



HEIDENHAIN

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User's Manual

ND 281B

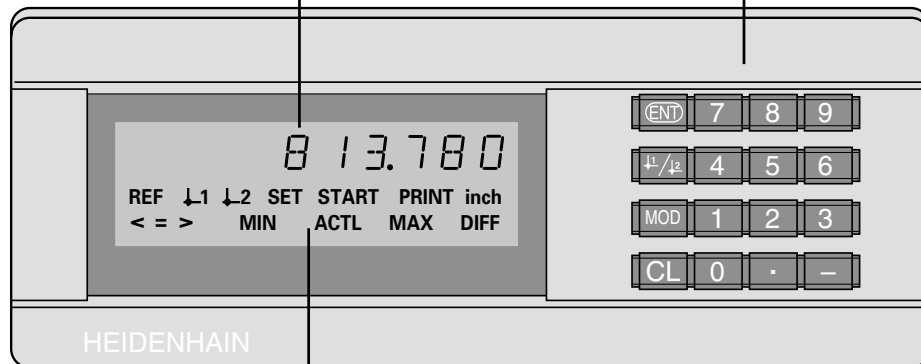
Measured Value Displays

English (en)

10/2002

Display of actual value and input
(9 decades with algebraic sign)

**Numeric keypad
with decimal point**



Status display with indicators

Key	Function
	- Set datum - Transfer input value - Set display to value from P79 (P80!) - Leave parameter list
	- Select datum - Page backwards in parameter list
	- Select parameter after switch-on - Page forward in parameter list - Start series of measurements¹⁾ - Switch display for measurement series¹⁾ - Start measured value output "PRINT"
	- Delete entry - Set display to zero (P80!) - CL plus MOD: select parameter list - CL plus number: select parameter - Delete parameter input and show parameter number
	- Algebraic sign - Reduce parameter value
	- Decimal point - Increase parameter value

Indicator	Meaning
REF	If the decimal point is also blinking: Display is waiting for reference mark traversing. If decimal point is not blinking: Reference mark has been traversed—display stores datum points in nonvolatile memory Blinking: display is waiting for ENT or CL to be depressed
inch	Position values in inches
<u>1</u> / <u>2</u>	Selected datum point
PRINT	"Linear measurement" Blinking: Display is waiting for ENT to be pressed for data output "Angular measurement" Measured value output with MOD key
SET	Blinking: Display is waiting for input values
< / = / >	Sorting and tolerance checking: measured value smaller than lower limit / within the limits / greater than upper limit
MIN / MAX / DIFF / ACTL ¹⁾	Series of measurements: Minimum / maximum / greatest difference (MAX–MIN) / current measured value Blinking: Confirm selection or deselect function
START ¹⁾	Series of measurements is running Blinking: Display is waiting for signal to start series of measurements

¹⁾ Only in linear measurement mode.

Items supplied with ND 281 B

ND 281 B	Measured value display unit, benchtop model
Encoder input 11 μA_{pp} /1 V_{pp}	Id. Nr. 344 996-xx
Power cord	3 m (9.9 ft)
User's Manual	ND 281B
Adhesive plug-in feet	For stacking ND 281B units



This manual is for the ND 281 B measured value display with the following software number or higher:

349 797-04

The software number is indicated on a label on the rear panel.

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¹⁾ Only in linear measurement mode

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Position Encoders

The ND 281 B display unit is designed for use with photo-electrical linear or angular encoders with sinusoidal signals: primarily for HEIDENHAIN **MT length gauges**.

When shipped by HEIDENHAIN, the display units are set to the linear measurement mode.

You can switch between the linear and angular modes by entering the code number **41 52 63** (see “Linear/Angular Measurement Modes”).

On the back of the display you will find two flange sockets for connecting the encoder: X1 for encoders with $11 \mu\text{A}_{\text{PP}}$ sinusoidal current signals and X2 for 1 V_{PP} sinusoidal voltage signals.

Before shipping, HEIDENHAIN activates the encoder connection X1 for $11 \mu\text{A}_{\text{PP}}$ sinusoidal current signals. With parameter P02 you can activate the encoder input that matches your encoder (see “Operating Parameters”).

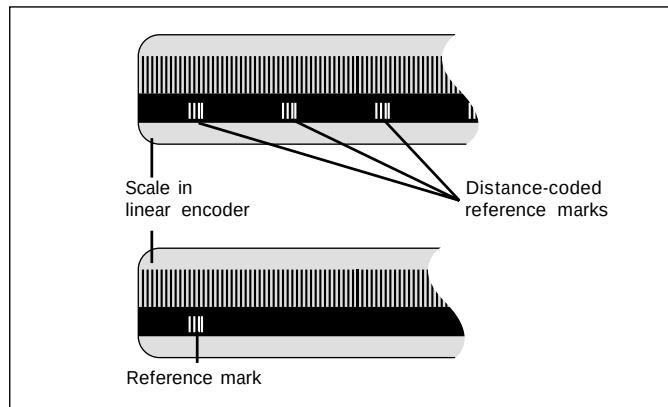
Reference Marks

The MT length gauges have **one** reference mark. The scales of other photoelectric linear or angular encoders can contain one reference mark or many *distance-coded* reference marks.

If there is an interruption of power, the relationship between the position of the length gauge and the displayed position value is lost. The reference marks on the position encoders and the REF reference mark evaluation feature enable the display unit to quickly reestablish this relationship again when the power is restored.

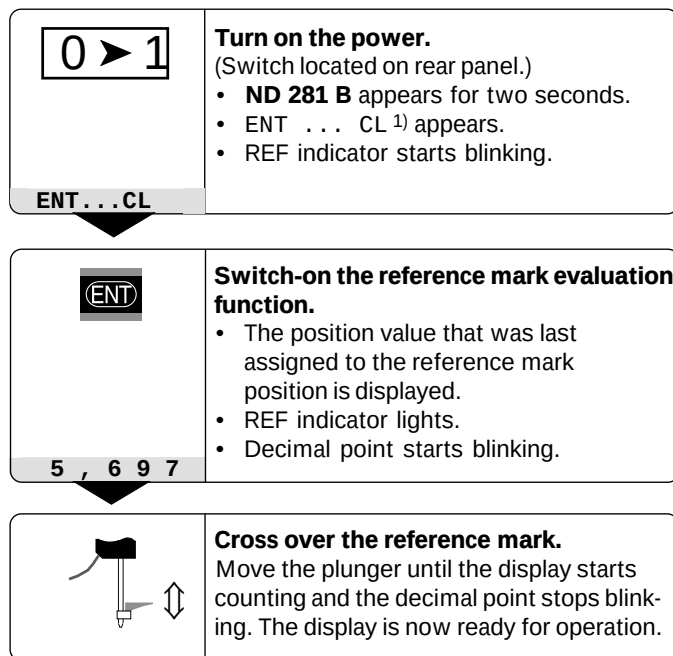
When a reference mark is crossed over, a signal is generated which identifies that position as a reference point. At the same time, the display unit restores the relationship between length gauge position and display values which you last defined by setting the datum.

To restore the datum on scales with **distance-coded** reference marks, you only need to traverse a maximum of 20 mm for linear encoders, and 10° or 20° for angle encoders, depending on the model.



Reference marks on linear encoders

Switch-On, Traversing the Reference Marks



For automation purposes, crossing over the reference marks and the display ENT ... CL can be disabled with parameter P82.

REF mode

Crossing over the reference marks automatically switches the display to REF mode: The last assignment of display values to length gauge positions is stored in nonvolatile memory.

¹⁾ Press the CL key if you choose **not** to traverse the reference marks. Note that, in this case, the relationship between length gauge position and display value will be lost if the power is interrupted or if the unit is switched off.

Datum Setting

The datum setting procedure assigns a display value to a known position. With the ND 200 series, you can set two separate datum points.

There are several ways to set the datum:

- Enter a numerical value, or
- Transfer a value from an operating parameter (see P79, P80), or
- By external signal



Select datum 1 or 2.

5

5

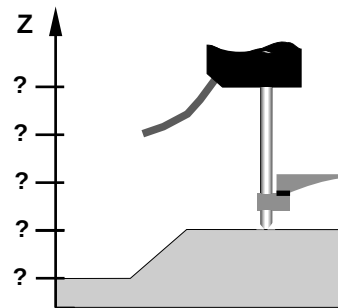
Enter a numerical value (here, 5).
SET starts blinking.



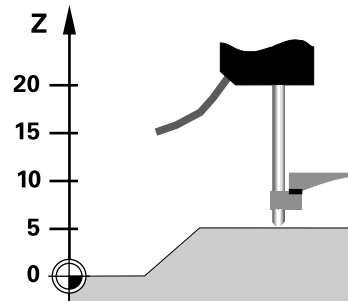
Confirm the entered numerical value.

You can switch between datums 1 and 2 as desired. Datum 2 can be used, for example, for working with incremental dimensions.

When you switch back to datum 1, the display unit resumes display of the encoder's actual position.



Without datum setting: unknown assignment of measured values to positions



After datum setting: Assignment of measured values to positions

Finding Minimum and Maximum Values from a Series of Measurements¹⁾

After a series of measurements has been started, the display transfers the first measured value to the memory for minimum and maximum values. Every 0.55 ms, the display compares the current measured value with the memory contents: A new value is stored if it is greater than the stored maximum value or smaller than the stored minimum value. At the same time, the display calculates and stores the difference DIFF between the current MIN and MAX values.

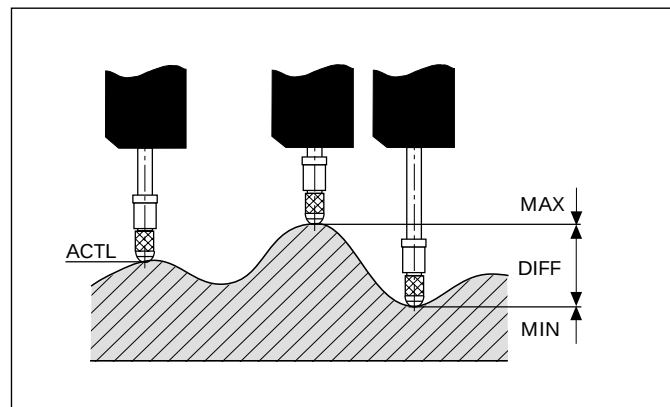
Display	Meaning
MIN	Minimum value from the series of measurements
MAX	Maximum value from the series of measurements
DIFF	Difference MAX – MIN
ACTL	Current measured value

Starting the measurement series and selecting the display

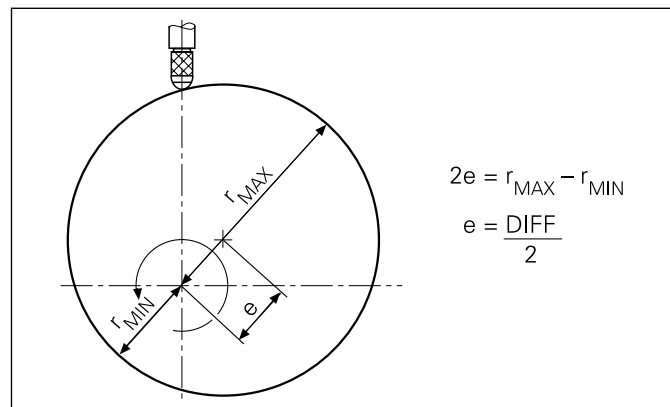
You can start the series of measurements either by pressing MOD and selecting the desired display—as described on the following pages—or by external signal over the **switching inputs at the D-sub connection EXT** (X41, see “Switching Inputs and Outputs”).

When a series of measurements is started, the internal MIN/MAX/DIFF memory is reset.

¹⁾ Only in the linear measurement mode.

