# HEIDENHAIN

**User's Manual**

# ND 281 B

**Measured Value Displays**

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

**Numeric keypad with decimal point**

```
    8 13.780
REF  ⌄1 ⌄2  SET  START  PRINT  inch
< = >      MIN    ACTL   MAX    DIFF
```

ENT  7  8  9

⌄1/⌄2  4  5  6

MOD  1  2  3

CL  0  ·  −

HEIDENHAIN
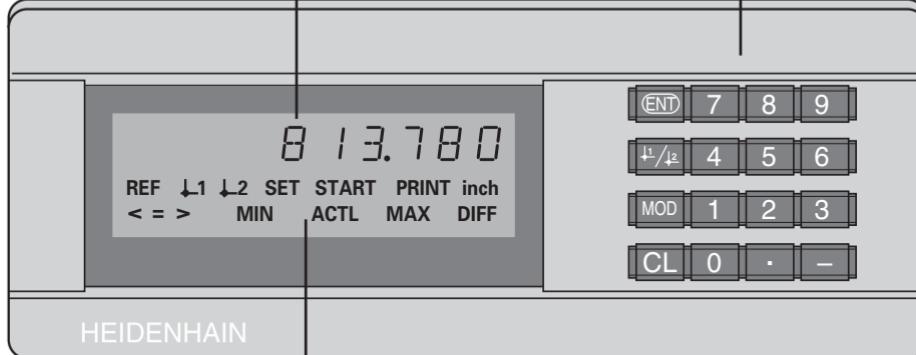
**Status display with indicators**

| Key | Function |
|---|---|
| (ENT) | • Set datum<br>• Transfer input value<br>• Set display to value from P79 (P80!)<br>• Leave parameter list |
| ⌊1/⌊2 | • Select datum<br>• Page backwards in parameter list |
| MOD | • Select parameter after switch-on<br>• Page forward in parameter list<br>• Start series of measurements [1]<br>• Switch display for measurement series [1]<br>• Start measured value output "PRINT" |
| CL | • Delete entry<br>• Set display to zero (P80!)<br>• CL plus MOD: select parameter list<br>• CL plus number: select parameter<br>• Delete parameter input and show parameter number |
| — | • Algebraic sign<br>• Reduce parameter value |
| • | • Decimal point<br>• Increase parameter value |

[1] Only in linear measurement mode.

| 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<br>**Blinking:** display is waiting for ENT or CL to be depressed |
| **inch** | Position values in inches |
| ⌊1 / ⌊2 | Selected datum point |
| **PRINT** | **"Linear measurement"**<br>**Blinking:** Display is waiting for ENT to be pressed for data output<br>**"Angular measurement"**<br>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<br>**Blinking:** Confirm selection or deselect function |
| **START [1]** | Series of measurements is running<br>**Blinking:** Display is waiting for signal to start series of measurements |

| 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.

# Contents

## Working with the ND Display Units

[1] Only in linear measurement mode

## Installation and Specifications

## 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 $\mu A_{PP}$ sinusoidal current signals and X2 for 1 $V_{PP}$ sinusoidal voltage signals.

Before shipping, HEIDENHAIN activates the encoder connection X1 for 11 $\mu A_{PP}$ 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.
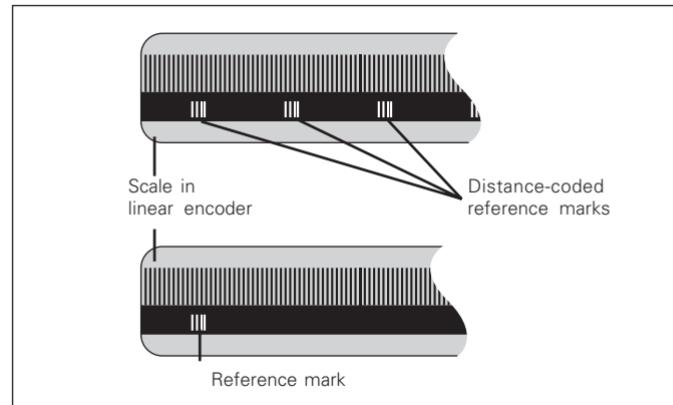


Reference marks on linear encoders

## Switch-On, Traversing the Reference Marks
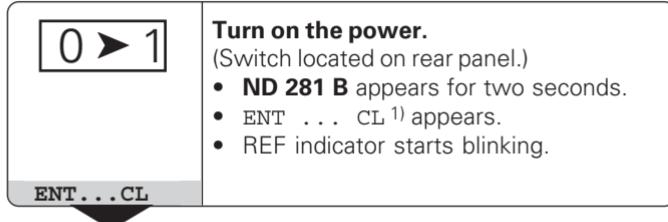
| | |
|---|---|
| `0 ➤ 1` <br><br> **ENT...CL** | **Turn on the power.** <br> (Switch located on rear panel.) <br> • **ND 281 B** appears for two seconds. <br> • `ENT ... CL` [1] appears. <br> • REF indicator starts blinking. |
| (ENT) <br><br> **5 , 6 9 7** | **Switch-on the reference mark evaluation function.** <br> • The position value that was last assigned to the reference mark position is displayed. <br> • REF indicator lights. <br> • Decimal point starts blinking. |
| ⇕ | **Cross over the reference mark.** <br> Move the plunger until the display starts counting and the decimal point stops blinking. The display is now ready for operation. |
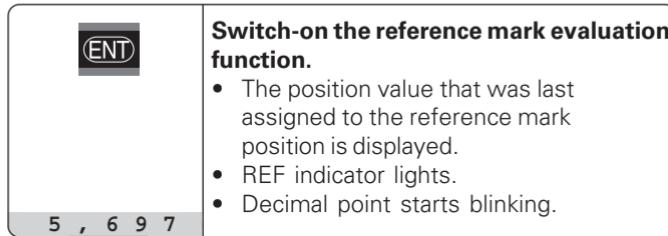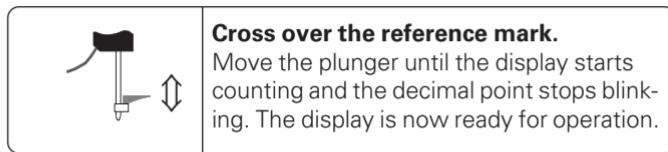
For automation purposes, crossing over the reference marks and the display ENT ... CL can be disabled with parameter P82.

