



HEIDENHAIN



User's Manual

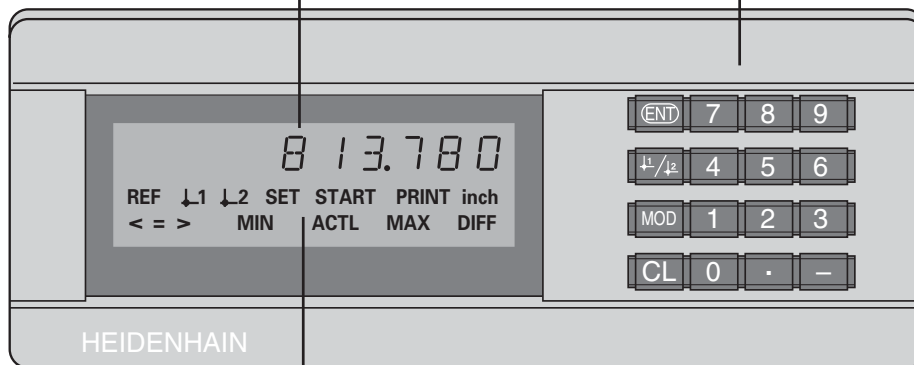
ND 221 B

Measured Value Displays







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

Numeric keypad with decimal point



Status display with indicators

Key	Function
	<ul style="list-style-type: none"> • Set datum • Transfer input value • Set display to value from P79 (P80!) • Leave parameter list
	<ul style="list-style-type: none"> • Select datum • Page backwards in parameter list
	<ul style="list-style-type: none"> • Select parameter after switch-on • Page forward in parameter list • Start measured value output "PRINT"
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • Algebraic sign • Reduce parameter value
	<ul style="list-style-type: none"> • Decimal point • Increase parameter value

Indicator	Meaning
REF	<p>If the decimal point is also blinking: Display is waiting for reference mark traversing.</p> <p>If decimal point is not blinking: Reference mark has been traversed—display stores datum points in nonvolatile memory.</p> <p>Blinking: display is waiting for ENT or CL to be depressed.</p>
inch	Position values in inches
	Selected datum point
PRINT	Measured value output with MOD key
SET	Blinking: Display is waiting for input values
< / = / > MIN / MAX / DIFF / ACTL / START	Without function

Items supplied with ND 221 B

ND 221 B Encoder input 11 μA_{PP}	Measured value display unit, benchtop model Id. Nr. 344 992-xx
Power cord	3 m (9.9 ft)
User's Manual	ND 221 B
Adhesive plug-in feet	For stacking ND 221B units



This manual is for the ND 221 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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Position Encoders and Reference Marks

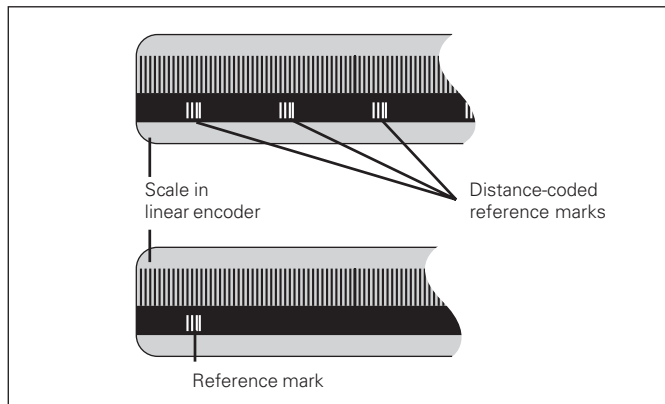
The ND 221 B display unit is designed for use with photoelectrical linear encoders with $11 \mu\text{A}_{\text{pp}}$ sinusoidal signals: primarily for HEIDENHAIN **MT length gauges** with $11 \mu\text{A}_{\text{pp}}$.

The MT length gauges have **one** reference mark. The scales of other photoelectric linear encoders (see "Linear 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 (signal period: 20 μm).