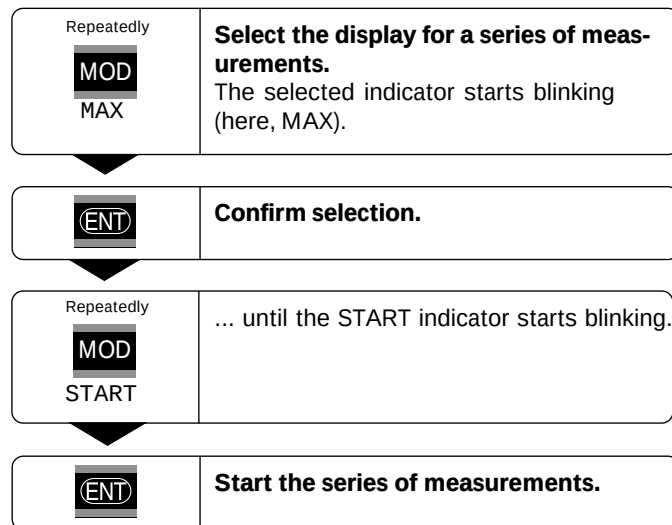


Series of measurements: The MIN, MAX and DIFF values of an uneven surface



Example: Measurement series for determining eccentricity e

Starting a series of measurements



Indicator preselection

Press MOD to start the series of measurements and select the display with the indicators.

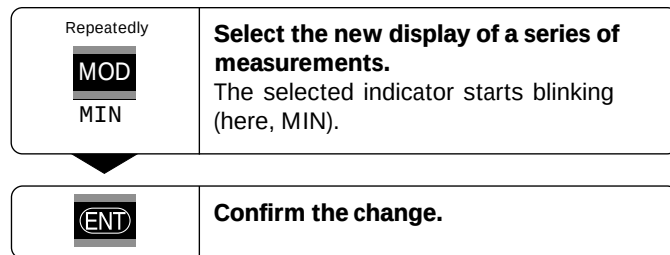
Operating parameter **P86** allows you to define which indicator is displayed first when MOD is pressed.

Switching between MIN, MAX, DIFF and ACTL displays



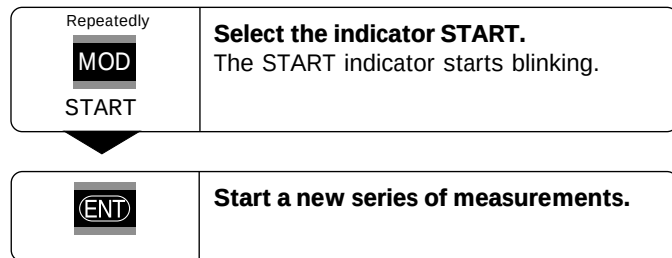
It is **not** possible to switch between the displays as described below if the switching input for external control of the series of measurements (pin 6 on D-sub connection EXT) is active.

As an alternative, you can select the display with operating parameter P21 (see "Operating Parameters").

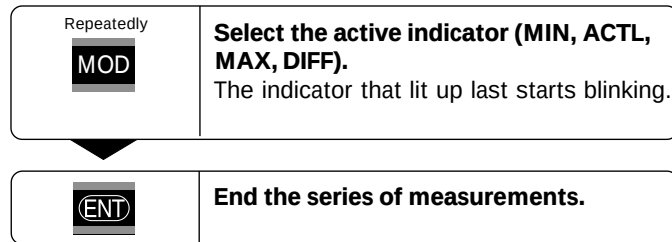


The display now shows the smallest value measured during the current series of measurements.

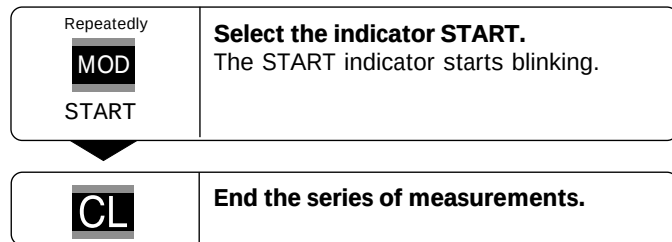
Starting a new series of measurements



Ending a series of measurements



or



Sorting and Tolerance Checking

In the sorting and tolerance checking mode, the display unit compares the displayed value with the programmed upper and lower sorting limits. The sorting and tolerance checking mode is enabled and disabled with operating parameter **P17**.

Entering sorting limits

Sorting limits are entered in operating parameters **P18** and **P19** (see operating parameters).

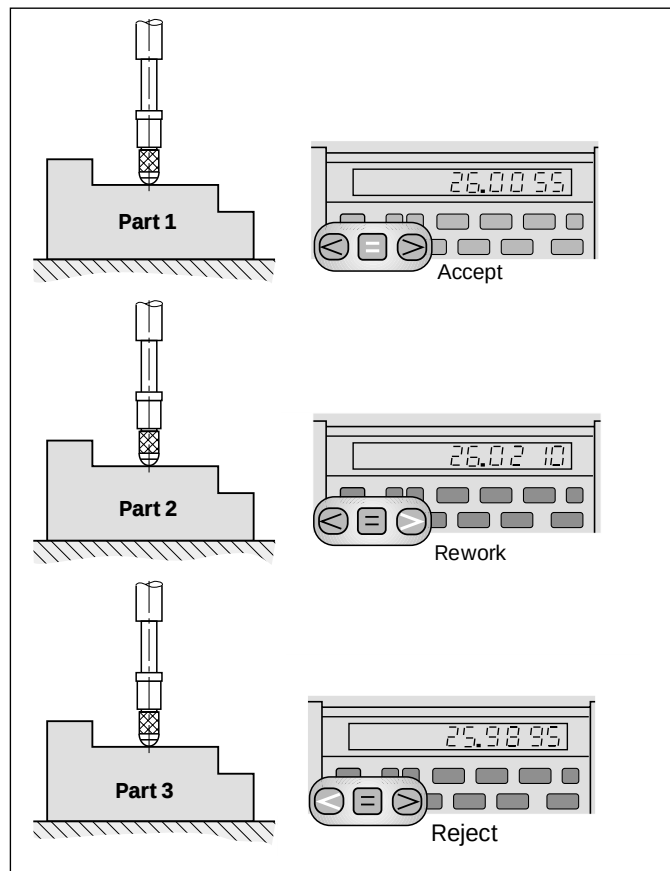
Sorting signals

The indicators and switching outputs at D-sub connection EXT (see section on X41) sort the display value into one of three classes.

Display	Meaning
=	Measured value is within sorting limits
<	Measured value is smaller than lower sorting limit
>	Measured value is greater than upper sorting limit

Operating parameters for sorting and tolerance checking

P17 CLASS	Sorting ON/OFF
P18 L.CLASS.	Lower sorting limit
P19 U.CLASS.	Upper sorting limit



Example: Upper sorting limit = 26.02 mm
Lower sorting limit = 26.00 mm

Measured Value Output

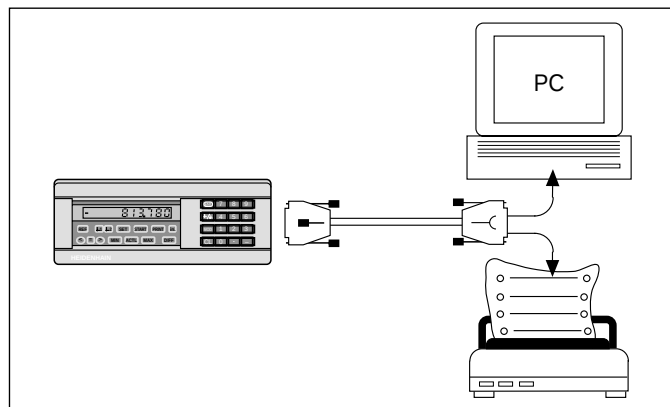


For technical information on the RS-232-C/V.24 data interface (X31), information on the data format, etc., see the chapter “RS-232-C/V.24 Data Interface (X31).”

Measured values can be transmitted over the RS-232-C/V.24 interface (X31), for example to a printer or PC.

There are several ways to start measured value output:

- In the **linear measurement** mode:
Press MOD repeatedly until the PRINT indicator starts blinking, then start measured value output with ENT.
- In the **angular measurement** mode:
Press the MOD key (this feature can be disabled with operating parameter 86).
- or**
- Input the command STX (Ctrl B) over the RXD input of the RS-232-C/V.24 interface (X31);
- or**
- Input a signal for measured data output (Pulse or Contact) at the D-sub connection EXT (X41).

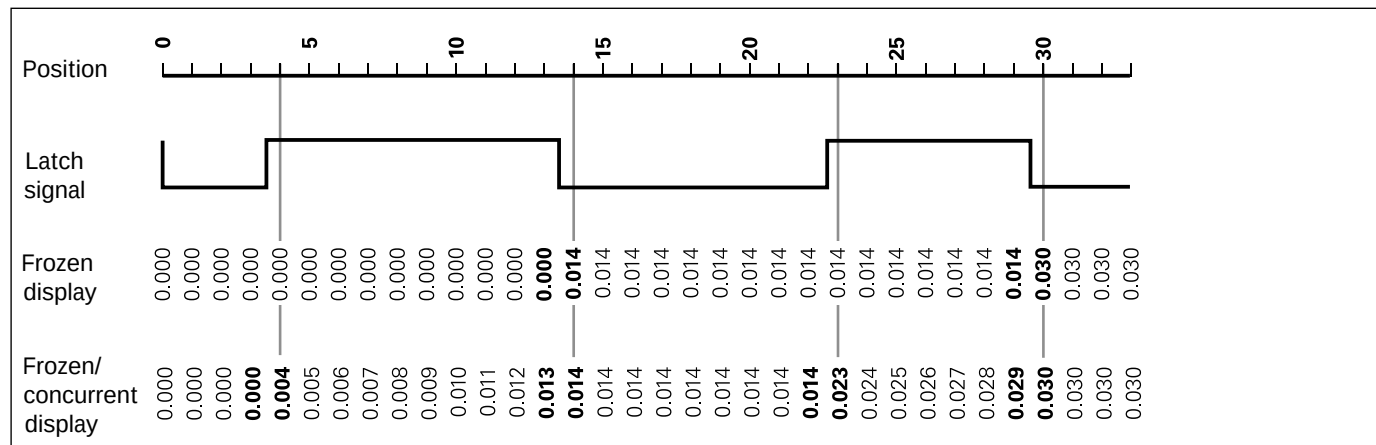


The RS-232-C/V.24 interface (X31) enables you to connect a printer or a PC to your display unit

Display Freeze

With the latch command, the display can be stopped for any period of time. The internal counter remains active. Parameter P23 selects the “display freeze” mode and offers three settings:

- **Concurrent display**, no display freeze—the display value is the current measured value.
- **Frozen display**—display value is frozen and is updated with each signal for measured value output.
- **Frozen/concurrent display**—display remains frozen as long as the latch signal is present; after the signal, the display resumes continuous display of the current measured values.



Error Messages

Display	Effect/Cause
RS232 FAST	Command for measured value output followed too quickly by another. ¹⁾
SIGNAL	Encoder signal is too weak. The scale may be contaminated. ¹⁾
DSR.MISSING	The connected device has not sent a DSR signal. ¹⁾
REF. ERR.	The spacing of the reference marks as defined in P43 is not the actual spacing. ¹⁾
FORMAT ERR.	Data format, baud rate, etc. do not match. ¹⁾
FREQUENCY	Input frequency too high for encoder input. Traversing speed may be too fast. ¹⁾
MEMORY ERR.	Checksum error: Check the datum, operating parameters and compensation values for multipoint axis error compensation. If this error recurs, contact your service agency!

¹⁾ These errors are important for the attached device. The error signal (pin 19) at D-sub connection EXT is active.

Display	Effect/Cause
REC. ERROR	Error during reception of parameter and compensation-value lists.

Other Error displays

If "OVERFLOW" appears, the measured value is too large or too small:

- Set a new datum.
- or**
- Traverse back.

If **all sorting signals light up**, the upper sorting limit is smaller than the lower limit:

- Change operating parameters P18 and/or P19.

To clear error messages:

Once you have removed the cause of the error:

- Clear the error message with the CL key.

Rear Panel



Ports X1, X2, X31 and X41 comply with the recommendations in EN 50 178 for separation from line power.

Encoder input X1

HEIDENHAIN flange socket	9-pin
Input signals	$\sim$ 11 μA_{PP}
Maximum encoder cable length	30 m (98.5 ft)
Maximum input frequency	100 kHz

Encoder input X2

HEIDENHAIN flange socket	12-pin
Input signals	1 V_{PP}
Maximum encoder cable length	60 m (197 ft)
Maximum input frequency	500 kHz

Rear Panel



Ports X1, X2, X31 and X41 comply with the recommendations in EN 50 178 for separation from line power.