### 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

| | |
|---|---|
| $\boxed{↓^1/↓^2}$ | **Select datum** 1 or 2. |

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

| | |
|---|---|
| (ENT) | **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.
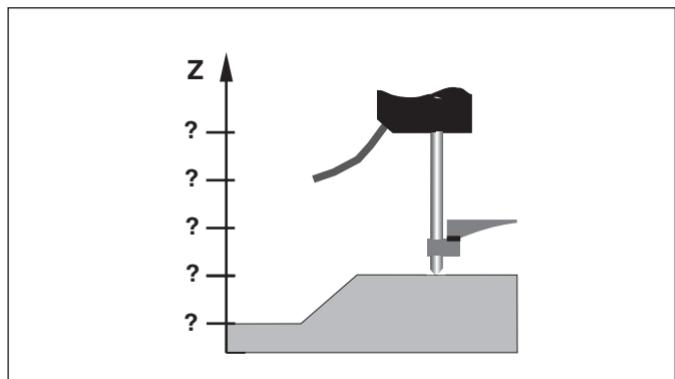


Without datum setting: unknown assignment of measured values to positions
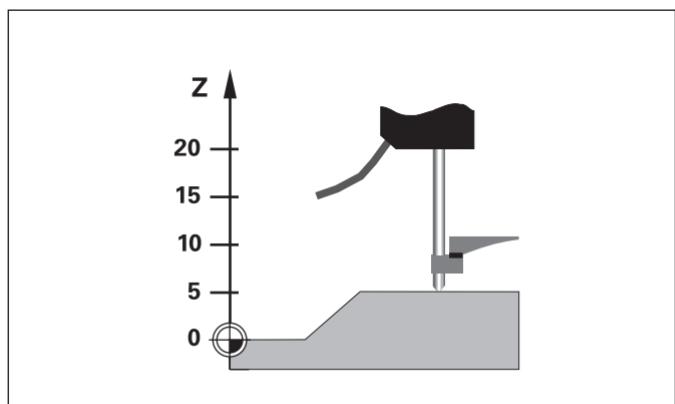


After datum setting: Assignment of measured values to positions

## Finding Minimum and Maximum Values from a Series of Measurements [1)

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.

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[1) Only in the linear measurement mode.
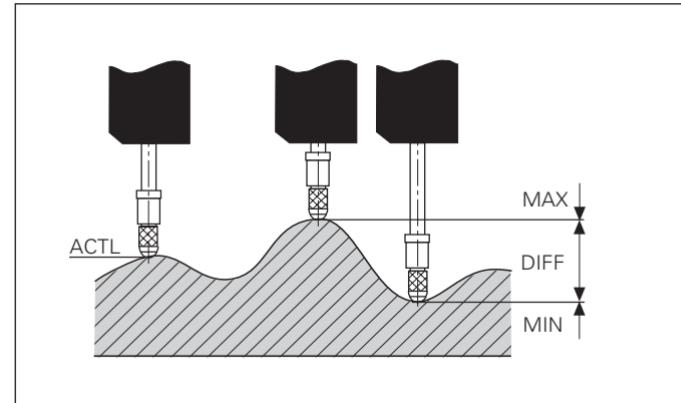


Series of measurements: The MIN, MAX and DIFF values of an uneven surface



$$2e = r_{MAX} - r_{MIN}$$

$$e = \frac{DIFF}{2}$$
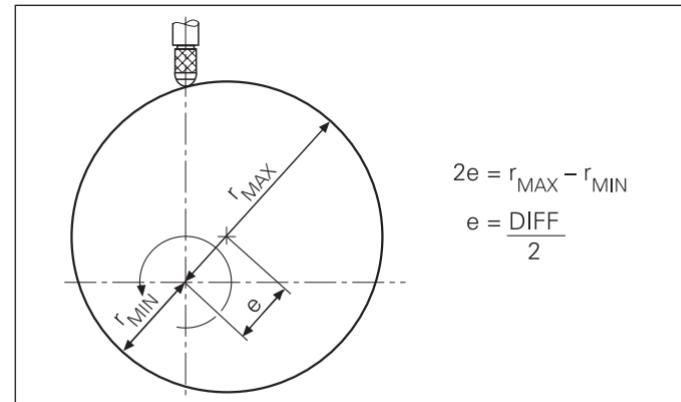
Example: Measurement series for determining eccentricity *e*

## Starting a series of measurements

| | |
|---|---|
| **Repeatedly**<br>MOD<br>MAX | **Select the display for a series of measurements.**<br>The selected indicator starts blinking (here, MAX). |
| ENT | **Confirm selection.** |
| **Repeatedly**<br>MOD<br>START | ... until the START indicator starts blinking. |
| ENT | **Start the series of measurements.** |
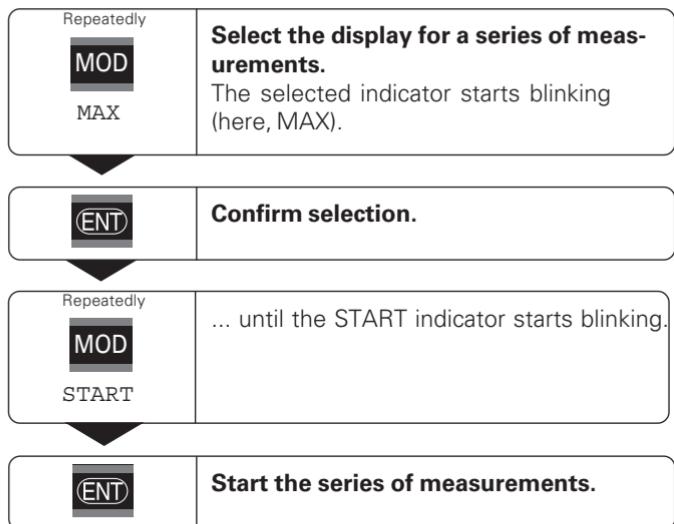
### Indicator preselection

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").

| | |
|---|---|
| **Repeatedly**<br>MOD<br>MIN | **Select the new display of a series of measurements.**<br>The selected indicator starts blinking (here, MIN). |
| ENT | **Confirm the change.** |
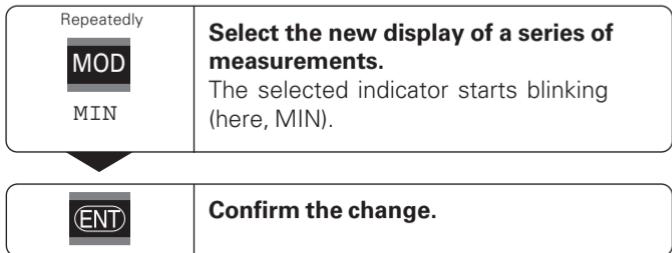
The display now shows the smallest value measured during the current series of measurements.