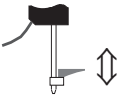


Reference marks on linear encoders

Switch-On, Traversing the Reference Marks

	<p>Turn on the power. (Switch located on rear panel.)</p> <ul style="list-style-type: none">• ND 221 B appears for two seconds.• ENT . . . CL ¹⁾ appears.• REF indicator is blinking.
ENT . . . CL	

	<p>Switch-on the reference mark evaluation function.</p> <ul style="list-style-type: none">• The position value that was last assigned to the reference mark position is displayed.• REF indicator lights up.• Decimal point is blinking.
5,697	

	<p>Cross over the reference mark. Move the plunger until the display starts counting and the decimal point stops blinking. The display is now ready for operation.</p>
---	---

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).



Select datum 1 or 2.

5

Enter numerical value (here, 5).

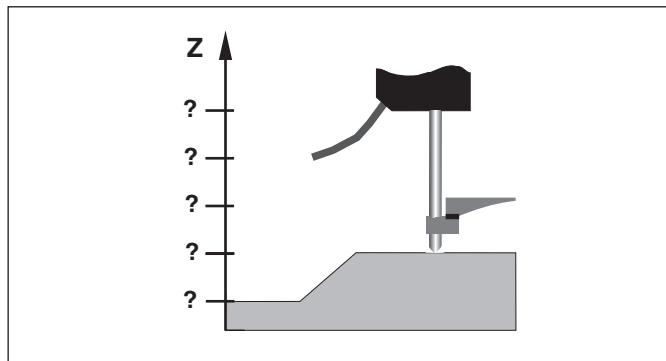
5



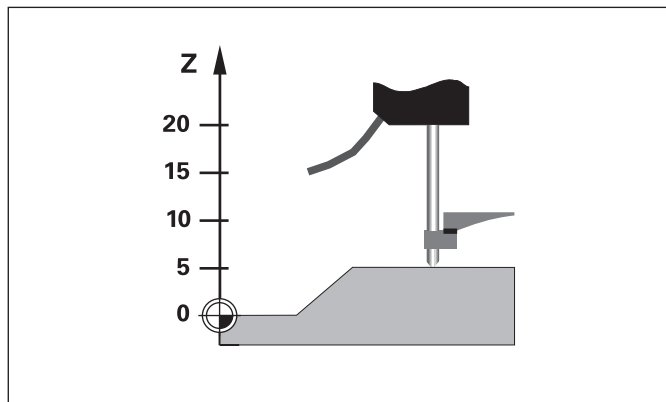
Confirm the entered numerical value.

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

Measured Value Output

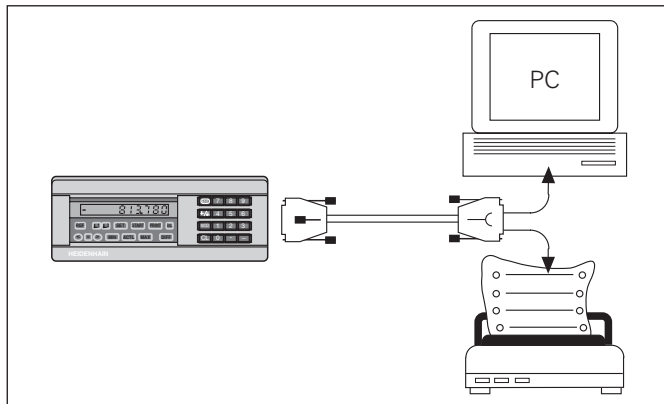


For technical information on the RS-232-C/V.24 data interface (X31), information on the data format, etc., see the chapter "RS-232-C/V.24 Interface (X31)."

Measured values can be output 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:

- ▶ Press the MOD key (check the parameter settings for P86).
- or**
- ▶ Input the command STX (Ctrl B) over the RXD input of the RS-232-C/V.24 interface (X31).



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

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 nonlinear axis error compensation. If this error recurs, contact your service agency!

¹⁾ These errors are important for the attached device.

Display	Effect/Cause
REC. PARAM.	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.

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 and X31 comply with the recommendations in EN 50 178 for separation from line power.