RS-232-C/V.24 data interface (X31)

25-pin D-sub connection (female)

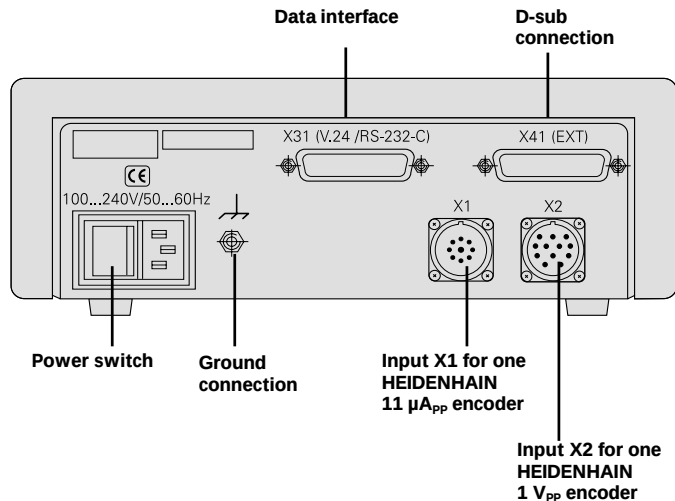
Switching inputs and outputs EXT (X41)

25-pin D-sub connection (male)

Accessories

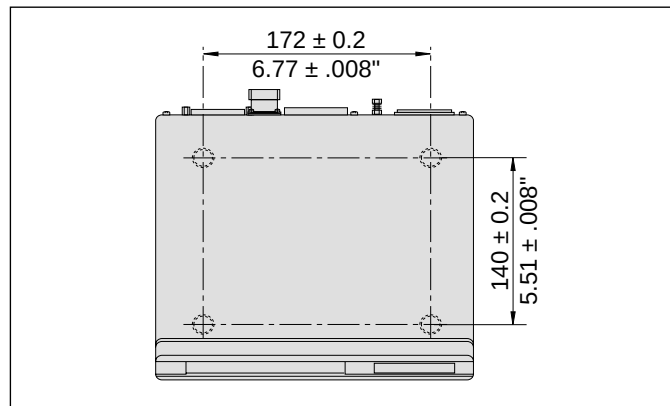
Connecting elements

Connector (female)	25-pin for D-sub connection X41 Id. Nr. 249 154 ZY
Connector (male)	25-pin for D-sub connection X31 Id. Nr. 245 739 ZY
Data interface cable, complete	3 m (9.9 ft), 25-pin for D-sub connection X31, Id. Nr. 274 545-01



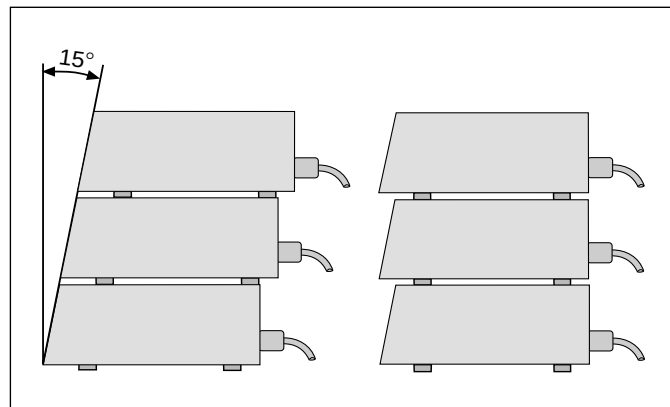
Mounting

You can fasten the ND 281 B from below by using M4 screws (see illustration at right).



Hole positions for mounting the ND display unit

ND 281 B display units are stackable. Adhesive plug-in feet (supplied with your unit) prevent the stacked units from being moved out of place.



Alternatives of stacking the display units

Power Connection

The rear panel of the ND 281 B contains a connecting jack for a power cord with Euro connector (power cord supplied with the delivery).

Minimum cross section of the power cord: 0.75 mm²

Power supply: 100 Vac to 240 Vac (–15% to +10%)
50 Hz to 60 Hz (± 2 Hz)

A voltage selector is therefore not necessary.



Danger of electrical shock!

Unplug the power cord before opening the housing. Connect the grounding conductor. Do not interrupt the grounding conductor.



Danger to internal components!

Do not engage or disengage any connections while the unit is under power. Use only original replacement fuses.



To increase noise immunity, connect the ground terminal on the rear panel to the central ground point of the machine.
(Minimum cross-section: 6 mm²)

Linear/Angular Measuring Modes

You can select the linear measuring mode or angular measuring mode by entering the code number 41 52 63:

- Select the user parameter P00 CODE (see "Operating Parameters").
- Enter the code number 41 52 63.
- Confirm your entry with ENT.
- With the "." or "-" key, select the ND LENGTH or ND ANGLE mode, respectively.
- Confirm your selection with ENT.
- The display unit resets itself.
- For further procedure, see "Switch-On, Traversing the Reference Marks."

Operating Parameters

Operating parameters allow you to modify the operating characteristics of your ND display unit and define the evaluation of the encoder signals.

Operating parameters are designated by:

- The letter P,
- A two-digit parameter number, and
- An abbreviation.

Example: P01 INCH

The **factory settings of the operating parameters** are indicated in the parameter list (see “List of Operating Parameters”) in boldface type.

Parameters consist of “user parameters” and “protected operating parameters,” which can only be accessed by entering a code number.

User parameters

User parameters are operating parameters that can be changed **without** entering the code number:

P00 to P30, P50, P51, P79, P86, P98

The functions of the individual user parameters are detailed in the list of operating parameters (see “List of Operating Parameters”).

To access a user parameter ...

... after switching on the display:

While ENT ... CL is displayed: 	Display first user parameter.
---	-------------------------------

... during operation:

Together:  	Display first user parameter.
--	-------------------------------

To go directly to a user parameter:

Together:  	Press and hold CL while entering the first digit of the parameter number (here, 1).
	Enter the second digit of the parameter number (here, 9). The display shows the selected user parameter.

Code number for changing protected operating parameters

If you wish to change protected operating parameters, you must first enter the **code number 9 51 48**:

- Select the user parameter P00 CODE.
- Enter the code number 9 51 48.
- Confirm entry with ENT.

Parameter P30 appears on the display. By paging through the list of operating parameters you can display—and, if necessary, change—each protected operating parameter and, of course, each user parameter.



Once you have entered the code number, the protected operating parameters remain accessible until the display unit is switched off.

Functions for changing the operating parameters

Function	Key
Page forward in the list of operating parameters	
Page backward in the list of operating parameters	
Reduce parameter value	
Increase parameter value	
Correct entry and display parameter designations	
Confirm change or numerical entry, exit the list of operating parameters	

A changed parameter is stored as soon as you

- Exit the list of operating parameters
- or**
- Page forward or backward after the change.

List of Operating Parameters

Parameter	Settings / Function
P00 CODE	Enter a code number : 9 51 48: To change the protected operating parameters 41 52 63: To select the linear or angular measurement mode 10 52 96: Multipoint axis error compensation 24 65 84: To lock the keyboard 66 55 44: To show the software version 24 65 82: Distance-to-go display 48 61 53: Input and output of parameter and compensation-value lists
P01	Units of measurement¹⁾ Display in millimeters MM Display in inches INCH
P02 X1/X2	Select an encoder input Signals at X1 11 μAPP Signals at X2 1 VPP
P08 DISPL.	Display mode²⁾ Decimal degrees DEC. DEGREE Deg., minutes, seconds DEG. MIN. SEC.

Parameter	Settings / Function
P09 ANGLE	Angle display²⁾ +/- 180° +/- 180 DEG. +/- ∞ ENDLESS 360° 360 DEG.
P11 SCL	Scaling factor¹⁾ Scaling factor off SCALING OFF Scaling factor on SCALNG. ON
P12 SCL	Scaling factor¹⁾ Enter a numerical value 0.100000 < P12 < 9.999999 Default setting: 1.000000
P17 CLASS	Sorting and tolerance checking Sorting and tol. checking ON CLASS ON Sorting and tol. checking OFF CLASS OFF
P18 L.CLASS	Lower limit for sorting
P19 U.CLASS	Upper limit for sorting
P21 SERIES	Display for series of measurements¹⁾ OFF MIN MAX ACTL DIFF

¹⁾ Only in linear measurement mode.

²⁾ Only in angular measurement mode.

Parameter	Settings/ Function
P23 DISPL.	Display stop for measured value output Concurrent display , no display freeze; the display value is the current actual value DISPL. ACTL. Frozen display ; hold display until next measured value output DISPL. HOLD Frozen/concurrent display ; freeze display as long as Pulse/Contact for measured value output is present DISPL. STOP
P30 DIR	Counting direction Positive counting direction with positive direction of traverse DIRECT. POS Negative counting direction with positive direction of traverse DIRECT. NEG
P31 S. PER.	Signal period ¹⁾ of encoder 0.000 000 01 < P31 < 99 999.9999 Default setting: 10 µm
P33 COUNT	Counting mode ¹⁾ 0-1-2-3-4-5-6-7-8-9 COUNT 0-1 0-2-4-6-8 COUNT 0-2 0-5 COUNT 0-5
P36 SP/R	Signal periods per revolution ²⁾ 1 < P36 < 999 999 Default setting: 36 000

Parameter	Settings/ Function
P37 STEP	Counting mode ²⁾ 0-1-2-3-4-5-6-7-8-9 COUNT 0-1 0-2-4-6-8 COUNT 0-2 0-5 COUNT 0-5
P38 DEC.	Decimal places ³⁾ 1 / 2 / 3 / 4 / 5 / 6 (up to 8 for inch display)
P40 COMP.	Select encoder compensation No compensation COMP. OFF Multipoint: up to 64 compensation points for linear encoders, up to 72 for angle encoders (fixed spacing of 5 deg.) COMP. MULTI Linear compensation COMP. LIN ¹⁾

¹⁾ Only in linear measurement mode.

²⁾ Only in angular measurement mode.

³⁾ Depends on signal period (P31) and unit of measure (P01)

Parameter	Settings / Function
P41 L . COMP .	Linear error compensation ¹⁾ – 99 999.9 < P41 < + 99 999.9 [μm/m] Default setting: 0
Example: Find input value for P41 Displayed measuring length $L_d = 620.000$ mm Actual length (measured, e.g. with the VM 101 comparator system from HEIDENHAIN) $L_a = 619.877$ mm Length difference $\Delta L = L_a - L_d = -123$ μm Compensation factor k (= P41): $k = \Delta L / L_d = -123 \text{ μm} / 0.62 \text{ m} \dots\dots \mathbf{k = -198.4}$ [μm/m]	
P42 BACKLASH	Backlash compensation ¹⁾ Input range (mm): +9.999 to -9.999 Default setting: 0.000 = no backlash compensation During a change in direction, the mechanical play between the encoder and table, the so-called backlash, can cause error. Positive backlash: The rotary encoder moves before the table, therefore the display value is too high (positive value input). Negative backlash: The rotary encoder moves after the table, therefore the display value is too low (negative value input).

Parameter	Settings / Function
P43 REF	Reference marks One reference mark SINGLE REF . Distance-coded with 500 • SP (SP: signal period) 500 SP Distance-coded with 1000 • SP (e.g. for HEIDENHAIN LS ...C) 1000 SP Distance-coded with 2000 • SP 2000 SP Distance-coded with 5000 • SP 5000 SP
P44 REF	Reference mark evaluation Evaluate the reference mark REF . ON Do not evaluate the reference mark REF . OFF
P45 ALARM	Encoder monitoring No monitoring ALARM OFF Monitor the frequency FREQUENCY Monitor contamination CONTAMINAT . Contamination + frequency FRQ . + CONT .
P50 RS232	Baud rate 110 / 150 / 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19 200 / 38 400 baud

¹⁾ Only in linear measurement mode.

