

HEIDENHAIN

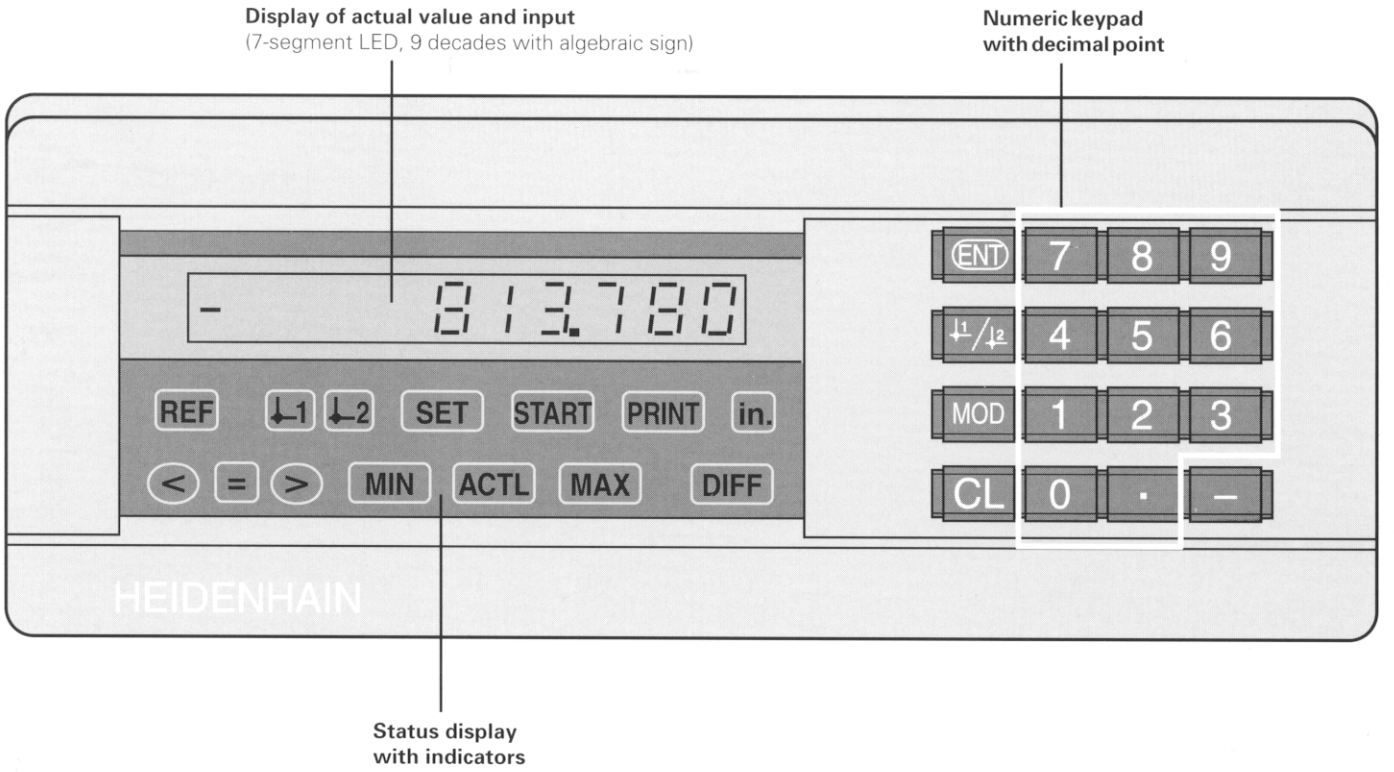
User's Manual

ND 281
NDP 281

Measured value display

3/95

AMI
Automation and Metrology
8808 Tyler Blvd, Mentor, OH 44060
1-888-354-2525 | sales@auto-met.com
Request a quote: auto-met.com