Encoder input X1

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

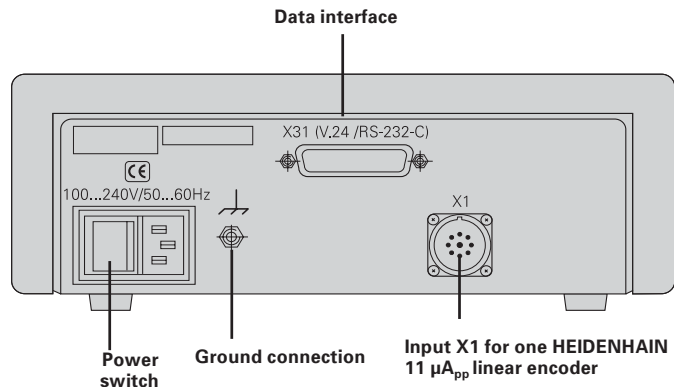
RS-232-C/V.24 data interface (X31)

25-pin D-sub connection (female)

Accessories

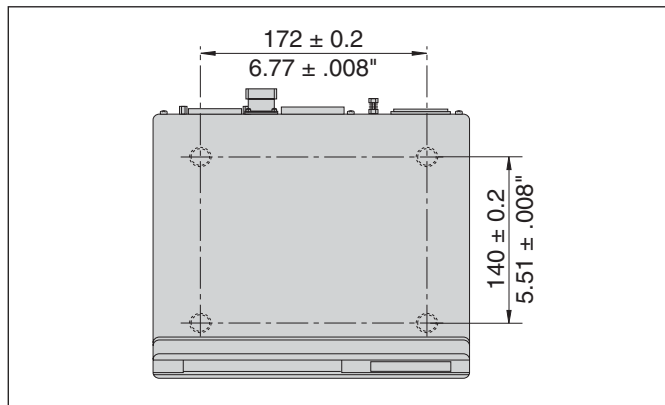
Connecting elements

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



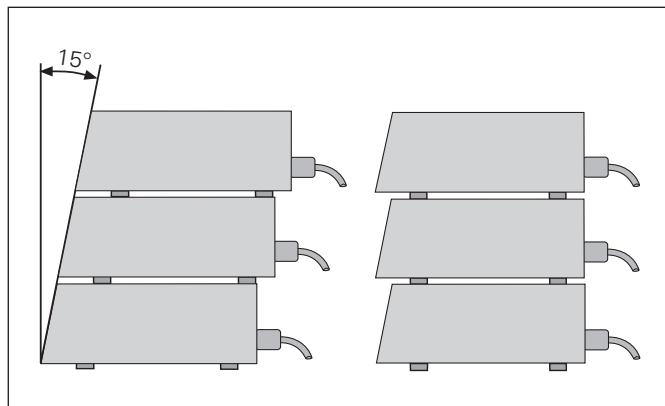
Mounting

You can fasten the **ND 221 B** from below by using M4 screws (see illustration at right).



Hole positions for mounting the ND display unit

ND 221 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 221 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)

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, 2). 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 95 148**:

- Select the user parameter P00 CODE.
- Enter the code number 95 148.
- 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, leave list of operating parameters	

A changed parameter is stored as soon as you

- leave 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 10 52 96: Nonlinear 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 measurement Display in millimeters MM Display in inches INCH
P11 SCL	Scaling factor Scaling factor off SCALING OFF Scaling factor on SCALING ON
P12 SCL	Scaling factor Enter a numerical value 0.100000 < P12 < 9.999999 Default setting: 1.000000
P30 DIR	Counting direction Positive counting direction with positive direction of traverse DIRECT. POS Negative counting direction with positive direction of traverse DIRECT. NEG

Parameter	Settings/ Function
P31 S. PER.	Signal period of encoder 0.000 000 01 < P31 < 99 999.9999 μm Default setting: 10 μm
P33 COUNT	Counting mode 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 DP POS	Decimal places ¹⁾ 1 / 2 / 3 / 4 / 5 / 6 (up to 8 for inch display)
P40 COMP.	Select encoder compensation No compensation COMP. OFF Nonlinear: up to 64 compensation points for linear encoders NONL. COMP Linear compensation COMP. ON

¹⁾ Depends on signal period (P31) and measuring unit (P01)