Parameter	Settings / Function	
P51 RS232	Additional blank lines during data output	BK LINE 1
	0 ≤ P51 ≤ 99 Default setting: 1	
P62 A1	Trigger limit 1	
P63 A2	Trigger limit 2	
P79 PRESET	Value for datum point	
	Enter numerical value for datum setting over switching input or with ENT key	
P80 ENT-CL	Set display	
	No zero reset/Set with CL/ENT	CL-ENT OFF
	Zero reset with CL setting disabled with ENT	CL ON
	Zero reset with CL and set with ENT to value selected in P79	CL-ENT ON
P82 DISPL.ON	Message after switch-on	
	ENT . . . CL message	MESSAGE ON
	No message	MESSG. OFF
P85 EXT.REF	External REF	
	REF over D-sub port EXT	EXT.REF ON
	No REF over D-sub port EXT	EXT.REF OFF

Parameter	Settings / Function	
P86 MOD	In the linear measurement mode	
	First indicator after pressing MOD	
	START	PRINT
	MIN	ACTL MAX DIFF
	In the angular measurement mode	
	PRINT via MOD disabled	PRINT OFF
	PRINT via MOD enabled	PRINT ON
P98 LANGUA.	Conversational language	
	German	LANGUAGE DE
	English	LANGUAGE EN
	French	LANGUAGE FR
	Italian	LANGUAGE IT
	Dutch	LANGUAGE NL
	Spanish	LANGUAGE ES
	Danish	LANGUAGE DA
	Swedish	LANGUAGE SV
	Finnish	LANGUAGE FI
	Czech	LANGUAGE CS
	Polish	LANGUAGE PL
	Hungarian	LANGUAGE HU
	Portuguese	LANGUAGE PT

Linear Encoders

The ND 281 B display unit is designed for use together with photoelectrical encoders with sinusoidal signals— $11 \mu\text{A}_{\text{PP}}$ or 1 V_{PP} .

Display step with linear encoders

You can select a specific display step by adapting the following operating parameters:

- Signal period (P31)
- Counting mode (P33)
- Decimal places (P38)

Example

Linear encoder with a signal period of $10 \mu\text{m}$

Desired display step 0.0005 mm

Signal period (P31) 10

Counting mode (P33) 5

Decimal places (P38) 4

The following tables will help you select the appropriate parameter settings.

Recommended parameter settings for HEIDENHAIN linear encoders with 11 μA_{pp} signals

Model	Signal period in μm	Reference marks	Millimeters			Inches		
			Display step in mm	Count. mode	Decimal places	Display step in inches	Count. mode	Decimal places
	P 31	P 43		P 33	P 38		P 33	P 38
CT	2	Single	0.0005	5	4	0.00002	2	5
MT xx01		Single	0.0002	2	4	0.00001	1	5
LIP 401A/401R			0.0001	1	4	0.000005	5	6
			0.00005	5	5	0.000002	2	6
			<i>Recommd. only for LIP 401</i>					
			0.00002	2	5	0.000001	1	6
			0.00001	1	5	0.0000005	5	7
			0.000005	5	6	0.0000002	2	7
LF 103/103C	4	Single/5000	0.001	1	3	0.00005	5	5
LF 401/401C			0.0005	5	4	0.00002	2	5
LIF 101/101C			0.0002	2	4	0.00001	1	5
LIP 501/501C			0.0001	1	4	0.000005	5	6
			0.00005	5	5	0.000002	2	6
LIP 101		Single	<i>Recommd. only for LIP 101</i>					
			0.00002	2	5	0.000001	1	6
			0.00001	1	5	0.0000005	5	7
MT xx	10	Single	0.0005	5	4	0.00002	2	5
			0.0002	2	4	0.00001	1	5
			0.0001	1	4	0.000005	5	6
LS 303/303C	20	Single/1000	0.01	1	2	0.0005	5	4
LS 603/603C			0.005	5	3	0.0002	2	4

Recommd. parameter settings for HEIDENHAIN linear encoders with 11 μA_{pp} signals (continued)

Model	Signal period in μm	Reference marks	Millimeters			Inches		
			Display step in mm	Count. mode	Decimal places	Display step in inches	Count. mode	Decimal places
	P 31	P 43		P 33	P 38		P 33	P 38
LS 106/106C LS 406/406C LS 706/706C	20	Single/1000	0.001 0.0005	1 5	3 4	0.00005 0.00002	5 2	5 5
ST 1201		-						
LB 302/302C LIDA 10x/10xC	40	Single/2000	0.005 0.002 0.001 0.0005	5 2 1 5	3 3 3 4	0.0002 0.0001 0.00005 0.00002	2 1 5 2	4 4 5 5
			<i>Recommd. only for LB 302</i>					
			0.0002 0.0001	2 1	4 4	0.000001 0.0000005	1 5	5 6
LB 301/301C	100	Single/1000	0.005 0.002 0.001	5 2 1	3 3 3	0.0002 0.0001 0.00005	2 1 5	4 4 5
LIM 501	10240	Single	0.1 0.01 0.05	1 1 5	1 2 2	0.005 0.0005 0.002	5 5 2	3 4 3

Recommended parameter settings for HEIDENHAIN linear encoders with 1 V_{pp} signals

Model	Signal period in μm	Reference marks	Millimeters			Inches		
			Display step in mm	Count. mode	Decimal places	Display step in inches	Count. mode	Decimal places
	P 31	P 43		P 33	P 38		P 33	P 38
LIP 382	0.128	-	0.000002 0.000001	2 1	6 6	0.0000001 0.0000000 5	1 5	7 8
MT xx81 LIP 481A/481R	2	Single	0.0005 0.0002 0.0001 0.00005	5 2 1 5	4 4 4 5	0.00002 0.00001 0.000005 0.000002	2 1 5 2	5 5 6 6
			<i>Recommd. only for LIP 481 X</i>					
			0.00002 0.00001 0.000005	2 1 5	5 5 6	0.000001 0.0000005 0.0000002	1 5 2	6 7 7
LF 183/183C LF 481/481C LIF 181/181C LIP 581/581C	4	Single/5000	0.001 0.0005 0.0002 0.0001 0.00005	1 5 2 1 5	3 4 4 4 5	0.00005 0.00002 0.00001 0.000005 0.000002	5 2 1 5 2	5 5 5 6 6
VM 182		-	<i>Recommd. only for VM 182</i>					
			0.00002 0.00001	2 1	5 5	0.000001 0.0000005	1 5	6 7
LS 186/186C LS 486/486C	20	Single/1000	0.001 0.0005	1 5	3 4	0.00005 0.00002	5 2	5 5
ST 1281		-						

Recommended parameter settings for HEIDENHAIN linear encoders with 1 V_{pp} signals (continued)

Model	Signal period in μm	Reference marks	Millimeters			Inches		
			Display step in mm	Count. mode	Decimal places	Display step in inches	Count. mode	Decimal places
	P 31	P 43		P 33	P 38		P 33	P 38
LB 382/382C LIDA 18x/18xC	40	Single/2000	0.005	5	3	0.0002	2	4
			0.002	2	3	0.0001	1	4
			0.001	1	3	0.00005	5	5
			0.0005	5	4	0.00002	2	5
			<i>Recommd. only for LB 382</i>					
			0.0002	2	4	0.00001	1	5
LB 381/381C	100	Single/1000	0.0001	1	4	0.000005	5	6
			0.005	5	3	0.0002	2	4
			0.002	2	3	0.0001	1	4
			0.001	1	3	0.00005	5	5

Recommended parameter settings for HEIDENHAIN angle encoders with $11 \mu A_{pp}$ / $1 V_{pp}$ signals

Model	Signal periods per revolution	Reference marks		Display step	Count. mode	Decimal places
	P36				P37	P38
ROD 450 / ROD 456 / ROD 486 / ROD 1080	3600	One	Single	0.01° 0.005° 0.001°	1 5 1	3 3 3
ROD 250 C / ROD 280 C RON 255 C / RON 285 C	9000	Dist.- coded	500	0.005° 0.001°	5 1	3 3
ROD 250 C / ROD 280 C ROD 255 C / RON 285 C ROD 700 C / ROD 780 C RON 705 C / RON 785 C RON 706 C / RON 786 C	18 000	Dist.- coded	1000	0.001° 0.0005° 0.0001°	1 5 1	3 4 4
RON 905 /	36 000	One	Single	0.0001°	1	4
ROD 800 C / ROD 880 C ROD 806 C / ROD 886 C	36 000	Dist.- coded	1000	0.0001°	1	4

Convert decimal degrees into degrees, minutes, seconds

1 degree (1°) = 60 minutes (60'); 1 minute (1') = 60 seconds (60")

1 second (1") $\approx 0.000278^\circ$

Multipoint Axis Error Compensation



If you want to use the multipoint axis error compensation feature, you must:

- Activate the feature with operating parameter 40 (see "Operating Parameters"),
- Traverse the reference marks after switching on the display unit,
- Enter a compensation value table.

Your machine may have a nonlinear axis error due to factors such as axis sag or leadscrew errors. Such deviations are usually measured with a comparator measuring system (such as the HEIDENHAIN VM 101).

In the **linear measurement** mode:

You can make a compensation value table with 64 compensation values.

In the **angular measurement** mode:

You can make a compensation value table with 72 compensation points (point spacing: 5 degrees). The datum is the reference point.

You select the compensation table through P00 CODE and by entering the code number 10 52 96 (see "Operating Parameters").

Ascertaining the compensation values

To ascertain the compensation values (e.g. with a VM 101) you must select the compensation table and then press the "–" key to select the REF display.

The letter "R" at the left of the display indicates that the displayed position value is given with respect to the reference mark. If "R" blinks, you must traverse the reference mark.

Entries in the compensation value table

- Datum ¹⁾:
Here you enter the point at which the compensation is to begin. This point indicates the absolute distance to the reference point.



Do not change the datum after measuring the axis error and before entering the axis error into the compensation table.

- Spacing of the compensation points ¹⁾:
The spacing of the compensation points is expressed as:
Spacing = 2^x [μm].
Enter the value of the exponent x in into the compensation value table.
Minimum input value: 6 (= 0.064 mm)
Maximum input value: 20 (= 1048.576 mm)
Example: 900 mm traverse with 15 compensation points
==> 60.000 mm spacing between points.
Nearest power of two: 2^{16} = 65.536 mm (see "Table for determining the point spacing")
Input value in the table: 16
- Compensation value:
You enter the measured compensation value (in millimeters) for the displayed compensation point. Compensation point 0 always has the value 0 and cannot be changed.

¹⁾ Only in the linear measurement mode

Table for determining the point spacing

Exponent	Point spacing	
	in mm	in inches
6	0.064	0.0025"
7	0.128	0.0050"
8	0.256	0.0100"
9	0.512	0.0200"
10	1.024	0.0403"
11	2.048	0.0806"
12	4.096	0.1612"
13	8.192	0.3225"
14	16.384	0.6450"
15	32.768	1.290"
16	65.536	2.580"
17	131.072	5.160"
18	262.144	10.32"
19	524.288	20.64"
20	1048.576	41.28"

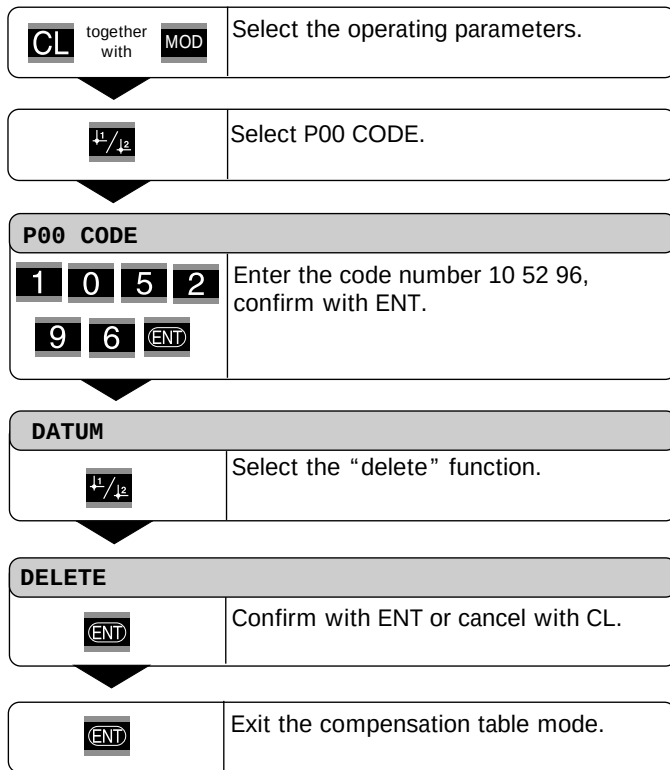
Selecting the compensation table, entering an axis correction

CL together with MOD	Select the operating parameters.
$\frac{1}{2} / \frac{1}{2}$	Select P00 CODE.
P00 CODE	
1 0 5 2 9 6 ENT	Enter the code number 10 52 96, confirm with ENT.
DATUM (shown for approx. two seconds) ¹⁾	
2 7 MOD	Enter the active datum for the error on the axis to be corrected, e.g. 27 mm. Press MOD to select the next input box.
SPACING ¹⁾	
1 0 4 x MOD	Enter the spacing of the compensation points on the axis to be corrected, for example $2^{10} \mu\text{m}$ (equals 1.024 mm). Press MOD four times to select COMP. NR. 01. (You cannot enter values in the POS. NR. 00, COMP. NR. 00 and POS. NR. 01 boxes.)