Starting a new series of measurements

## Starting a new series of measurements

| Repeatedly<br>**MOD**<br>START | **Select the indicator START.**<br>The START indicator starts blinking. |
| --- | --- |

| **ENT** | **Start a new series of measurements.** |
| --- | --- |

## Ending a series of measurements

| Repeatedly<br>**MOD** | **Select the active indicator (MIN, ACTL, MAX, DIFF).**<br>The indicator that lit up last starts blinking. |
| --- | --- |

| **ENT** | **End the series of measurements.** |
| --- | --- |

**or**

| Repeatedly<br>**MOD**<br>START | **Select the indicator START.**<br>The START indicator starts blinking. |
| --- | --- |

| **CL** | **End the series of measurements.** |
| --- | --- |

## 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 |
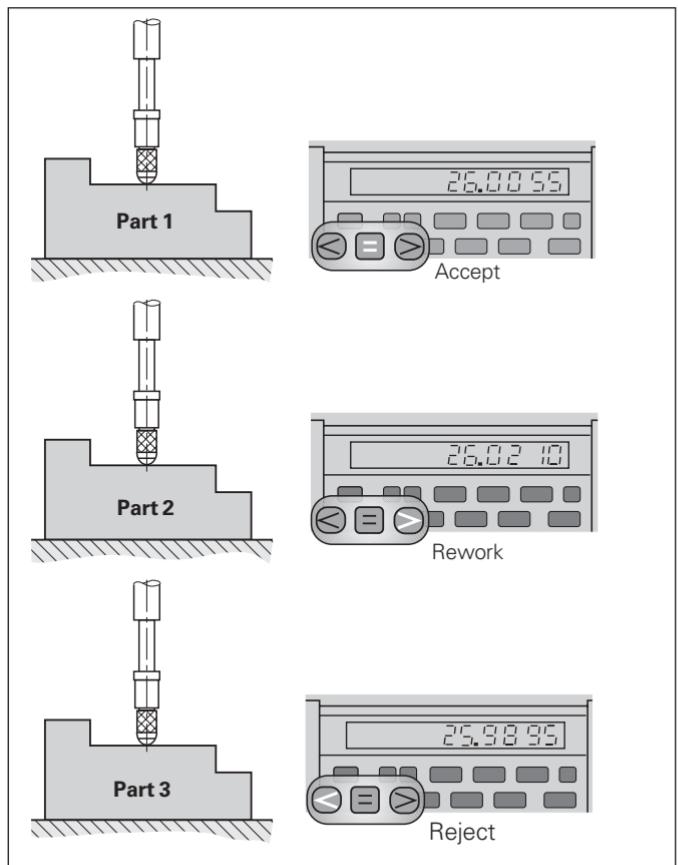


Example:  Upper sorting limit = 26.02 mm
Lower sorting limit = 26.00 mm

## 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).
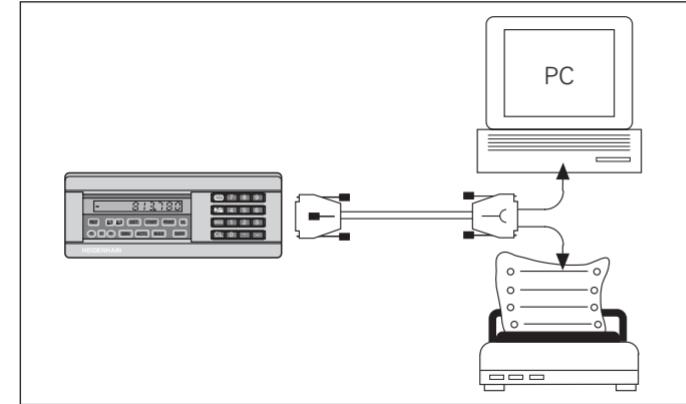


The RS-232-C/V.24 interface (X31) enables you to connect a printer or a PC to your display unit

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## 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.

| Position | | | |
|---|---|---|---|

Position scale: 0 5 10 15 20 25 30

Latch signal

Frozen display:
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 **0.000 0.014** 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 **0.014 0.030** 0.030 0.030 0.030

Frozen/concurrent display:
0.000 0.000 0.000 **0.000 0.004** 0.005 0.006 0.007 0.008 0.009 0.010 0.011 0.012 **0.013 0.014** 0.014 0.014 0.014 0.014 0.014 0.014 **0.014 0.023** 0.024 0.025 0.026 0.027 0.028 **0.029 0.030** 0.030 0.030 0.030

## 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 $\mu A_{PP}$ |
| 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 |

**Data interface**

**D-sub connection**

X31 (V.24 /RS-232-C)    X41 (EXT)