Display of actual value and input
(7-segment LED, 9 decades with algebraic sign)
Numeric keypad
with decimal point
- 813.780
REF
↓1
↓2
SET
START
PRINT
in.
<
=
>
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 • Transfer input value • Leave parameter list
↓1/↓2	• Select datum • Page backwards in parameter list
MOD	• Start series of measurements • Switch display for series of measurements • Start measured value output "PRINT" • Select parameter after switch-on • Page forward in parameter list
CL	• Abort entry / clear display • CL plus MOD: select parameter list • CL plus number: select parameter
–	• Algebraic sign • Page backwards through parameter settings
.	• Decimal point • Page forward through parameter settings

Indicator	Meaning
REF	Reference mark has been traversed — display stores datum points in nonvolatile memory **Blinking:** display is waiting for ENT or CL to be depressed
in.	Position values in inches
↓1 / ↓2	Selected datum point
PRINT	**Blinking:** Display is waiting for ENT to be depressed for data output
SET	**Blinking:** Display is waiting for input values
< / = / >	**Sorting and tolerance checking:** measured value smaller than lower sorting limit / within the sorting limits / greater than upper sorting limit
MIN / MAX / DIFF / ACTL	**Series of measurements:** Minimum / maximum / greatest difference (MAX–MIN) / current measured value **Blinking:** Confirm selection or deselect function
START	Series of measurements is running **Blinking:** Display is waiting for signal to start series of measurements

Items delivered with ND 281	
ND 281	Measured value display unit, bench-top design
Power cord	3 m (9.9 ft)
User's Manual	ND 281/NDP 281
Adhesive plug-in feet	for stacking ND 281 units

Items delivered with NDP 281	
NDP 281	Measured value display unit, for panel mounting
Power terminal	
User's Manual	ND 281/NDP 281



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

246 110 10

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

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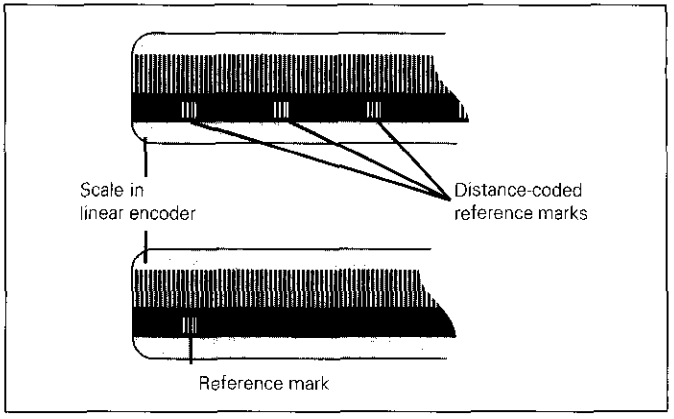
Position Encoders and Reference Marks

The ND 281 and NDP 281 display units are primarily intended for use with HEIDENHAIN **MT length gauges**. These length gauges have **one** reference mark. The scales of other photoelectric linear encoders (see "Linear Encoders") can contain one refereence mark or several *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 re-establish this relationship again when the power is restored.

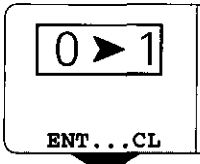
When a reference mark is crossed over, a signal is generated which identifies that position as a reference point. At the same time, the display unit restores the relationship between length gauge position and display values which you last defined by setting the datum.

If the linear encoders have **distance-coded** reference marks, you only need to traverse a maximum of 20 mm to restore the datum.

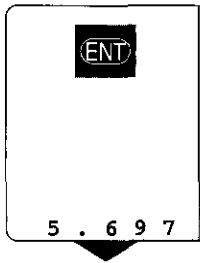


Reference marks on linear encoders

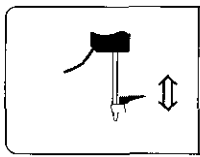
Switch-On, Crossing Over the Reference Marks



Turn on power.
(Switch located on rear panel.)
- ENT ... CL * is displayed.
- Indicator REF is blinking.



Switch on the reference mark evaluation function.
- The position value that was last assigned to the reference mark position is displayed.
- REF indicator lights up.
- Decimal point is blinking.



Cross over the reference mark.
Move the plunger until the display starts counting and the decimal point stops blinking. The display now is 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.

