.de

NC programming ☎ +49 8669 31-3103

service.nc-pgm@heidenhain.de

PLC programming ☎ +49 8669 31-3102

service.plc@heidenhain.de

APP programming ☎ +49 8669 31-3106

service.app@heidenhain.de

www.heidenhain.com