100...240V/50...60Hz

X1    X2

**Power switch**

**Ground connection**

**Input X1 for one HEIDENHAIN 11 $\mu A_{PP}$ encoder**

**Input X2 for one HEIDENHAIN 1 $V_{PP}$ encoder**
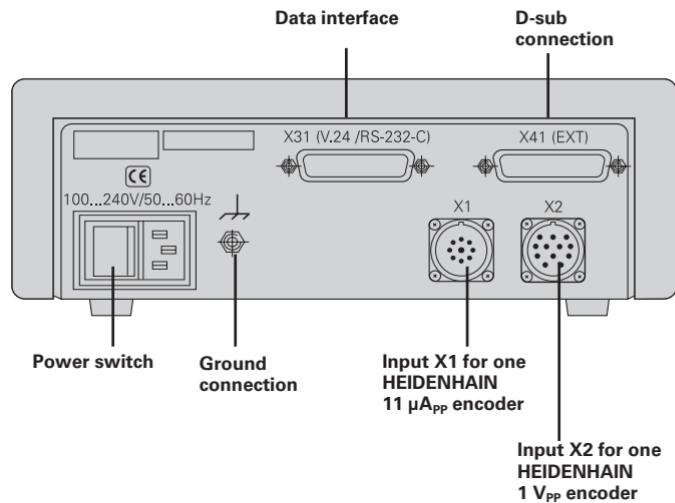
## Mounting

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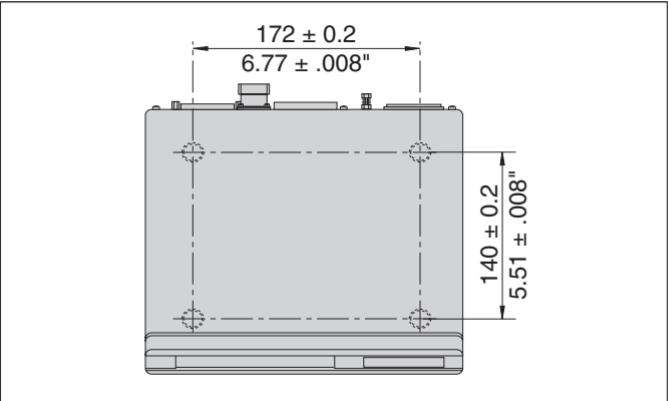


Hole positions for mounting the ND display unit

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.
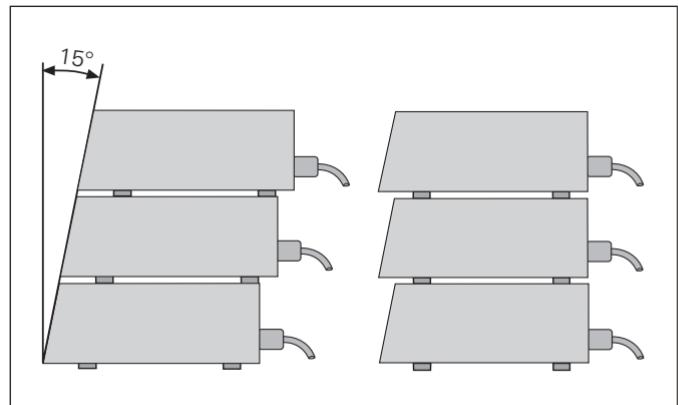


Alternatives of stacking the display units

## 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 mm$^2$

**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 mm$^2$)

## 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:<br><br>MOD | Display first user parameter. |

**... during operation:**

| Together:<br><br>CL   MOD | Display first user parameter. |

**To go directly to a user parameter:**

| Together:<br><br>CL   1 | Press and hold CL while entering the first digit of the parameter number (here, 1). |
| 9 | Enter the second digit of the parameter number (here, 9).<br>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 | MOD |
| Page backward in the list of operating parameters | ↓1/↓2 |
| Reduce parameter value | — |
| Increase parameter value | • |
| Correct entry and display parameter designations | CL |
| Confirm change or numerical entry, exit the list of operating parameters | ENT |

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 measurement** [1] | |
| | 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 mode** [2] | |
| | Decimal degrees | **DEC. DEGREE** |
| | Deg., minutes, seconds | DEG.MIN.SEC. |

| | | |
|---|---|---|
| P09 ANGLE | **Angle display** [2] | |
| | +/- 180° | **+/- 180 DEG.** |
| | +/- ∞ | ENDLESS |
| | 360° | 360 DEG. |
| P11 SCL | **Scaling factor** [1] | |
| | Scaling factor off | **SCALING OFF** |
| | Scaling factor on | SCALNG. ON |
| P12 SCL | **Scaling factor** [1] | |
| | 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 measurements** [1] | |
| | **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** <br> **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** <br> 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** <br> 0.000 000 01 < P31 < 99 999.9999 <br> 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]** <br> 1 < P36 < 999 999 <br> 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]** <br> 1 / 2 / 3 / **4** / 5 / 6 <br> (up to 8 for inch display) |
| P40 COMP. | Select **encoder compensation** <br> 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] –<br>99 999.9 < P41 < + 99 999.9 [μm/m]<br>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):
$k = \Delta L / L_d = -123$ μm / 0.62 m ....... **k = –198.4** [μm/m]

| Parameter | Settings / Function |
|---|---|
| P42 BACKLASH | **Backlash compensation** [1]<br>Input range (mm):  +9.999 to -9.999 |
| | Default setting: **0.000**<br>= no backlash compensation |
| | During a change in direction, the mechanical play between the encoder and table, the so-called backlash, can cause error.<br>Positive backlash: The rotary encoder moves before the table, therefore the display value is too high (positive value input).<br>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**<br>One reference mark  **SINGLE REF.** |
| | Distance-coded with  500 • SP<br>(SP: signal period)  500 SP |
| | Distance-coded with 1000 • SP<br>(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**<br>Evaluate the reference mark  **REF. ON** |
| | Do not evaluate the reference<br>mark  REF. OFF |
| P45 ALARM | **Encoder monitoring**<br>No monitoring  ALARM OFF |
| | Monitor the frequency  FREQUENCY |
| | Monitor contamination  CONTAMINAT. |
| | Contamination + frequency  **FRQ. + CONT.** |
| P50 RS232 | **Baud rate**<br>110 / 150 / 300 / 600 / 1200 /<br>2400 / 4800 / **9600** / 19 200 /<br>38 400 baud |

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[1] Only in linear measurement mode.