Parameter	Settings/ Function
P41 L.COMP.	Linear error compensation $-99\,999.9 < P41 < +99\,999.9$ [$\mu\text{m}/\text{m}$] Default setting: 0
Example: Find input value for P41 Displayed measuring length $L_a = 620.000$ mm Actual length (measured, e.g. with the VM 101 comparator system from HEIDENHAIN) $L_t = 619.877$ mm Length difference $\Delta L = L_t - L_a = -123$ μm Compensation factor k (= P41): $k = \Delta L / L_a = -123 \mu\text{m} / 0.62 \text{ m} \dots\dots\dots \mathbf{k = -198.4}$ [$\mu\text{m}/\text{m}$]	
P42 BKLASH	Backlash compensation 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 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. <hr/> Distance-coded with $500 \bullet \text{SP}$ (SP: signal period) 500 SP <hr/> Distance-coded with $1000 \bullet \text{SP}$ (e.g. for HEIDENHAIN LS ...C) 1000 SP <hr/> Distance-coded with $2000 \bullet \text{SP}$ 2000 SP <hr/> Distance-coded with $5000 \bullet \text{SP}$ 5000 SP
P44 REF	Reference mark evaluation Evaluate the reference mark REF. ON <hr/> Do not evaluate the reference mark REF. OFF
P45 ALARM	Encoder monitoring No monitoring ALARM OFF <hr/> Monitor the frequency FREQUENCY <hr/> Monitor contamination CONTAMINAT. <hr/> Contamination + frequency FRQ. + CONT.
P50 RS232	Baud rate $110 / 150 / 300 / 600 / 1200 /$ $2\,400 / 4\,800 / \mathbf{9\,600} / 19\,200 /$ $38\,400$ baud

Parameter	Settings / Function
P51 RS232	Additional blank lines during data output 0 ≤ P51 ≤ 99 Default setting: 1 BK LINE 1
P79 PRESET	Value for datum point Enter numerical value for datum setting with ENT key
P80 ENT-CL	Set display No set/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 DRO ON	Message after switch-on ENT . . . CL message MESSAGE ON No message MESSG. OFF
P86 MOD	PRINT via MOD disabled PRINT OFF PRINT via MOD enabled PRINT ON

Parameter	Settings / Function
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 221 B display unit is designed for use together with photoelectrical encoders with sinusoidal signals—11 μA_{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 μm

Desired display step 0.000 5 mm

Signal period (P31) 10

Counting mode (P33) 5

Decimal places (P38) 4

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

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

Model	Signal periods in μm	Reference marks	Millimeters			Inches		
			Display step in mm	Count mode	Decimal places	Display step in inches	Count mode	Decimal places
CT MT xx01	2	Single	0.0005	5	4	0.00002	2	5
LIP 401A/401R		Single	0.0002	2	4	0.00001	1	5
			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 LF 401/401C LIF 101/101C LIP 501/501C	4	Single/5000	0.001	1	3	0.00005	5	5
LIP 101		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
			0.00005	5	5	0.000002	2	6
			<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 LS 603/603C	20	Single/1000	0.01	1	2	0.0005	5	4
			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 33	P 38
LS 106/106C LS 406/406C LS 706/706C	20	Single/1000	0.001	1	3	0.00005	5	5		
0.0005			5	4	0.00002	2	5			
ST 1201		-								
LB 302/302C LIDA 10x/10xC	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 302</i>			0.0002	2	4	0.000001	1	5		
					0.0001	1	4	0.0000005	5	6
LB 301/301C	100	Single/1000	0.005	5	3	0.0002	2	4		
0.002			2	3	0.0001	1	4			
0.001			1	3	0.00005	5	5			
LIM 501	10240	Single	0.1	1	1	0.005	5	3		
0.01			1	2	0.0005	5	4			
0.05			5	2	0.002	2	3			

Nonlinear Axis Error Compensation



If you want to use the nonlinear 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).

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: 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:
The spacing of the compensation points is expressed as:
$$\text{Spacing} = 2 \times [\mu\text{m}].$$
Enter the value of the exponent x 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.