COMP. NR. 01	
0 . 0 1 2 x MOD	Enter the associated compensation value, e.g. 0.01 mm. Press MOD twice to select COMP. NR. 02. (You cannot enter any values in the POS. NR. 02 box).
COMP. NR. 02	
0 . 0 2 2 x MOD	Enter all further compensation points. If you want so select a compensation point directly, press CL and simultaneously enter the desired compensation point number.
ENT	Conclude entry.

¹⁾ Only in the linear measurement mode
For "angle measurement": Datum = reference point
Point separation: 5 degrees

Deleting a compensation value table



Switching Inputs and Outputs EXT (X41)



Danger to internal components!

Voltage sources for external circuitry must conform to the recommendations in EN 50 178 for low-voltage electrical separation. Connect inductive loads only with a quenching diode parallel to the inductance.



Only use shielded cables!

Connect the shield to the connector housing.

Outputs at D-sub connection EXT (X41)

Pin	Function
14	Display value is zero
15	Measured value $\geq$ trigger limit A1 (P62)
16	Measured value $\geq$ trigger limit A2 (P63)
17	Measured value $<$ lower sorting limit (P18)
18	Measured value $>$ upper sorting limit (P19)
19	Error (see "Error Messages")

Inputs at D-sub connection EXT (X41)

Pin	Function
1, 10	0 V
2	Reset display to zero, clear error message
3	Set display to the value selected in P79
4	Ignore reference mark signals
5	Start series of measurements ¹⁾
6	Externally select display value for series of measurements ¹⁾
7	Display MIN value of series of measurements ¹⁾
8	Display MAX value of series of measurements ¹⁾
9	Display difference MAX – MIN ¹⁾
22	Pulse: Transmit measured value
23	Contact: Transmit measured value
25	Enable or disable REF mode (current REF status is changed)
12, 13, 24	<i>Do not assign</i>
11, 20, 21	<i>Vacant</i>

Special case: Display current measured value ACTL

If you wish to display the current measured value ACTL of a series of measurements, note for inputs **7, 8 and 9**: Either none or more than one of these inputs must be active.

¹⁾ Only in the linear measurement mode

Inputs

Input signals

Internal pull-up resistor 1 k Ω , active with low level

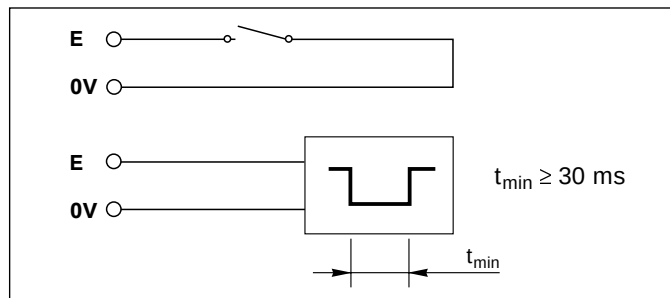
Trigger by making contact against 0 V **or**
by low-level signal over TTL logic device

Delay for set/zero reset: $t_d \leq 2$ ms

Minimum pulse duration for all signals: $t_{\min} \geq 30$ ms

Signal level of inputs

Status	Level
High	$+3.9 \text{ V} \leq U \leq +15 \text{ V}$
Low	$-0.5 \text{ V} \leq U \leq +0.9 \text{ V}; I \leq 6 \text{ mA}$



Outputs

Output signals

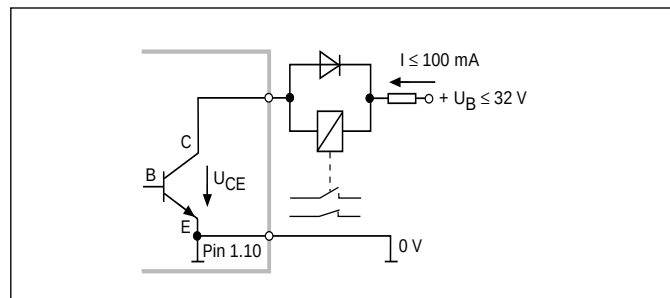
"Open collector" outputs, active with low level

Delay until signal output: $t_d \leq 30$ ms

Signal duration of zero signal, trigger limit A1, A2: $t_0 \geq 180$ ms

Signal level of outputs

Status	Level
High	$U \leq +32 \text{ V}; I \leq 10 \mu\text{A}$
Low	$U \leq +0.4 \text{ V}; I \leq 100 \text{ mA}$



Setting and zero resetting the display

With an external signal, you can set the display to the value selected in parameter P79 (pin 3) or reset each axis to zero (pin 2).

Enabling and disabling REF mode

Operating parameter P85 allows you to activate the input (pin 25) which will be used for setting the display externally to REF mode when the unit is switched on or when the power is restored after an interruption. The next signal deactivates REF mode again (switchover function).

Ignoring reference mark signals

If this input (pin 4) is active, the display will ignore all reference mark signals. A typical application of this function is for measuring lengths with a rotary encoder and spindle; in this case, a cam switch releases the reference mark signal at a preset position.

Externally selecting MIN/MAX ¹⁾

Starting a series of measurements

Switching the display between MIN/MAX/DIFF/ACTL

You can activate the operating mode for finding minimum and maximum values from a series of measurements with an external signal (pin 6, low-level signal must be present continuously). The setting selected with MOD or operating parameter P21 is disabled. You can switch to MIN/MAX/DIFF/ACTL display (pins 7, 8, 9, low-level signal must be present continuously) and START (pin 5, Pulse) of a new series of measurements only by external signal over the switching inputs.

¹⁾ Only in linear measurement mode.

Switching signals

As soon as the trigger points defined in parameters are reached, the corresponding outputs (pins 15, 16) are activated. You can set up to two trigger points. The switching point “zero” has a separate output (see “Zero crossover”).

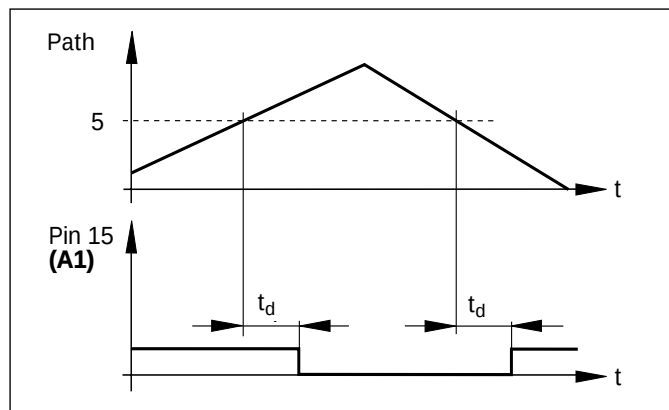
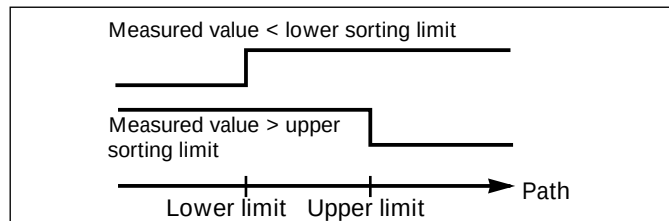
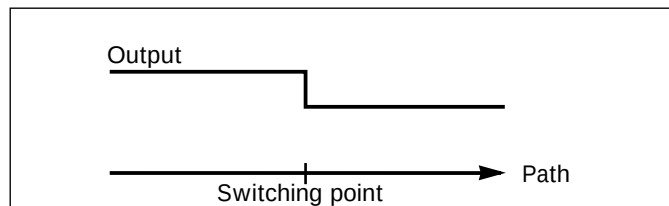
Signals for sorting and tolerance checking

If the sorting limits defined in parameters are exceeded, the corresponding outputs (pins 17, 18) are activated.

Signals	Operating parameters	Pin
Switching signals	P62, switching limit 1	15
	P63, switching limit 2	16
Sorting signals	P18, lower sorting limit	17
	P19, upper sorting limit	18

Zero crossover

The display value “zero” activates the corresponding output (pin 14). Minimum signal duration is 180 ms.

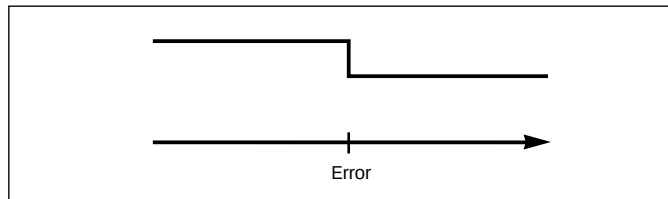


Time curve of signal at pin 15 for trigger limit (A1) = 5 mm , $t_d \leq 30$ ms

Switching signal for errors

The display unit permanently monitors functions such as measuring signal, input frequency, and data output, and displays an error message if it detects an error.

If errors occur that seriously influence measurement or data output, the display unit activates a switching output. This feature allows monitoring of automated processes.



Locking the Keypad

You can lock or release the keypad by entering the code number 24 65 84:

- Select the user parameter **P00 CODE** (see “Operating Parameters”).
- Enter the code number 24 65 84.
- Confirm the entry with ENT.
- With the “•” or “–” key, select **KEYS ON** or **KEYS OFF**.
- Confirm your selection with ENT.

If the keypad is locked, you can only select the datum or select **P00 CODE** over the MOD key.

Displaying the Software Version

To display the software version of the display unit, enter the code number 66 55 44:

- Select the user parameter **P00 CODE**.
- Enter the code number 66 55 44.
- Confirm your entry with ENT.
- The display unit shows the software number.
- With the “–” key you can switch the display to the date of issue.
- To exit the software version display mode, press ENT.

Distance-to-Go Mode ¹⁾

Normally, the display shows the actual position of the encoder. However, it is often more helpful to display the remaining distance to an entered nominal position—especially when you are using the display unit for machine tools and automation purposes. You can then position simply by traversing to display value zero.

You can access the distance-to-go display by entering the **code number 24 65 82**.

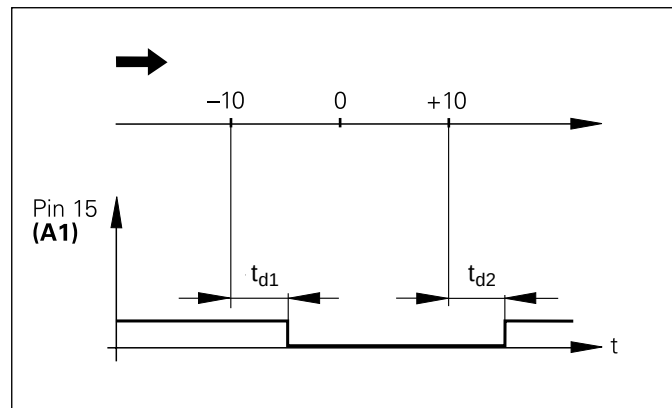
Display	Meaning
DELTA ON	Distance-to-go display active
DELTA OFF	Distance-to-go display not active

“Traversing to zero” with distance-to-go display

- Select datum point 2.
- Enter the nominal position.
- Move the axis until the display value is zero.

Function of switching outputs A1 and A2

In the distance-to-go mode, switching outputs A1 (pin 15) and A2 (pin 16) have a different function: they are symmetrical to the display value zero. For example, if a switching point of 10 mm is entered in P62, output A1 switches at both +10 mm and -10 mm. The figure below shows output signal A1 when approaching zero from the negative direction.