| Parameter | Settings / Function | | Parameter | Settings / Function | |
|-----------|---------------------|--|-----------|---------------------|--|
| P51 RS232 | **Additional blank lines during data output** 0 ≤ P51 ≤ 99 Default setting: **1** | BK LINE 1 | P86 MOD | In the **linear measurement** mode First indicator after pressing MOD **START**     PRINT MIN    ACTL    MAX    DIFF | |
| P62 A1 | **Trigger limit 1** | | | In the **angular measurement** mode PRINT via MOD disabled | **PRINT OFF** |
| P63 A2 | **Trigger limit 2** | | | PRINT via MOD enabled | PRINT ON |
| P79 PRESET | **Value for datum point** Enter numerical value for datum setting over switching input or with ENT key | | P98 LANGUA. | **Conversational language** German | **LANGUAGE DE** |
| P80 ENT-CL | **Set display** No zero reset/Set with CL/ENT | **CL-ENT OFF** | | English | LANGUAGE EN |
| | Zero reset with CL setting disabled with ENT | CL......ON | | French | LANGUAGE FR |
| | Zero reset with CL and set with ENT to value selected in P79 | CL-ENT ON | | Italian | LANGUAGE IT |
| P82 DISPL.ON | **Message after switch-on** ENT...CL message | **MESSAGE ON** | | Dutch | LANGUAGE NL |
| | No message | MESSG. OFF | | Spanish | LANGUAGE ES |
| P85 EXT.REF | **External REF** REF over D-sub port EXT | EXT.REF ON | | Danish | LANGUAGE DA |
| | No REF over D-sub port EXT | **EXT.REF OFF** | | 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 $\mu A_{PP}$ 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 µm

Desired display step ................. 0.000 5 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<br>MT xx01 | 2 | Single | 0.0005<br>0.0002 | 5<br>2 | 4<br>4 | 0.00002<br>0.00001 | 2<br>1 | 5<br>5 |
| LIP 401A/401R | | Single | 0.0001<br>0.00005 | 1<br>5 | 4<br>5 | 0.000005<br>0.000002 | 5<br>2 | 6<br>6 |
| | | | *Recommd. only for LIP 401*<br>0.00002<br>0.00001<br>0.000005 | 2<br>1<br>5 | 5<br>5<br>6 | 0.000001<br>0.0000005<br>0.0000002 | 1<br>5<br>2 | 6<br>7<br>7 |
| LF 103/103C<br>LF 401/401C<br>LIF 101/101C<br>LIP 501/501C | 4 | Single/5000 | 0.001<br>0.0005<br>0.0002<br>0.0001 | 1<br>5<br>2<br>1 | 3<br>4<br>4<br>4 | 0.00005<br>0.00002<br>0.00001<br>0.000005 | 5<br>2<br>1<br>5 | 5<br>5<br>5<br>6 |
| LIP 101 | | Single | 0.00005 | 5 | 5 | 0.000002 | 2 | 6 |
| | | | *Recommd. only for LIP 101*<br>0.00002<br>0.00001 | 2<br>1 | 5<br>5 | 0.000001<br>0.0000005 | 1<br>5 | 6<br>7 |
| MT xx | 10 | Single | 0.0005<br>0.0002<br>0.0001 | 5<br>2<br>1 | 4<br>4<br>4 | 0.00002<br>0.00001<br>0.000005 | 2<br>1<br>5 | 5<br>5<br>6 |
| LS 303/303C<br>LS 603/603C | 20 | Single/1000 | 0.01<br>0.005 | 1<br>5 | 2<br>3 | 0.0005<br>0.0002 | 5<br>2 | 4<br>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 |
| | | | *Recommd. only for  LB 302* 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<br>0.000001 | 2<br>1 | 6<br>6 | 0.0000001<br>0.00000005 | 1<br>5 | 7<br>8 |
| MT xx81<br>LIP 481A/481R | 2 | Single | 0.0005<br>0.0002<br>0.0001<br>0.00005 | 5<br>2<br>1<br>5 | 4<br>4<br>4<br>5 | 0.00002<br>0.00001<br>0.000005<br>0.000002 | 2<br>1<br>5<br>2 | 5<br>5<br>6<br>6 |
| | | | *Recommd. only for LIP 481 X*<br>0.00002<br>0.00001<br>0.000005 | 2<br>1<br>5 | 5<br>5<br>6 | 0.000001<br>0.0000005<br>0.0000002 | 1<br>5<br>2 | 6<br>7<br>7 |
| LF 183/183C<br>LF 481/481C<br>LIF 181/181C<br>LIP 581/581C | 4 | Single/5000 | 0.001<br>0.0005<br>0.0002<br>0.0001 | 1<br>5<br>2<br>1 | 3<br>4<br>4<br>4 | 0.00005<br>0.00002<br>0.00001<br>0.000005 | 5<br>2<br>1<br>5 | 5<br>5<br>5<br>6 |
| VM 182 | | - | 0.00005 | 5 | 5 | 0.000002 | 2 | 6 |
| | | | *Recommd. only for VM 182*<br>0.00002<br>0.00001 | 2<br>1 | 5<br>5 | 0.000001<br>0.0000005 | 1<br>5 | 6<br>7 |
| LS 186/186C<br>LS 486/486C | 20 | Single/1000 | 0.001<br>0.0005 | 1<br>5 | 3<br>4 | 0.00005<br>0.00002 | 5<br>2 | 5<br>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 |
| | | | *Recommd. only for LB 382* | | | | | |
| | | | 0.0002 | 2 | 4 | 0.00001 | 1 | 5 |
| | | | 0.0001 | 1 | 4 | 0.000005 | 5 | 6 |
| LB 381/381C | 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 |

**Recommended parameter settings for HEIDENHAIN angle encoders with 11 µA$_{PP}$ / 1 V$_{PP}$ signals**

| Model | Signal periods per revolution | Reference marks | | Display step | | Count. mode | Decimal places |
|---|---|---|---|---|---|---|---|
| | P36 | | P43 | | | P37 | P38 |
| ROD 450 / <br> ROD 456 / ROD 486 <br> / ROD 1080 | 3600 | One | Single | 0.01° <br> 0.005° <br> 0.001° | | 1 <br> 5 <br> 1 | <br> 3 <br> 3 |
| ROD 250 C / ROD 280 C <br> RON 255 C / RON 285 C | 9000 | Dist.-coded | 500 | 0.005° <br> 0.001° | | 5 <br> 1 | 3 <br> 3 |
| ROD 250 C / ROD 280 C <br> ROD 255 C / RON 285 C <br> ROD 700 C / ROD 780 C <br> RON 705 C / RON 785 C <br> RON 706 C / RON 786 C | 18 000 | Dist.-coded | 1000 | 0.001° <br> 0.0005° <br> 0.0001° | | 1 <br> 5 <br> 1 | 3 <br> 4 <br> 4 |
| RON 905 / | 36 000 | One | Single | 0.0001° | | 1 | 4 |
| ROD 800 C / ROD 880 C <br> 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") ≈ 0.000278°