Table for determining the point spacing

Exponent	Point spacing	
	in mm	in inches
6	.064	.0023"
7	.128	.0050"
8	.256	.0100"
9	.512	.0200"
10	1.024	.0403"
11	2.048	.0806"
12	4.016	.1581"
13	8.192	.3225"
14	16.384	.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	41.25"

Selecting the compensation table, entering an axis correction

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

L/**I** Select P00 CODE.

P00 CODE

1 0 5 2 Enter the code number 10 52 96, confirm with ENT.

9 6 **ENT**

DATUM (shown for approx. two seconds)

2 7 **MOD** Enter the active datum for the error on the axis to be confirmed, e.g. 27 mm. Press MOD to select the next input box.

SPACING

1 0 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.)

4 x **MOD**

COMP. NR. 01

0 . 0 1 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).

2 x **MOD**

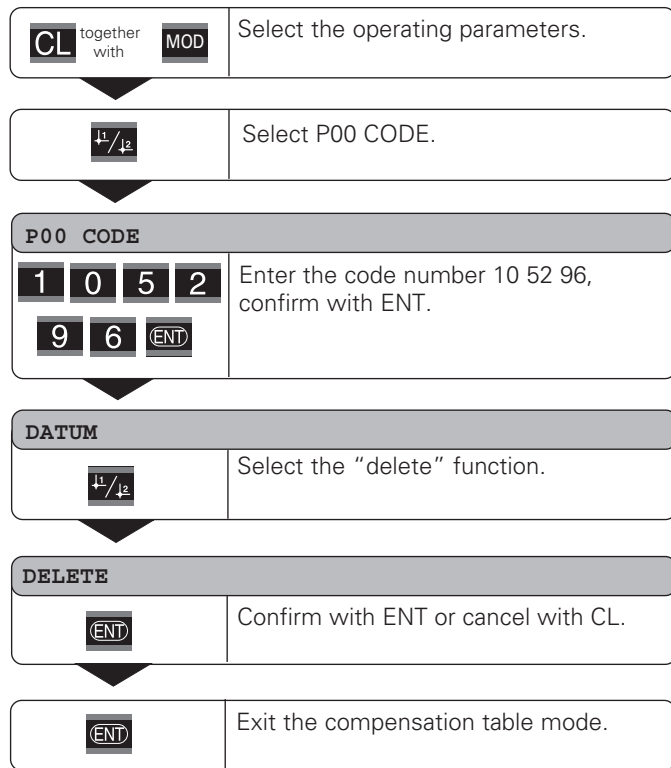
COMP. NR. 02

0 . 0 2 Enter all further compensation points. If you want so select a compensation point directly, press CL and simultaneously enter the desired compensation point number.

2 x **MOD**

ENT Conclude entry.

Deleting a compensation value table



Locking the Keypad

You can disable or re-enable 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 Display Mode

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 246 582**.

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

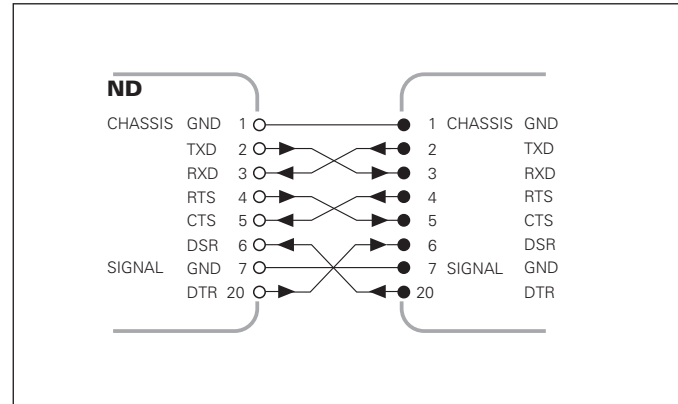
RS-232-C/V.24 Data Interface (X31)