* Press the CL key if you choose **not** to cross over 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

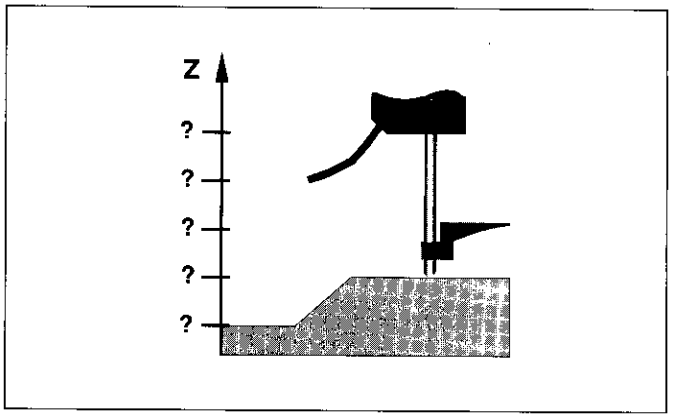
The datum setting procedure assigns a display value to a known position. With the ND 200 series, you can set two separate datum points.
There are several ways to set the datum:

- Enter a numerical value, or
- Transfer a value from an operating parameter (see P79, P86), or
- By external signal

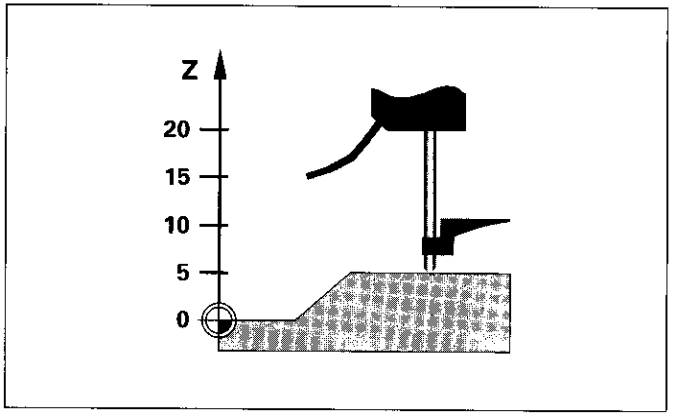
$\downarrow^1/\downarrow^2$	**Select datum** 1 or 2.
5	**Enter numerical value** (here, 5).
ENT	**Confirm** the entered **numerical value.**

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 MT's actual position.



Without datum setting: unknown assignment of measured values to positions



After datum setting: Assignment of measured values to positions

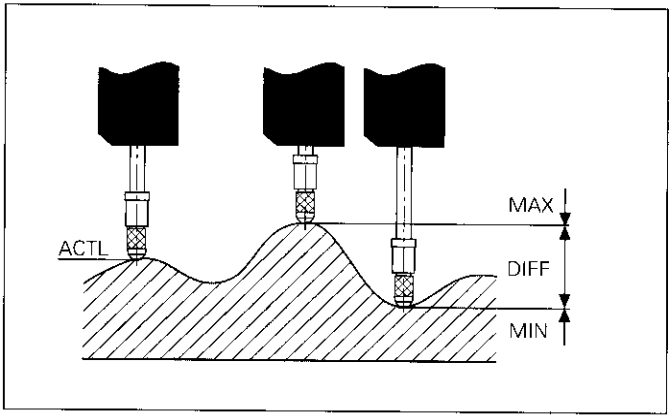
Finding Minimum and Maximum Values From a Series of Measurements

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.

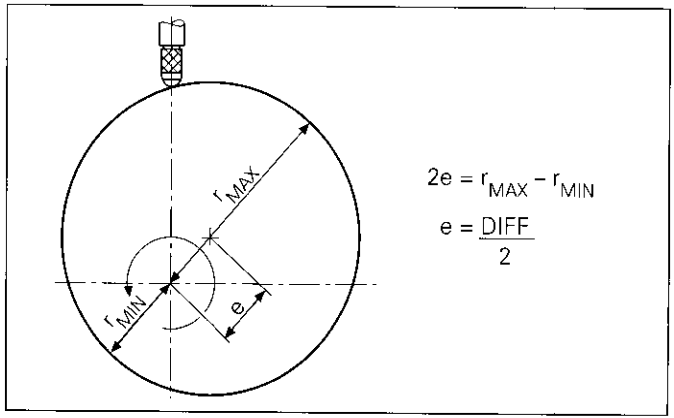
Display	Meaning
MIN	Minimum value from the series of measurements
MAX	Maximum value from the series of measurements
DIFF	Difference MAX – MIN
ACTL	Current measured value

Starting the series of measurements 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 page 34). When a series of measurements is started, the internal MIN/MAX/DIFF memory is reset.