# 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).

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:
  $$\text{Spacing} = 2^x \, [\mu m].$$
  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

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**Table for determining the point spacing**

| Exponent | Point spacing | |
|---|---|---|
| | in mm | in inches |
| 6 | 0.064 | 0.0023″ |
| 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 | 4.016 | 0.1581″ |
| 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 | 41.25″ |

**Selecting the compensation table, entering an axis correction**

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

| | |
|---|---|
| ⌐₁/₁₂⌐ | Select P00 CODE. |

**P00 CODE**

| | |
|---|---|
| 1 0 5 2 <br> 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 <br> 4 x MOD | Enter the spacing of the compensation points on the axis to be corrected, for example $2^{10}$ μm (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 <br> 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 <br> 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

**Deleting a compensation value table**

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

| | |
|---|---|
| ↑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**

| | |
|---|---|
| ↑¹/↓² | Select the "delete" function. |

**DELETE**

| | |
|---|---|
| **ENT** | Confirm with ENT or cancel with CL. |

| | |
|---|---|
| **ENT** | Exit the compensation table mode. |
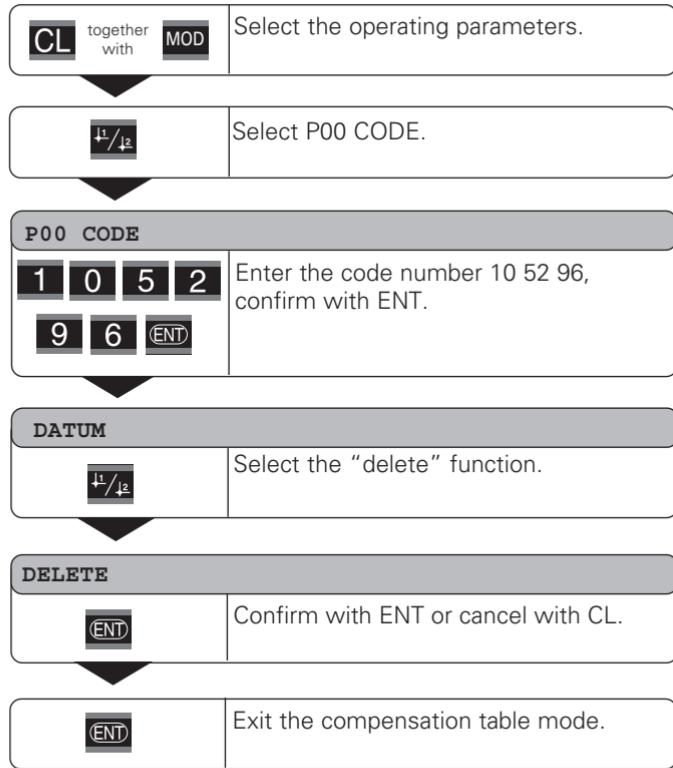
# Switching Inputs and Outputs EXT (X41)

⚠ **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 ≥ trigger limit A1 (P62) |
| 16 | Measured value ≥ 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 | *Do not assign* |
| 11, 20, 21 | *Vacant* |

### 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$\Omega$, 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 | $+ 3.9$ V $\leq$ U $\leq + 15$ V |
| Low | $- 0.5$ V $\leq$ U $\leq + 0.9$ V; I $\leq 6$ mA |
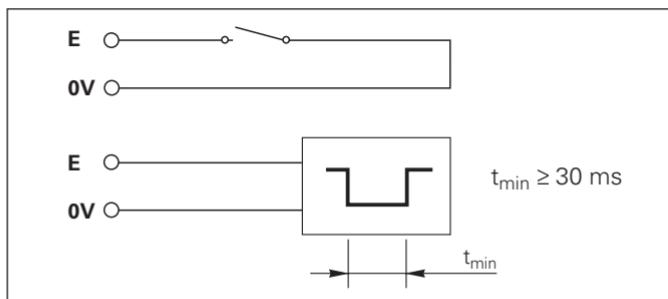


## Outputs

| 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 $\leq + 32$ V; I $\leq 10$ µA |
| Low | U $\leq + 0.4$ V; I $\leq 100$ mA |
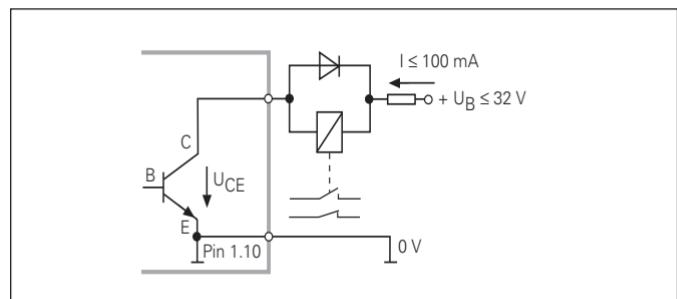
### Setting and zero resetting the display

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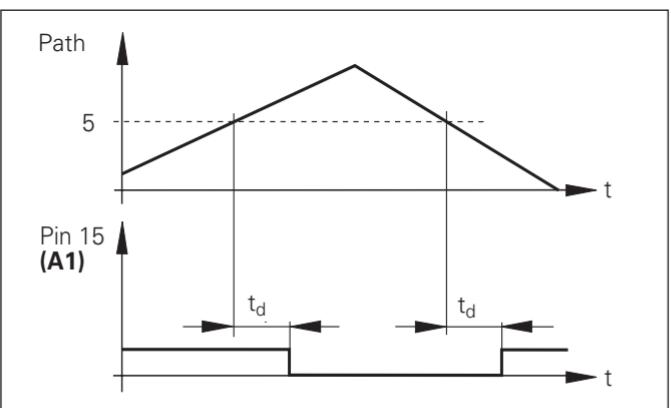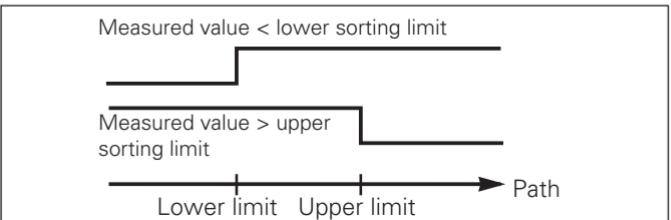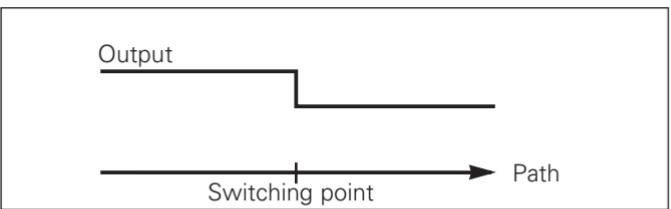
Time curve of signal at pin 15 for trigger limit (A1) = 5 mm , $t_d \leq 30$ ms