Time curve of a signal for switching limit (A1) = 10 mm,
 $t_{d1} \leq 30$ ms, $t_{d2} \leq 180$ ms

¹⁾ Only in linear measurement mode

RS-232-C/V.24 Data Interface (X31)

The RS-232-C/V.24 interface (X31) of your display unit enables you to transmit measured data in ASCII format, for example to a printer or PC.

Connecting cable

You can use a connecting cable with full wiring (figure at upper right) or simplified wiring (below right). A cable with full wiring is available from HEIDENHAIN.

Data transmission cable for RS-232-C/V.24

D-sub (male) 25-pin/D-sub (female) 25-pin

Id. Nr. 274 545-..

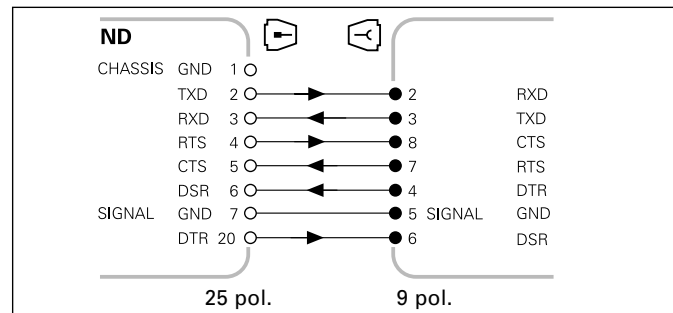
On this type of cable, pin 6 and pin 8 are additionally connected over a jumper.

Data transmission cable for RS-232-C/V.24

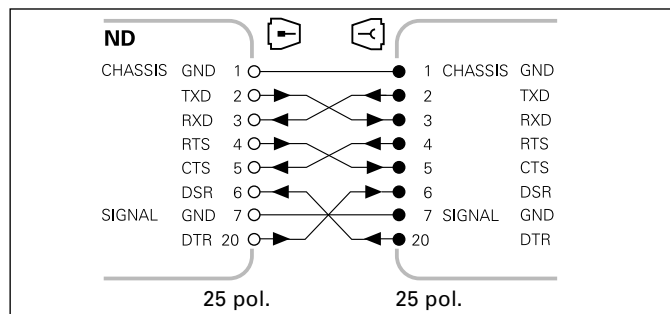
D-sub (male) 25-pin/D-sub (female) 9-pin

Id. Nr. 368 017-..

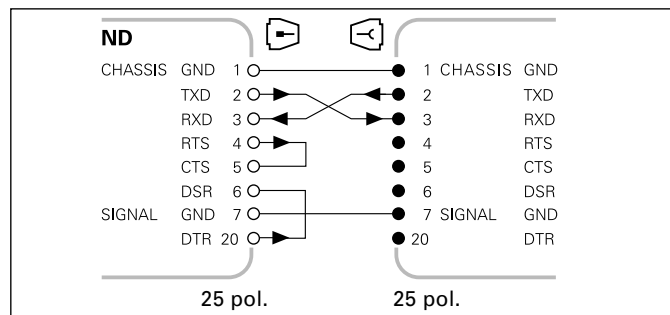
Maximum cable length: 20 m (66 ft)



Data transmission cable 25-pin/9-pin



Data transmission cable 25-pin/25-pin
(full wiring)



Data transmission cable 25-pin/25-pin
(simplified wiring)

Pin layout RS-232-C/V.24 (X31)

Pin	Signal	Assignment
1	CHASSIS GND	Chassis ground
2	TXD	Transmitted data
3	RXD	Received data
4	RTS	Request to send
5	CTS	Clear to send
6	DSR	Data set ready
7	SIGN. GND	Signal ground
8 to 19	–	<i>Not assigned</i>
20	DTR	Data terminal ready
21 to 25	–	<i>Not assigned</i>

Levels for TXD and RXD

Logic level	Voltage level
Active	– 3 V to – 15 V
Not active	+ 3 V to +15 V

Levels for RTS, CTS, DSR and DTR

Logic level	Voltage level
Active	+ 3 V to + 15 V
Not active	– 3 V to – 15 V

Data format and control characters

Data format	1 start bit 7 data bits Even parity bit 2 stop bits
Control characters	Call measured value: STX (Ctrl B) Interrupt DC3 (Ctrl S) Continue DC1 (Ctrl Q) Interrogate error message: ENQ (Ctrl E)

Example: Data sequence during measured value output

Measured value = – 5.23 mm

The measured value is within the sorting limits (=) and is the current value (A) of a series of measurements.

Measured value output

-	5	.	2	3			=	A	<	C	R	>	<	L	F	>
---	---	---	---	---	--	--	---	---	---	---	---	---	---	---	---	---

- ① Algebraic sign
 ② Numerical value with decimal point (10 characters on the whole, leading zeros are output as blank spaces.) (Angle measurement “min, sec” up to 3 dec. spaces.)
 ③ Blank space
 ④ Unit: Blank space = mm; " = inch; ? = fault
 ⑤ Sorting status (<, >, =; ? if P18 > P19)
or blank space
 ⑥ Series of measurements
 (S = MIN; A = ACTL; G = MAX; D = DIFF)
or blank space
 ⑦ CR (carriage return)
 ⑧ LF (line feed)

Operating parameters for measured value output

Parameter	Function
P50 RS232	Baud rate
P51 RS232	Number of additional blank lines for measured value output

Display freeze during measured value output

In operating parameter P23, you can specify how the measured value output signal will affect the display unit.

Display freeze during measured value output	P23
Concurrent display , no display freeze: The display value is the current measured value	DISPL . ACTL .
Frozen display : Display is stopped (frozen) and updated by every measured value output signal	DISPL . HOLD
Frozen/concurrent display : Display is frozen as long as a measured value output signal is present	DISPL . STOP

Measured value output via PRINT function

In the **linear measurement** mode, press MOD repeatedly until the PRINT indicator starts blinking. Start the measured value output with ENT.

In the **angular measurement** mode, press MOD (this feature can be disabled with operating parameter 86).

Duration of measured value transfer

$$t_D = \frac{187 + (11 \cdot \text{number of blank lines})}{\text{baud rate}} \quad [\text{s}]$$

Indicator preselection (linear measurement mode)

Operating parameter **P86** allows you to define which indicator is displayed first when MOD is pressed.

Measured value output after signal through the “Contact” or “Pulse” inputs

To start measured value output through the EXT interface (X41), you can either:

- Close the “Contact” input (pin 23 on X41) against 0 V, for example with a simple switch (make contact);
or
- Close the “Pulse” input (pin 22 on X41) against 0 V, for example by triggering the input with a TTL logic device (such as SN74LSxx).

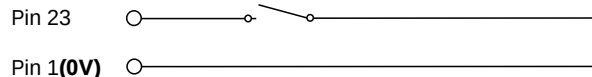
Characteristic times for measured value output

Process	Time
Minimum duration of “Contact” signal	$t_e \geq 7 \text{ ms}$
Minimum duration of “Pulse” signal	$t_e \geq 1.5 \mu\text{s}$
Storage delay after “Contact”	$t_1 \leq 5 \text{ ms}$
Storage delay after “Pulse”	$t_1 \leq 1 \mu\text{s}$
Measured value output after	$t_2 \leq 57 \text{ ms}$
Regeneration time	$t_3 \geq 0$

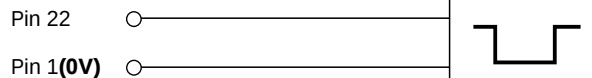
Duration of measured value transfer

$$t_D = \frac{187 + (11 \cdot \text{number of blank lines})}{\text{baud rate}} [\text{s}]$$

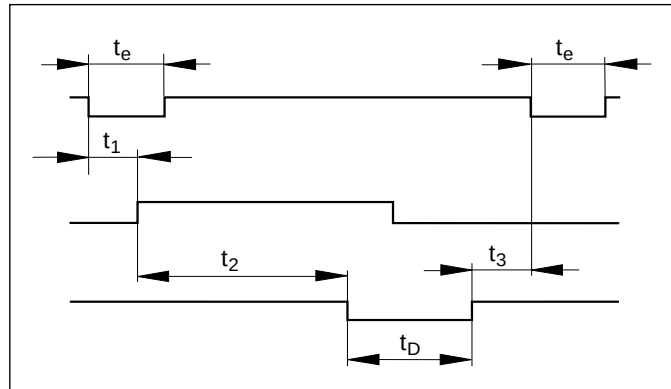
EXT(X41)



EXT(X41)



Triggering the “Contact” and “Pulse” inputs at D-sub connection EXT (X41)



Signal transit times for measured value output after “Pulse” or “Contact”

Measured value output with CTRL B

If the display unit receives the control character STX (Ctrl B) over the RS-232-C/V.24 interface, it transmits the current measured value back over the interface. Ctrl B is received over the RXD line of the interface and the measured values are transferred over the TXD line.

The measured values can be received and saved using a terminal program (e.g. HyperTerminal, which is a component of Windows®).

The basic program at the upper right shows the fundamental structure of a program for measured value output.

Characteristic times for measured value output

Process	Time
Storage after	$t_1 \leq 1 \text{ ms}$
Measured value output after	$t_2 \leq 50 \text{ ms}$
Regeneration time	$t_3 \geq 0$



These times are prolonged if functions are active (for example, series of measurements with DIFF value display).

Duration of measured value transfer

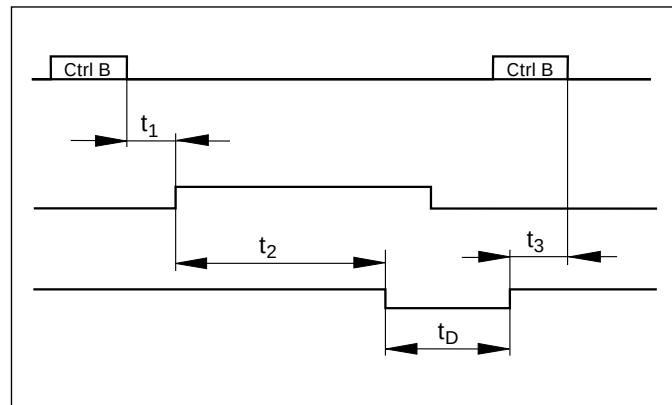
$$t_D = \frac{187 + (11 \cdot \text{number of blank lines})}{\text{baud rate}} \quad [\text{s}]$$

```

10  L%=18
20  CLS
30  PRINT "V. 24/RS-232-C"
40  OPEN "COM1:9600,E,7" AS#1
50  PRINT #1, CHR$ (2);
60  IF INKEY$<>" " THEN 130
70  C%=LOC(1)
80  IF C%<L% THEN 60
90  X$=INPUT$(L%,#1)
100 LOCATE 9,1
110 PRINT X$;
120 GOTO 50
130 END

```

BASIC program for measured value output with "Ctrl B"



Propagation times for measured value output after "Ctrl B"

Input/Output of Parameter and Compensation-Value Lists

Calling the "data transfer" function:

CL together with MOD	Select the operating parameters.
------------------------------------	----------------------------------

1 / 2	Select P00 CODE.
---------------------	------------------

P00 CODE	
4 8 6 1	Enter the code number 48 61 53 and confirm with ENT.
5 3 ENT	

Data transfer function:

TRANSFER	
ENT	Continue with ENT.

SEND PARAM.	
If reqd. ENT . or —	Press the ENT key if you want to transmit the parameter list over the RS-232-C/V.24 interface. After transmission, return to the beginning ("TRANSFER") to transmit or receive further lists. Press the decimal point key to continue in the data transfer menu.

REC. PARAM.	
If reqd. . or —	The display unit is ready to receive a parameter list over the RS-232-C/V.24 interface. After successful reception of the parameter list, the display unit resets itself and restarts. Continue in the data transfer menu with the decimal point key.

SEND COMP.	
If reqd. ENT . or —	With the ENT key, you transmit the compensation value list over the RS-232-C/V.24 interface. After transmission, return to the beginning ("TRANSFER") to transmit or receive more lists. Continue in the data transfer menu with the decimal point key.

REC. COMP.	
If reqd. . or —	The display unit is ready to receive a parameter list over the RS-232-C/V.24 interface. After successful reception, return to the beginning ("TRANSFER") to transmit or receive more lists. Continue in the data transfer menu with the decimal point key.