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

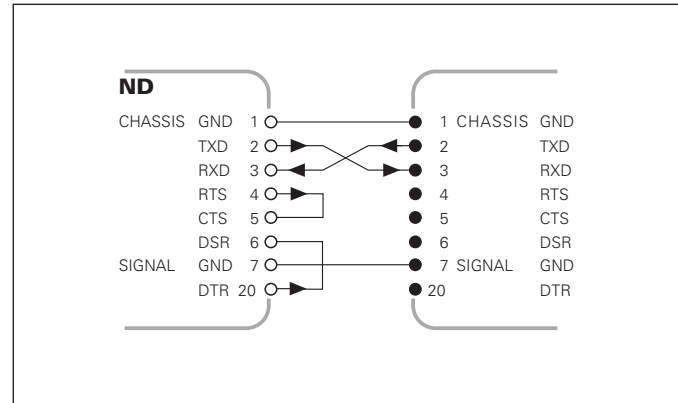
Connecting cable

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 (Id. Nr. 274 545-xx). On this type of cable, pin 6 and pin 8 are additionally connected over a jumper.

Maximum cable length: 20 m (66 ft)



Full wiring



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

Measured value output

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

- ① ② ③ ④ ⑤ ⑥ ⑦ ⑧
- ① Algebraic sign
 - ② Numerical value with decimal point (10 characters on the whole, leading zeros are output as blank spaces.)
 - ③ Blank space
 - ④ Unit:
Blank space = mm; " = inch; ? = fault
 - ⑤ Blank space
 - ⑥ 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

Duration of measured value transfer

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

Duration of storage and measured value transfer

The time required for data transfer depends on the selected baud rate and the number of additional blank lines.

Latch signal	Storage after	Data transfer after
STX (CTRL B)	≤ 1 ms	≤ 37 ms
PRINT (MOD key)	≤ 18 ms	≤ 36 ms

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 immediately 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 transmitted over the TXD line.