**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.



Error
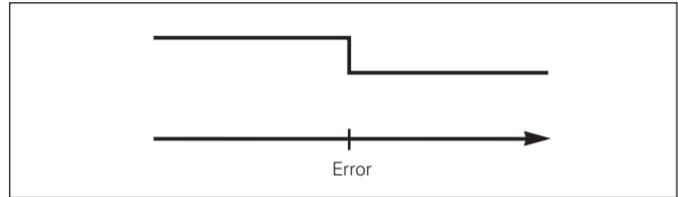
**Locking the Keypad**

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.
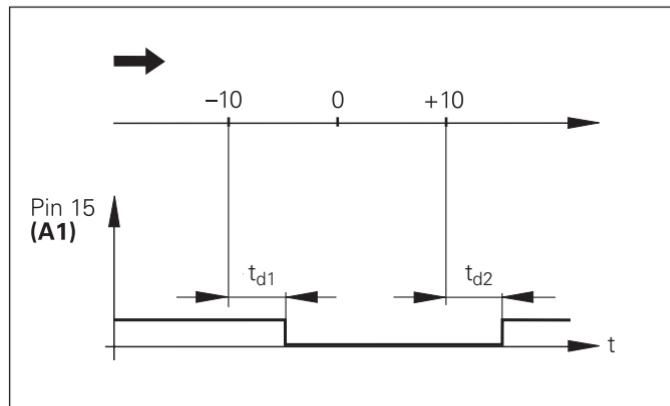


Time curve of a signal for switching limit (A1) = 10 mm, $t_{d1} \leq 30$ ms, $t_{d2} \leq 180$ ms

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

**Maximum cable length:** 20 m (66 ft)
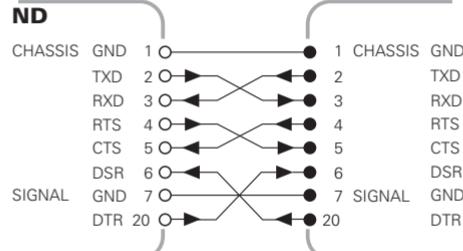


Full wiring
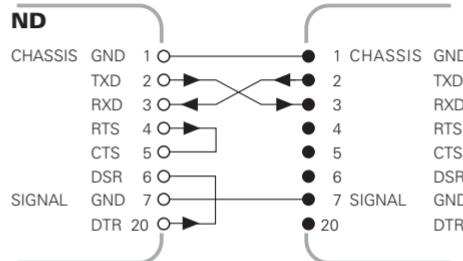


Simplified wiring

## 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 | – | *Not assigned* |
| 20 | DTR | Data terminal ready |
| 21 to 25 | – | *Not assigned* |

## 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<br>7 data bits<br>Even parity bit<br>2 stop bits |
|-------------|------------------------------------------|
| Control characters | Call measured value: STX (Ctrl B)<br>Interrupt DC3 (Ctrl S)<br>Continue DC1 (Ctrl Q)<br>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 | 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.) (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**

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

**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 | $t_e \geq 7$ ms |
| Minimum duration of "Pulse" signal | $t_e \geq 1.5$ µs |
| Storage delay after "Contact" | $t_1 \leq 5$ ms |
| Storage delay after "Pulse" | $t_1 \leq 1$ µs |
| Measured value output after | $t_2 \leq 57$ ms |
| Regeneration time | $t_3 \geq 0$ |

## Duration of measured value transfer

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



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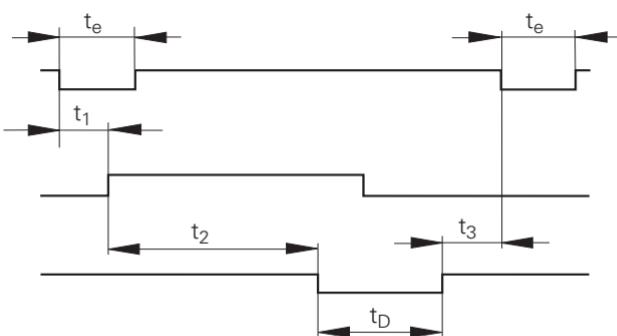


Signal transit times for measured value output after "Pulse" or "Contact"

## 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 | $t_1 \leq 1$ ms |
| Measured value output after | $t_2 \leq 50$ 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

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

```
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"
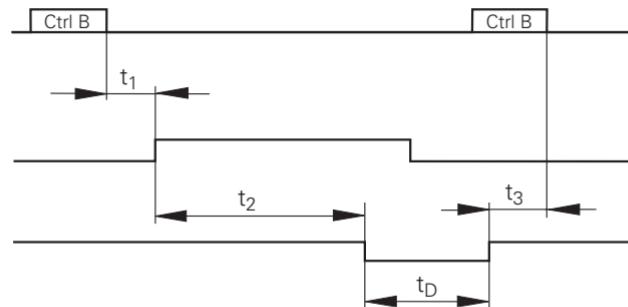


Propagation times for measured value output after "Ctrl B"

## 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 5 3 ENT | Enter the code number 48 61 53 and confirm with 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 tranfer 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 | 5 characters | 2 characters |
|---|---|---|
| Model of display unit | Unit of meas. | 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 11µAPP = 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