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



Example: Series of measurements for determining eccentricity *e*

Starting a series of measurements

repeatedly MOD (MAX)	**Select the display for a series of measurements.** The selected indicator blinks (here, MAX).
ENT	**Confirm selection.**
repeatedly MOD (START)	... until the indicator START blinks.
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** possiple 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 MOD (MIN)	**Select the new display of a series of measurements.** The selected indicator blinks(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

repeatedly MOD START	**Select the indicator START.** The indicator START blinks.
ENT	**Start a new series of measurements.**

Ending a series of measurements

repeatedly MOD	**Select the active indicator (MIN, ACTL, MAX, DIFF).** The indicator that lit up last blinks.
ENT	**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

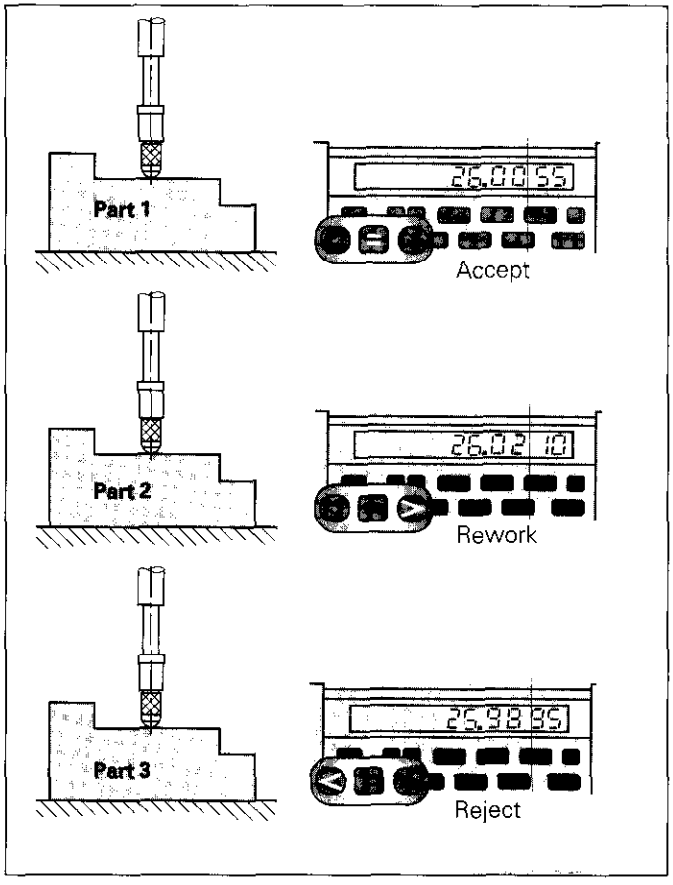
Sorting limits are entered in operating parameters **P18** and **P19** (see "Operating Parameters").

Sorting signals

The indicators and switching outputs at D-sub connection EXT (X41, see page 34) 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	CLSS	Sorting ON/OFF
P18	CLSS	Lower sorting limit
P19	CLSS	Upper sorting limit