CL	Exit the data transfer function.
-----------	----------------------------------

Note on the input/output of parameter and compensation-value lists

With a terminal program (e.g. HyperTerminal, included with Windows®), you can receive the lists output by the display unit over the RS-232-C/V.24 interface as text files and save them on your PC. Each list must be saved as a separate text file. You can then use the terminal program to transmit the text files back to the display unit .

If you wish, you can edit the text files with a text editor and change the parameter values, for example. However, this requires knowledge of the different output formats of the lists (see following pages). When receiving lists, the display unit expects the same list structure as used for the output.

When receiving lists, the display unit first waits for the starting character < * >. The receiving mode ends as soon as the display unit has received the final character < * >.

The lists received are first checked for the type of display unit (line 2 of output list). The receiving display unit accepts only lists prepared by the same type of display unit. Furthermore, the list is checked for completeness. Lists that contain, for example, too many or too few parameters are ignored. If an error occurs, the following error message appears:

REC. ERROR

To clear the error message, press the CL key.

If the display unit receives invalid parameter values, it sets the respective operating parameter to the default setting.

Example: "P01 INCH = INCH = 3"

The value 3 is not allowed. The parameter P01 is set to the default setting "P01 MM = MM = 0".

Output Format of the Parameter List

1st line

Each parameter output begins with the start character < * > (HEX: 0x2A)

*	<CR>	<LF>
---	------	------

3 characters

2nd line

Output of the counter designation

N	D	-	2	8	1		B						M	M			<CR>	<LF>
---	---	---	---	---	---	--	---	--	--	--	--	--	---	---	--	--	------	------

13 characters
Model of display unit

5 characters
Unit of meas.

2 characters
End of line

Subsequent lines for the individual parameters:

a: Parameters:

Parameter settings can be changed with the MINUS key (e.g.: counting direction positive/counting direction negative etc.)

Examples:

P	1	1					S	C	L					=			S	C	A	L	I	N	G	.	O	F	F		=					0	<CR>	<LF>
---	---	---	--	--	--	--	---	---	---	--	--	--	--	---	--	--	---	---	---	---	---	---	---	---	---	---	---	--	---	--	--	--	--	---	------	------

15 characters

3 char.

13 characters

3 char.

6 characters

2 characters

P	5	0						R	S	2	3	2		=				3	8	4	0	0		B	A	U	D		=			3	8	4	0	0	<CR>	<LF>
---	---	---	--	--	--	--	--	---	---	---	---	---	--	---	--	--	--	---	---	---	---	---	--	---	---	---	---	--	---	--	--	---	---	---	---	---	------	------

15 characters

3 char.

13 characters

3 char.

6 characters

2 characters

Parameter designation
left-aligned

Text
right-aligned

Separator
block

Parameter in plain language
right-aligned

Separator
block

Parameter value
right-aligned

End of line

b: Parameters:

Parameter settings can be changed by entering a value
(e.g.: LINEAR COMP. 13.600 etc.)

P	1	8					L	.	C	L	A	S	S	.		=			+				1	2	0	.	0	0	0	0	<CR>	<LF>
15 characters															3 char.			13 characters													2 characters	
P	4	1					L	.	C	O	M	P	.			=			-						1	4	0	0	.	0	<CR>	<LF>
15 characters															3 char.			13 characters													2 characters	
Parameter designation left-aligned							Text right-aligned							Separator block			Parameter value right-aligned													End of line		

Last line:

Each parameter list ends with the final character <*> (HEX: 0x2A)

*	<CR>	<LF>
---	------	------

The parameter text is sent in the language you have set and corresponds to the dialog text that is shown on the display unit.
The parameter value, not the text, is definitive when the parameters are transferred to the display unit.

Parameter list for ND 281 B: "Linear measurement" mode of operation (factory default setting)

Parameter list

Description

*				Start character (*);
ND-281 B	MM			Model of display unit; MM or IN;
P01	MM =	MM =	0	Unit of measure: MM = 0; INCH = 1;
P02	X1/X2 =	X1 11 uAPP =	0	Encoder input: X1 11uAPP = 0; X2 1VPP = 1;
P11	SCL =	SCALING OFF =	0	SCALING OFF = 0; ON = 1;
P12	SCL =	1.000000		SCALING = 1.000000; (value input without sign)
P17	CLASS. =	CLASS. OFF =	0	Sorting: CLASS. OFF = 0; CLASS. ON = 1;
P18	L.CLASS. =	+ 0.0000		Lower limit: L.CLASS = 0; (value input)
P19	U.CLASS. =	+ 0.0000		Upper limit: U.CLASS = 0; (value input)
P21	SERIES =	DISPL. OFF =	0	SERIES: DISPL.OFF =0; MIN=1; MAX=2; ACTL=3; DIFF=4;
P23	DISPL. =	DISPL. ACTL. =	0	DISPLAY: ACTUAL = 0; HOLD = 1; STOP = 2;
P30	DIR =	DIRECT. POS =	0	COUNTING DIRECTION POS = 0; NEG = 1;
P31	S. PER. =	10		SIGNAL PERIOD = 10 µm; (value input without sign)
P33	STEP =	COUNT 0-5 =	5	COUNTING MODE 0-5 = 5; 0-2 = 2; 0-1 = 1;
P38	DEC. =	DP POS 4 =	4	DECIMAL PLACES 4 (range: 1-8)
P40	COMP. =	COMP. OFF =	0	COMPENSATION OFF = 0; LIN = 1; MULTI = 2;
P41	L.COMP. =	+ 0.0		LINEAR COMPENSATION= 0 µm/m (value input)
P42	BKLASH =	+ 0.0000		BACKLASH compensation= 0.0000 mm (value input)
P43	REF =	SINGLE REF. =	0	SINGLE REF. = 0; 500; 1000; 2000; 5000S P;
P44	REF =	REF. ON =	1	REF.ON = 1; REF. OFF = 0;
P45	ALARM =	FRQ.+ CONT. =	3	OFF = 0; FRQ. = 1; CONTAMINAT. = 2; FRQ + CONT. = 3;
P50	RS232 =	9600 BAUD =	9600	BAUD RATE = 9600; (110-38400)
P51	RS232 =	BK LINE 1 =	1	LINE FEEDS = 1; (0-99)
P62	A1 =	+ 0.0000		Switching limit 1: A1 = 0; (value input)
P63	A2 =	+ 0.0000		Switching limit 2: A2 = 0; (value input)
P79	PRESET =	+ 0.0000		DATUM SETTING= 0; (value input)
P80	ENT-CL =	CL-ENT OFF =	0	CL-ENT OFF=0; CL-ON = 1; CL-ENT ON = 2;
P82	DISPL.ON =	ENT...CL ON =	1	DISPLAY: ENT...CL ON = 1; ENT...CL OFF = 0;
P85	EXT.REF =	EXT.REF OFF =	0	EXTERNAL REF OFF = 0; EXTERNAL REF ON= 1;
P86	MOD =	MOD START =	0	MOD key: START= 0; PRINT = 1; MIN = 2; ACTL = 3; MAX = 4; DIFF = 5;
P98	LANGUA. =	LANGUAGE DE =	1	NATIONAL LANGUAGE: 0 = EN; 1 = DE; 2 = FR; 3 = IT; 4 = NL; 5 = ES;
*				6 = DA; 7 = SV; 8 = FI; 9 = CS; 10 = PL; 11 = HU;
				12 = PT;
				Final character(*);

Parameter list for ND 281 B: "Angular measurement" mode of operation (factory default setting)

Parameter list

Parameter list				Description
*				Start character (*);
ND-281 B	DEC			Model of display unit; DEC (decimal) or DMS (min-sec);
P02	X1/X2 =	X1 11 uAPP =	0	Encoder input: X1 11uAPP = 0; X2 1VPP = 1;
P08	DISPL. =	DEC. DEGREE =	0	Display: DEC.DEGREE = 0; DEG.MIN.SEC = 1;
P09	ANGLE =	+/-180 DEG. =	0	Angle: +/- 180 DEG. = 0; 360 DEG. = 1; ENDLESS = 2;
P17	CLASS =	CLASS. OFF =	0	Sorting: CLASS. OFF = 0; CLASS. ON = 1;
P18	L.CLASS. =	+ 0.0000		Lower limit: L.CLASS = 0; (value input)
P19	U.CLASS. =	+ 0.0000		Upper limit: U.CLASS = 0; (value input)
P23	DISPL. =	DISPL. ACTL. =	0	DISPLAY: ACTUAL = 0; HOLD = 1; STOP = 2;
P30	DIR =	DIRECT. POS =	0	COUNTING DIRECTION POS = 0; NEG = 1;
P36	SP/R =	36000		SIGNAL PERIODS / R = 36000 (value input);
P37	STEP =	COUNT 0-5 =	5	COUNTING MODE 0-5 = 5; 0-2 = 2; 0-1 = 1;
P38	DEC. =	DP POS. 4 =	4	DECIMAL PLACES 4 (range: 1-8)
P40	COMP. =	COMP. OFF =	0	COMPENSATION OFF = 0; LIN = 1; MULTI = 2;
P43	REF =	SINGLE REF. =	0	SINGLE REF. = 0; 500; 1000; 2000; 5000 SP;
P44	REF =	REF. ON =	1	REF.ON = 1; REF. OFF = 0;
P45	ALARM =	FRQ. + CONT. =	3	OFF = 0; FRQ. = 1; CONTAMINAT. = 2; FRQ+CONT. = 3;
P50	RS232 =	9600 BAUD =	9600	BAUD RATE = 9600; (110-38400)
P51	RS232 =	BK LINE 1 =	1	LINE FEEDS = 1; (0-99)
P62	A1 =	+ 0.0000		Switching limit 1: A1 = 0; (value input)
P63	A2 =	+ 0.0000		Switching limit 2: A2 = 0; (value input)
P79	PRESET =	+ 0.0000		DATUM SETTING = 0; (value input)
P80	ENT-CL =	CL-ENT OFF =	0	CL-ENT OFF= 0; CL-ON = 1; CL-ENT ON = 2;
P82	DISPL.ON =	ENT...CL ON =	1	DISPLAY: ENT...CL ON = 1; ENT...CL OFF = 0;
P85	EXT.REF =	EXT.REF OFF =	0	EXTERNAL REF OFF = 0; EXTERNAL REF ON = 1;
P86	MOD =	PRINT OFF =	0	MOD KEY: PRINT OFF = 0; PRINT ON = 1;
P98	LANGUA. =	LANGUAGE DE =	1	NATIONAL LANGUAGE: 0 = EN; 1 = DE; 2 = FR;
*				3 = IT; 4 = NL; 5 = ES;
				6 = DA; 7 = SV; 8 = FI;
				9 = CS; 10 = PL; 11 = HU;
				12 = PT;

Final character (*);

Output Format of the Compensation-Value Table

Line: Start

Each compensation-value output begins with the start character < * > (HEX: 0x2A)

*	<CR>	<LF>
---	------	------

3 characters

Line: Counter model designation

Output of model designation and unit of measure

N	D	-	2	8	1	B						M	M			<CR>	<LF>
---	---	---	---	---	---	---	--	--	--	--	--	---	---	--	--	------	------

13 characters

Model display unit, left-aligned

5 characters

Unit of meas.

2 characters

End of line

Line: Compensation value 0

Output of compensation-value no. 0

C	M	P	.			N	R	.		0	0		=			+					0	.	0	0	0	0	<CR>	<LF>
---	---	---	---	--	--	---	---	---	--	---	---	--	---	--	--	---	--	--	--	--	---	---	---	---	---	---	------	------

13 characters

Compensation-value no., left-aligned

3 char.

Sep. block

13 characters

Compensation value, right-aligned

2 characters

End of line

Output of compensation values 1 - 63

Output of compensation values

C	M	P	.			N	R	.		6	3		=			+					0	.	0	1	2	3	<CR>	<LF>
---	---	---	---	--	--	---	---	---	--	---	---	--	---	--	--	---	--	--	--	--	---	---	---	---	---	---	------	------

13 characters

Compensation-value no., left-aligned

3 char.