```
*
ND-281 B        DEC
P02     X1/X2 =     X1 11 uAPP =        0
P08     DISPL. =    DEC. DEGREE =       0
P09     ANGLE =     +/-180 DEG. =       0
P17     CLASS =     CLASS. OFF =        0
P18  L.CLASS. =     +    0.0000
P19  U.CLASS. =     +    0.0000
P23     DISPL. =    DISPL. ACTL. =      0
P30       DIR =     DIRECT. POS =       0
P36      SP/R =         36000
P37      STEP =        COUNT 0-5 =      5
P38      DEC. =      DP POS. 4 =        4
P40     COMP. =      COMP. OFF =        0
P43      REF =     SINGLE REF. =        0
P44      REF =       REF.   ON =        1
P45     ALARM =     FRQ.+ CONT. =       3
P50     RS232 =       9600 BAUD =    9600
P51     RS232 =      BK LINE  1 =       1
P62       A1 =      +    0.0000
P63       A2 =      +    0.0000
P79    PRESET =      +    0.0000
P80    ENT-CL =     CL-ENT OFF =        0
P82  DISPL.ON =     ENT..CL ON =        1
P85   EXT.REF =     EXT.REF OFF =       0
P86       MOD =      PRINT OFF =        0
P98   LANGUA. =     LANGUAGE DE =       1
*
```

## Description

Start character (*);
Model of display unit;   DEC (decimal) or DMS (min-sec);
Encoder input: X1 11µAPP = 0;  X2 1VPP = 1;
Display: DEC.DEGREE = 0;  DEG.MIN.SEC = 1;
Angle: +/- 180 DEG. = 0; 360 DEG. = 1; ENDLESS = 2;
Sorting: CLASS. OFF = 0;  CLASS. ON = 1;
Lower limit: L.CLASS = 0; (value input)
Upper limit: U.CLASS = 0; (value input)
DISPLAY: ACTUAL = 0; HOLD = 1; STOP = 2;
COUNTING DIRECTION  POS = 0; NEG = 1;
SIGNAL PERIODS / R = 36000  (value input);
COUNTING MODE  0-5 = 5;  0-2  = 2;  0-1 = 1;
DECIMAL PLACES 4  (range: 1-8)
COMPENSATION OFF = 0;  LIN = 1;  MULTI = 2;
SINGLE REF. = 0; 500; 1000; 2000; 5000 SP;
REF.ON = 1;  REF. OFF = 0;
OFF = 0; FRQ.= 1; CONTAMINAT.= 2; FRQ+CONT. = 3;
BAUD RATE = 9600;  (110-38400)
LINE FEEDS = 1;  (0-99)
Switching limit 1:  A1 =  0; (value input)
Switching limit 2:  A2 =  0; (value input)
DATUM SETTING = 0; (value input)
CL-ENT OFF= 0;  CL-ON = 1; CL-ENT ON = 2;
DISPLAY: ENT...CL ON = 1;  ENT...CL OFF = 0;
EXTERNAL REF OFF = 0;  EXTERNAL REF ON = 1;
MOD KEY: PRINT OFF = 0;  PRINT ON = 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 | 5 characters | 2 characters |
|---|---|---|
| Model display unit, left-aligned | Unit of meas. | 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 | 3 char. | 13 characters | 2 characters |
|---|---|---|---|
| Compensation-value no., left-aligned | Sep. block | Compensation value, right-aligned | 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 | 3 char. | 13 characters | 2 characters |
|---|---|---|---|
| Compensation-value no., left-aligned | Sep. block | Compensation-value, right-aligned | 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** | | | | **Description:** |
|---|---|---|---|---|
| * | | | | Start character ( * ); |
| ND-281 B | MM | | | Model of display unit; unit of measure (MM or IN); |
| SCALING | = | | 14 | Spacing = 14  ( range: 6 – 20) |
| DATUM | = | + | 0.0000 | Datum point 0 mm  (value input) |
| CMP. NR. 00 | = | + | 0.0000 | Compensation value 0 = 0.000 mm  (compensation value 0 is always 0) |
| CMP. NR. 01 | = | | ---------- | Compensation value 1 = no value entered |
| CMP. NR. 02 | = | | ---------- | Compensation values 2 – 63: no values entered (axis is not corrected) |
| CMP. NR. 03 | = | | ---------- | Compensation-value table is empty |
| CMP. NR. 04 | = | | ---------- | |
| CMP. NR. 05 | = | | ---------- | |
| CMP. NR. 06 | = | | ---------- | |
| CMP. NR. 07 | = | | ---------- | |
| . | | | | |
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| . | | | | |
| . | | | | |
| . | | | | |
| CMP. NR. 60 | = | | ---------- | |
| CMP. NR. 61 | = | | ---------- | |
| CMP. NR. 62 | = | | ---------- | |
| CMP. NR. 63 | = | | ---------- | |
| * | | | | Final character (*); |

**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)          h = < (sorting)
b = datum 1                        i = = (sorting)
c = datum 2                        j = > (sorting)
d = SET (datum setting)            k = MIN (meas. series)
e = START (measurement series)     l = ACTL (meas. series)
f = PRINT (data output)            m = MAX (meas. series)
g = inch (inch display)            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. 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 281 B |
|---------|----------|
| | Benchtop design,<br>cast-metal housing (W · H · D)<br>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<br>< 90% in rare cases |
| **Power supply** | Primary-clocked power supply<br>100 Vac to 240 Vac (–15% to +10%)<br>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 $\mu A_{PP}$/1 $V_{PP}$); Reference mark evaluation for distance-coded and single reference marks |
| **Input frequency** | **X1**     11 $\mu A_{PP}$:<br>Max. 100 kHz for 30 m cable length<br>**X2**     1 $V_{PP}$:<br>Max. 500 kHz for 60 m cable length |
| **Display step** | Adjustable |
| **Datum points** | Two |
| **Functions** | • Series of measurements [1]<br>• Sorting and tolerance checking<br>• Switching and sorting signals<br>• Set display and reset display to zero with external signal<br>• Measured value output |
| **RS-232-C/V.24 Interface** | Baud rates:<br>110, 150, 300, 600, 1200, 2400,<br>4800, 9600, 19 200, 38 400 baud |

[1] Only in linear measurement mode.

# ND 281 B: Dimensions in mm/inches

# HEIDENHAIN