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

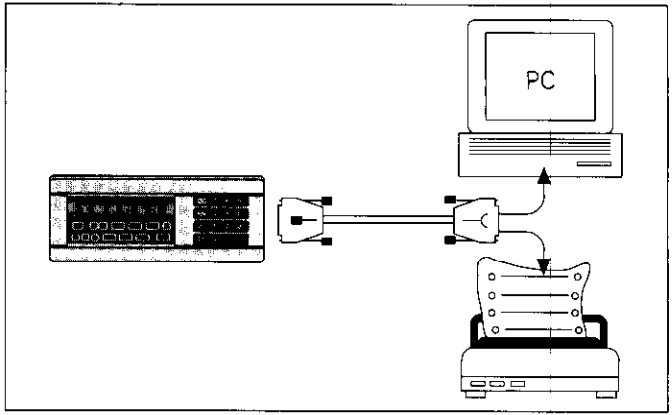
Measured Value Output

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 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 MOD repeatedly until the indicator PRINT blinks, then start measured value output with ENT;
  or
- ➤ Input the command Ctrl B over the RXD input of the RS-232-C/V.24 interface (X31);
  or
- ➤ Input a signal for measured data output (Pulse or Contact) at the D-sub connection EXT (X41).

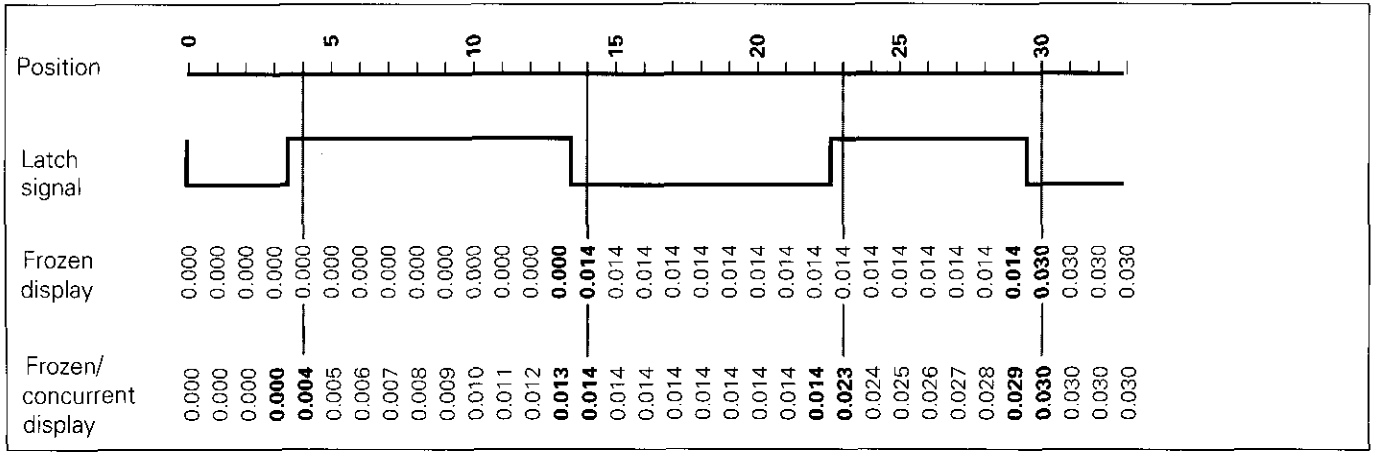


The RS-232-C/V.24 interface (X31) enables you to connect a printer or a PC to your display unit

Display Freeze

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

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



Error Messages

Display	Problem
ERROR 01	Last measured value has not been output*
ERROR 02	The external device is not connected, no DSR signal (only displayed once!)*
ERROR 03	Data interface: Parity error or wrong transfer format*
ERROR 10	Incorrect input value
ERROR 11	Overflow due to external setting (value for P79 too high)
ERROR 13	Overflow trigger limit 1
ERROR 14	Overflow trigger limit 2
ERROR 15	Overflow lower sorting limit
ERROR 16	Overflow upper sorting limit
ERROR 50	The encoder signal is too weak. The scale may be contaminated.*
ERROR 51	The input frequency for this encoder input is too high. This can occur when the scale is moved too fast.*
ERROR 53	Internal counter overflow*
ERROR 55	Error during traverse of the reference marks*

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

Display	Problem
ERROR 80 ERROR 83 ERROR 84	If these errors persist, contact your HEIDENHAIN service agency.
ERROR 99	Check the operating parameters. If this error persists, contact your HEIDENHAIN service agency.

Other error displays

If **all decimal points light up**, the measured value is too great 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:

When you have removed the cause of the error:

➤ Clear the error message with the CL key.