Sep. block

13 characters

Compensation-value, right-aligned

2 characters

End of line

Last line:

Each compensation-value table ends with the final character < * > (HEX: 0x2A)

*	<CR>	<LF>
---	------	------

3 characters

Compensation-value table for ND 281 B (linear measurement): factory default setting**Compensation-value table**

*			
ND-281 B	MM		
SCALING	=	14	
DATUM	=	+	0.0000
CMP. NR. 00	=	+	0.0000
CMP. NR. 01	=		-----
CMP. NR. 02	=		-----
CMP. NR. 03	=		-----
CMP. NR. 04	=		-----
CMP. NR. 05	=		-----
CMP. NR. 06	=		-----
CMP. NR. 07	=		-----
.			
.			
.			
.			
.			
.			
.			
.			
.			
CMP. NR. 60	=		-----
CMP. NR. 61	=		-----
CMP. NR. 62	=		-----
CMP. NR. 63	=		-----

* Final character (*);

Description:

Start character (*);
 Model of display unit; unit of measure (MM or IN);
 Spacing = 14 (range: 6 – 20)
 Datum point 0 mm (value input)
 Compensation value 0 = 0.000 mm (compensation value 0 is always 0)
 Compensation value 1 = no value entered
 Compensation values 2 – 63: no values entered (axis is not corrected)
 Compensation-value table is empty

Compensation-value table for ND 281 B (angular measurement): Active compensation**Compensation-value table**

*

ND-281 B	DMS
CMP. NR. 00	= + 0.00.00
CMP. NR. 01	= + 0.00.03
CMP. NR. 02	= + 0.00.05
CMP. NR. 03	= + 0.01.01
CMP. NR. 04	= + 0.00.43
CMP. NR. 05	= + 0.00.21
CMP. NR. 06	= + 0.00.06
CMP. NR. 07	= - 0.00.04
CMP. NR. 08	= - 0.00.12
CMP. NR. 09	= - 0.00.24
CMP. NR. 10	= - 0.00.44
CMP. NR. 11	= - 0.00.52
CMP. NR. 12	= - 0.00.43
CMP. NR. 13	= - 0.00.35
CMP. NR. 14	= - 0.00.24
CMP. NR. 15	= - 0.00.19
CMP. NR. 16	= - 0.00.13
CMP. NR. 17	= - 0.00.05
CMP. NR. 18	= + 0.00.00
CMP. NR. 19	= -----
CMP. NR. 20	= -----

.

.

.

CMP. NR. 70 = -----

CMP. NR. 71 = -----

*

Description:

Start character (*);

Model of display unit; DEC (decimal) or DMS (deg-min-sec);

Compensation value 0 = 0.0000mm (compensation value 0 is always 0)

Compensation values 1 – 18 are assigned values (value input)

i.e. a rotary encoder is corrected in 5-degree steps from 0 - 90 degrees

Input in deg-min-sec

Compensation values 11 – 71: no values entered (memory empty)

Final character (*);

Remote Operation over the RS-232-C/V.24 Data Interface

You can operate the display unit remotely over the RS-232-C/V.24 data interface. The following commands are available on the ND 281 B:

Format:

<ESC>TXXXX<CR> Pressed key
 <ESC>AXXXX<CR> Output of screen contents
 <ESC>FXXXX<CR> Execute function
 <ESC>SXXXX<CR> Special function

Sequence of commands	Meaning
<ESC>T0000<CR>	'0' key
<ESC>T0001<CR>	'1' key
<ESC>T0002<CR>	'2' key
<ESC>T0003<CR>	'3' key
<ESC>T0004<CR>	'4' key
<ESC>T0005<CR>	'5' key
<ESC>T0006<CR>	'6' key
<ESC>T0007<CR>	'7' key
<ESC>T0008<CR>	'8' key
<ESC>T0009<CR>	'9' key
<ESC>T0100<CR>	'CL' key
<ESC>T0101<CR>	'.' key
<ESC>T0102<CR>	'.' key
<ESC>T0104<CR>	'ENT' key
<ESC>T0105<CR>	'MOD' key
<ESC>T0107<CR>	'1/2' (datum) key

Sequence of commands	Meaning
<ESC>T1000<CR>	'CE+0' keys
<ESC>T1001<CR>	'CE+1' keys
<ESC>T1002<CR>	'CE+2' keys
<ESC>T1003<CR>	'CE+3' keys
<ESC>T1004<CR>	'CE+4' keys
<ESC>T1005<CR>	'CE+5' keys
<ESC>T1006<CR>	'CE+6' keys
<ESC>T1007<CR>	'CE+7' keys
<ESC>T1008<CR>	'CE+8' keys
<ESC>T1009<CR>	'CE+9' keys
<ESC>A0000<CR>	Output of model designation
<ESC>A0100<CR>	Output of 14-segment display
<ESC>A0200<CR>	Output of current value
<ESC>A0301<CR>	Output of error text
<ESC>A0400<CR>	Output of software number
<ESC>A0900<CR>	Output of status indicators
<ESC>F0000<CR>	REF function
<ESC>F0001<CR>	Start measurement ¹⁾
<ESC>F0002<CR>	Print
<ESC>S0000<CR>	Counter RESET
<ESC>S0001<CR>	Lock keypad
<ESC>S0002<CR>	Release keypad

¹⁾ Only in the linear measurement mode.

Description of RS-232-C/V.24 commands:

The display unit supports the XON-XOFF protocol when executing commands. As soon as the internal character buffer (100 characters) is full, the display unit sends the control character XOFF to the sender. After the buffer has been executed, the display unit sends the control character XON to the sender and is then ready to receive data again.

Pressed key (TXXXX commands)

The display unit acknowledges each identified key command by sending the control character **ACK** (Acknowledge Control-F). Then the key command becomes effective.

The display unit responds to commands that cannot be identified or to invalid commands by sending the control character **NAK** (No acknowledge Control-U).

Output of model designation:

The model of display unit, software number, and the date of software release are transmitted.

Example:

<STX>		N	D	-	2	8	1		B		<CR>	<LF>
		3	4	9	7	9	7	-	0	4	<CR>	<LF>
	2	0	0	1	-	0	5	-	0	4	<CR>	<LF>

String: STX;

10 characters; CR; LF;

10 characters; CR; LF;

10 characters; CR; LF;

Output of 14-segment display:

The contents displayed are transmitted (also dialogs and error messages).

<STX>	-	1	2	3	4	5	.	6	7	8	9	<CR>	<LF>
-------	---	---	---	---	---	---	---	---	---	---	---	------	------

String: STX;

Min. 10 to max. 13 characters; CR; LF; (depending on the number of commas and decimal points)

Output of current value:

The current position value (without decimal point, with leading zeros) is transmitted.

<STX>	+	1	2	3	4	5	6	7	8	9	<CR>	<LF>
-------	---	---	---	---	---	---	---	---	---	---	------	------

String: STX;

Algebraic sign; numerical value with 9 characters;
CR; LF;

Output of error text:

The displayed error text is transmitted. (Functions only if an error message is displayed.)

<STX>	F	O	R	M	A	T	.	E	R	R			<CR>	<LF>
-------	---	---	---	---	---	---	---	---	---	---	--	--	------	------

String: STX;

13 characters; CR; LF;

Output of software number:

The current software number is transmitted.

<STX>		3	4	9	7	9	7	-	0	4	<CR>	<LF>
-------	--	---	---	---	---	---	---	---	---	---	------	------

String: STX;

10 characters; CR; LF;

Output of status indicators:

The condition of the status display is transmitted.

Example:

0 = status indicator dark

1 = status indicator glows

2 = status indicator blinks

<STX>	0	1	0	0	1	0	0	1	0	0	1	2	0	0	<CR>	<LF>
	a	b	c	d	e	f	g	h	i	j	k	l	m	n		

String: STX;

4 characters; CR; LF;

a = REF (reference point)

b = datum 1

c = datum 2

d = SET (datum setting)

e = START (measurement series)

f = PRINT (data output)

g = inch (inch display)

h = < (sorting)

i = = (sorting)

j = > (sorting)

k = MIN (meas. series)

l = ACTL (meas. series)

m = MAX (meas. series)

n = DIFF (meas. series)

Execute functions (FXXX commands):

The display unit acknowledges every correctly received command by transmitting the control character **ACK** (Acknowledge, Control-F). Then it executes the command. It answers unrecognized or invalid commands by sending the control character **NAK** (No acknowledge Control U).

REF function:

Activate or deactivate REF mode (current REF condition is changed).

Print

Output of the current measured value. The measured value (string) is transmitted as described in the manual (page 47). Same function as calling the measured value with STX (Control B).

Special functions (SXXX commands):**Counter RESET:**

The software resets the counter and the counter restarts. (Function same as switching the display unit off and on.)

Locking the keypad:

The display unit acknowledges the special function by sending the control character **ACK** (acknowledge). All keys of the display unit are locked. The counter can be operated only by external RS-232-C/V.24 commands and via X41. The keyboard can be unlocked either by sending the special function

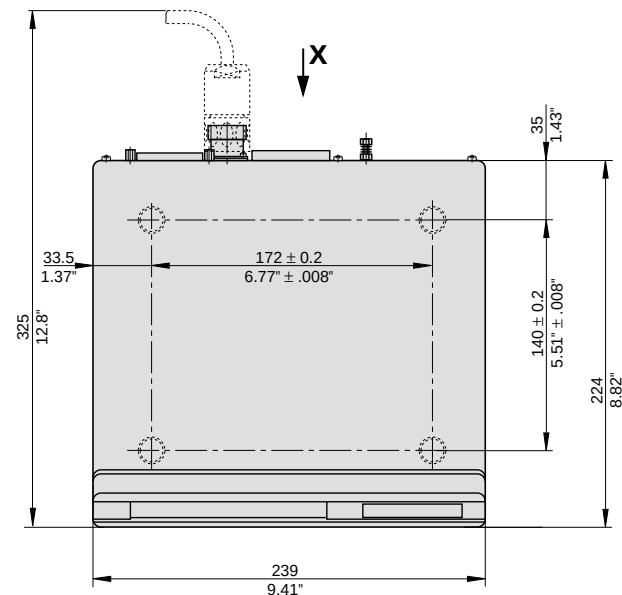
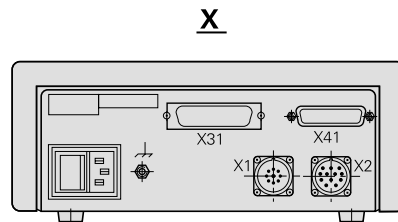
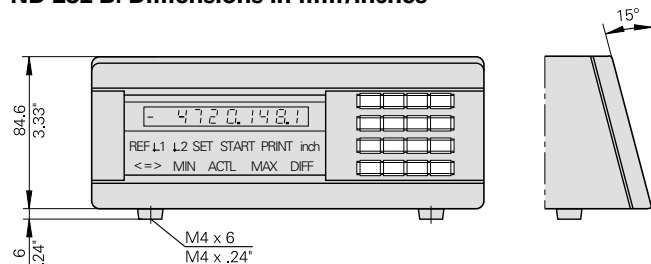
Specifications

Housing	ND 281 B Benchtop design, cast-metal housing (W · H · D) 239 mm · 84.6 mm · 224 mm
Operating temperature	0° to 45° C (32° to 113° F)
Storage temperature	–20 °C to 70 °C (–4 °F to 158 °F)
Weight	Approx. 1.5 kg (3.3 lb)
Relative humidity	< 75% annual average < 90% in rare cases
Power supply	Primary-clocked power supply 100 Vac to 240 Vac (–15% to +10%) 50 Hz to 60 Hz (± 2 Hz)
Line fuse	F 1 A inside the housing
Power consumption	8 W (typically)
Electromagnetic compatibility	Class B according to EN 55022

Noise immunity	As per VDE 0843 Parts 2 and 4, severity 4
Protection	IP40 according to IEC 529
Encoder inputs	For linear and angle encoders with sinusoidal output signals (11 μ A _{PP} /1 V _{PP}); Reference mark evaluation for distance- coded and single reference marks
Input frequency	X1 11 μ A _{PP} : Max. 100 kHz for 30 m cable length X2 1 V _{PP} : Max. 500 kHz for 60 m cable length
Display step	Adjustable
Datum points	Two
Functions	• Series of measurements ¹⁾ • Sorting and tolerance checking • Switching and sorting signals • Set display and reset display to zero with external signal • Measured value output
RS-232-C/V.24 Interface	Baud rates: 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19 200, 38 400 baud

¹⁾ Only in linear measurement mode.

ND 281 B: Dimensions in mm/inches



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