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

The basic program below shows the fundamental structure of a program for measured value output.

```
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 over "Ctrl B"

Input/Output of Parameter and Compensation-Value Lists

Calling the "data transfer" function:

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

↓/↕	Select P00 CODE.
------------	------------------

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

Data transfer function:

TRANSFER	
ENT	Continue with ENT.

SEND PARAM.	
if reqd. ENT •	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 to transmit or receive further lists. Press the decimal point key to continue in the data transmission menu.
or —	

REC. PARAM.	
if reqd. •	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.
or —	

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

REC. COMP.	
if reqd. •	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 to transmit or receive more lists. Continue in the data transfer menu with the decimal point key.
or —	

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 format 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".

Parameter List for ND 221 B: (factory default setting)

Parameter List

Parameter List				Description
*				Start character (*);
ND-221 B	MM			Device; MM or IN;
P01	MM =	MM =	0	Unit of measure : MM = 0; INCH = 1;
P11	SCL =	SCALING.OFF =	0	SCALING FACTOR OFF = 0; ON = 1;
P12	SCL =	1.000000		SCALING FACTOR = 1.000000; (value input without sign)
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 REFERENCE MARK = 0; 500;1000;2000;5000SP;
P44	REF =	REF. ON =	1	REF. ON = 1; REF. OFF = 0;
P45	ALARM =	FRQ. + CONT. =	3	OFF= 0; FRQ.= 1; CONT.= 2; FRQ+CONT. = 3;
P50	RS232 =	9600 BAUD =	9600	BAUD RATE = 9600; (110-38400)
P51	RS232 =	EMPTY LINE =	1	LINE FEES = 1; (0-99)
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 = 2;
P82	DRO.ON =	MESSAGE. ON =	1	DISPLAY: MESSAGE.ON = 1; MESSAGE.OFF = 0;
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

1st line: Start

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

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

3 characters

2nd line: Counter model designation

Output of model designation and unit of measure

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

13 characters

5 characters

2 characters

Model display unit, left-aligned

Unit of meas.

End of line

3rd line: Spacing of compensation points

Output of distance between compensation points

P	K	T	A	B	S	T	.								=					1	4	<CR>	<LF>
---	---	---	---	---	---	---	---	--	--	--	--	--	--	--	---	--	--	--	--	---	---	------	------

13 characters

3 char.

6 characters

2 char.

Point spacing left-aligned

Sep. block

Point spacing
right-aligned

End of line

Compensation value table for ND 221 B (length measurement): Factory default setting

Compensation value table

*			
ND-221 B		MM	
SPACING	=	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	=	_____	

*

Description:

Start character (*);
 Model of the unit; unit of measure (MM or IN);
 Point spacing = 14 (range: 6 – 20)
 Datum 0 mm (value input)
 Compensation value 0 = 0.000 mm (compensation value 0 is always 0)
 Compensation value 1 = no value entered
 Compensation value 2 – 63 no value entered (axis error is not compensated)
 Compensation value table is empty.

Final character (*);

Remote Operation over the RS-232-C/V.24 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 221 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 highlighted fields
<ESC>F0002<CR>	Print
<ESC>S0000<CR>	Counter RESET
<ESC>S0001<CR>	Lock keyboard
<ESC>S0002<CR>	Release keyboard

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	2	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	0	0	0	0	0	0	<CR>	<LF>
	a	b	c	d	e	f	g								

String: STX;

14 characters; CR; LF;

a = REF (reference point)

b = datum 1

c = datum 2

d = SET (set datum)

f = PRINT (data output)

g = inch (inch display)

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).

Print

Output of the current measured value. The measured value (string) is transmitted as described in the manual (page 30). 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. The keyboard can be unlocked either by sending the special function "Unlock keyboard" or by switching the display unit off and on.

Unlocking the keypad:

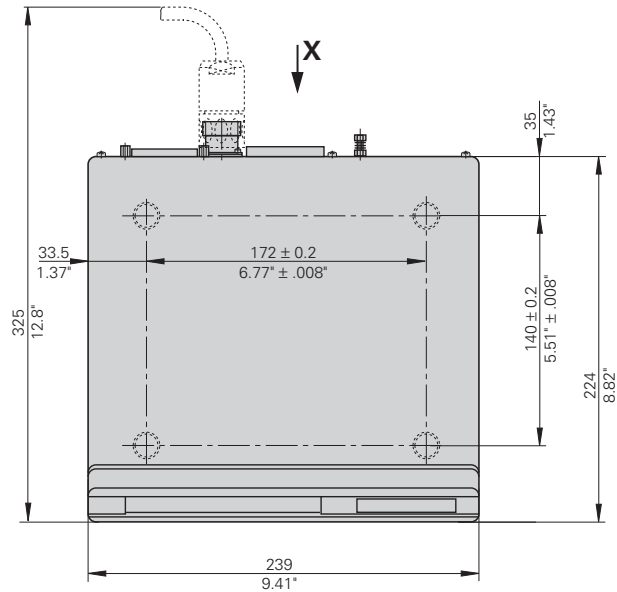
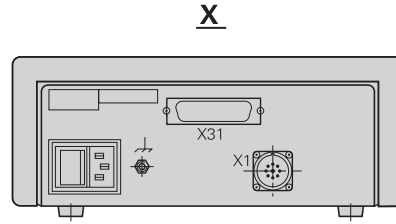
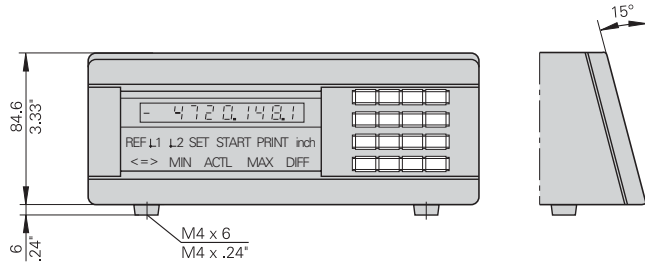
The display unit acknowledges the special function by sending the control character **ACK** (acknowledge). This unlocks a keyboard that has been locked with the special function "Lock keyboard."

Specifications

Housing	ND 221 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
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 encoders with sinusoidal output signals (11 μ A _{pp}); reference mark evaluation for distance-coded and single reference marks
Input frequency	ND 221 B 11 μ A _{pp} : Max. 100 kHz for 30 m cable length
Display step	Adjustable (see "Linear Encoders")
Datum points	Two
RS-232-C/V.24 interface	Baud rates: 110, 150, 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, 38 400 baud

ND 221 B: Dimensions in mm/inches



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