Rear Panel

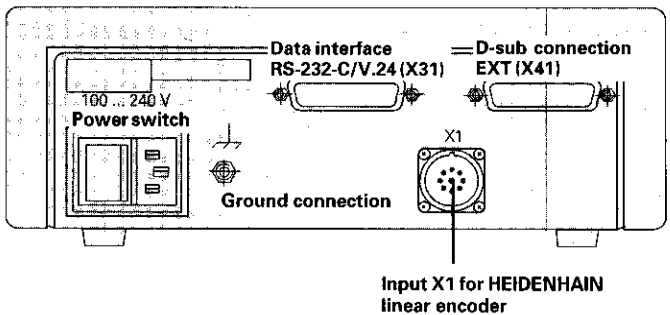
Connections X1, X31 and X41 comply with recommendations in DIN VDE 0160, 5.88. for separation from line power.

Encoder input X1	
HEIDENHAIN flange socket, 9-pin	
Input signals	~ 7 μA_{PP} to 16 μA_{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)	
Switching inputs and outputs EXT (X41)	
25-pin D-sub connection (male)	

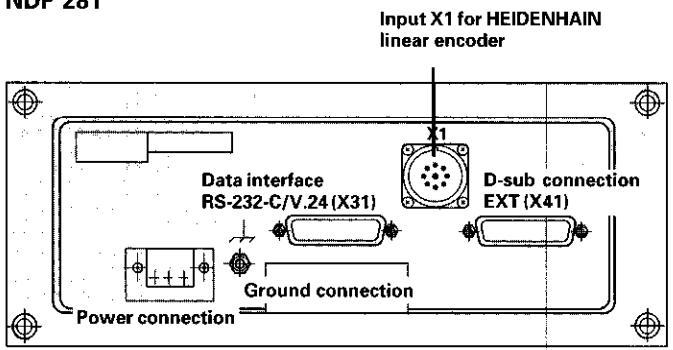
Accessories

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

ND 281



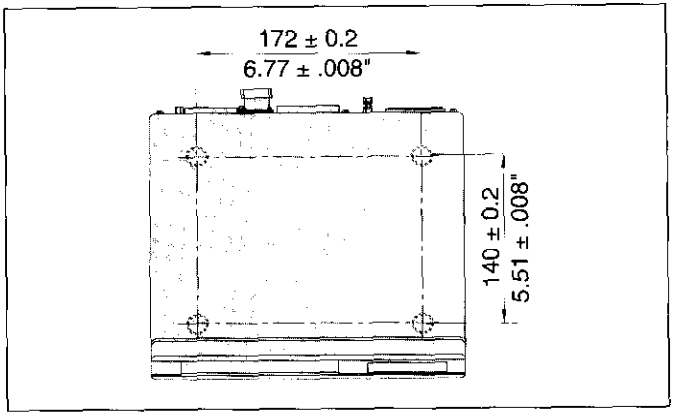
NDP 281



Mounting

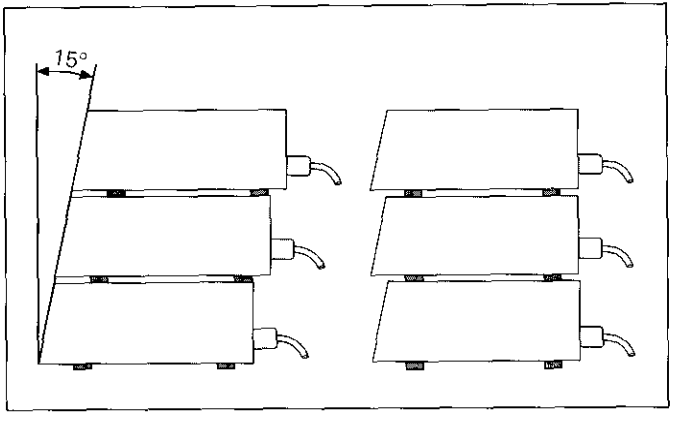
M4 screws are required for securing the **ND 281** display unit from below (see illustration at right).

The **NDP 281** display unit is designed for panel mounting (see "Dimensions" for the mounting dimensions).



Hole positions for mounting the ND display unit

ND 281 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

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

Potential component damage
Do not engage or disengage any connections unless the power is off. Only use original type fuses.

To increase the noise immunity, it is recommended that you attach the ground terminal to, for example, the central ground point of the machine. (Minimum cross section 6 mm^2)

Line voltage range: 100 Vac to 240 Vac

A voltage selector is therefore not necessary.

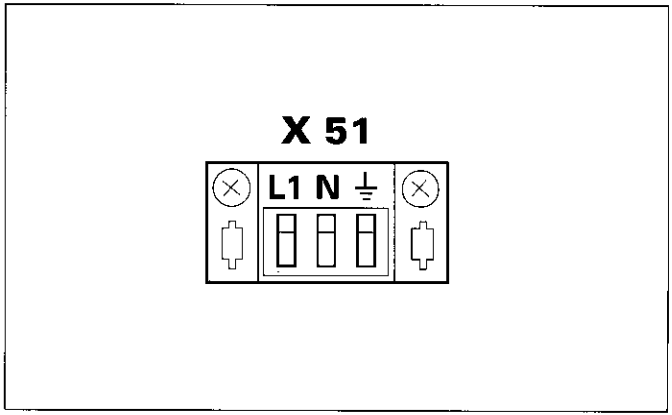
Minimum cross section of the power cord: 0.75 mm^2

ND 281

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

NDP 281

The rear panel of this unit features a terminal (X51) for power connection (see illustration to the right). Be careful to wire the connecting cable with the correct polarity.



NDP 281: Terminal for connecting the power cord

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 (starting on page 22) 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

The functions of the individual user parameters are detailed in the list of operating parameters (starting on page 22).

To access a user parameter ...

... after switching on the display:

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

... during operation:

Together: CL MOD	Display first user parameter.

To go directly to a user parameter:

Together: 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). 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	MOD
Page backward in the list of operating parameters	↓1/↓2
Page backward through operating parameter settings	—
Page forward through operating parameter settings	•
Correct entry and display parameter designations	CL
Confirm change or numerical entry, leave list of operating parameters	ENT

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 **code number 95 148** to change protected operating parameters
P01	INCH	**Unit of measurement** Display in millimeters — OFF Display in inches — ON
P17	CLSS	**Sorting and tolerance checking** Sorting into **class**es ON — CLSS. ON Sorting into **class**es OFF — CLSS. OFF
P18	CLSS	**Lower limit** for sorting
P19	CLSS	**Upper limit** for sorting
P21	SEQF	**Display for series of measurements** (MIN) (MAX) (ACTL) (DIFF) — OFF
P23	DISP	**Display stop for measured value output** **Concurrent display**, no display freeze; the display value is the current actual value — ACTL **Frozen display**; hold display until next measured value output — HOLD **Frozen/concurrent display**; freeze display as long as Pulse/Contact for measured value output is present — STOP

Parameter		Settings / Function
P30	DIR	**Counting direction** Positive counting direction with positive direction of traverse — POS Negative counting direction with positive direction of traverse — NEG
P32	SUBD	**Subdivision of the encoder signals** 400 / 320 / 256 / 200 / 160 / 128 / 100 80 / 50 / 40 / **20** / 10 / 8 / 5 / 4 / 2 / 1 0.8 / 0.5 / 0.4 / 0.2 / 0.1
P33	SLEP	**Counting mode** 0 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 — 1 0 - 2 - 4 - 6 - 8 — 2 0 - 5 — 5
P39	DEC	**Decimal places** 1 / 2 / 3 / **4** / 5 / 6 (up to 8 with display in inches)

Parameter		Settings / Function
P41	COMP	**Linear error compensation** – 99 999 [µm/m] < P41 < + 99 999 [µm/m] Factory setting: **0**

Example: Determine input value for P41

Displayed length ..... L_d = 620.000 mm
Actual length (as determined, for example, with the VM 101 comparator system from HEIDENHAIN) ..... L_a = 619.876 mm
Difference ..... $\Delta L = L_a - L_d = -124$ µm

Compensation factor k (= P41):
k = $\Delta L / L_d$ = – 124 µm / 0.62 m ..... **k = – 200** [µm/m]

P43	REF	**Reference marks**	
		One reference mark	SINGLE
		Distance-coded with 500 • GP (GP: grating period)	500
		Distance-coded with 1000 • GP (e.g. for HEIDENHAIN LS ...C)	1000
		Distance-coded with 2000 • GP	2000
P44	REF	**Reference mark evaluation**	
		Evaluate reference marks	REF ON
		Do not evaluate reference marks	REF OFF

Parameter		Settings / Function	
P45	ENCd	**Encoder monitoring**	
		Monitoring not active	ALAT. OFF
		Contamination	ALAT. C
		Frequency	ALAT. F
		Contamination and frequency	ALAT. CF
P50	Ud4	**Baud rate** baud 110 / 150 / 300 / 600 1200 / 2400 / 4800 / **9600** baud	
P51	Ud4	**Additional blank lines for data output** L INEFd 0 ≤ P51 ≤ 99 Factory setting: **1**	
P62	A1	**Trigger limit 1**	
P63	A2	**Trigger limit 2**	
P79	PRSt	**Value for datum point** Enter numerical value for datum setting over switching input or with ENT key	

Parameter		Settings / Function	
P80	SEt	**Set display**	
		No set/zero reset with CL/ENT	SEt OFF
		Zero reset with CL, setting with ENT disabled	SEt ZERO
		Zero reset with CL and set with ENT to value selected in P79	PRESEt
P82	MESO	**Message after switch-on**	
		ENt . . CL message	MESO On
		No message	MESO OFF
P85	REF	**External REF**	
		REF over D-sub connection EXT	EHt. On
		No REF over D-sub connection EXT	EHt. OFF
P95	MOd	**First indicator after pressing MOD** (START) (PRINT) (MIN) (ACTL) (MAX) (DIFF)	

Linear Encoders

Display step with linear encoders

The display step depends on the **signal period** of the encoder and the **subdivision** of the encoder signals.

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

- Subdivision (P32)
- Counting mode (P33)
- Decimal places (P38)

Example

Linear encoder with a signal period of 10 µm

Desired display step ..... 0.000 5 mm
Subdivision (P32) 20
Counting mode (P33) 5
Decimal places (P38) 4

The tables on this page and on the next will help you to select the appropriate parameter settings.

Display step, signal period and subdivision for linear encoders

Display step		Signal period [µm]							
		2	4	10	20	40	100	200	12 800
[mm]	[inch]	P32: Subdivision							
0.000 005	0.000 000 2	400	–	–	–	–	–	–	–
0.000 01	0.000 000 5	200	–	–	–	–	–	–	–
0.000 02	0.000 001	100	–	–	–	–	–	–	–
0.000 05	0.000 002	40	80	–	–	–	–	–	–
0.000 1	0.000 005	20	40	100	200	–	–	–	–
0.000 2	0.000 01	10	20	50	100	–	–	–	–
0.000 5	0.000 02	4	8	**20**	40	80	–	–	–
0.001	0.000 05	2	4	10	20	40	100	–	–
0.002	0.000 1	1	2	5	10	20	50	100	–
0.005	0.000 2	0.4	0.8	2	4	8	20	40	–
0.01	0.000 5	0.2	0.4	1	2	4	10	20	–
0.02	0.001	–	–	0.5	1	2	5	10	–
0.05	0.002	–	–	0.2	0.4	0.8	2	4	256
0.1	0.005	–	–	0.1	0.2	0.4	1	2	128
0.2	0.01	–	–	–	–	–	–	–	64

Parameter settings for HEIDENHAIN linear encoders

Encoder	Signal period [µm]	Ref. marks P43	Millimeters Disp. step [mm]	Subdiv. P32	Count. P33	Decim. P38	Inches Disp. step [inch]	Subdiv. P32	Count. P33	Decim. P38
LIP 40x	2	single	0.001	2	1	3	0.000 05	2	5	5
CP 60			0.000 5	4	5	4	0.000 02	4	2	5
			0.000 2	10	2	4	0.000 01	10	1	5
			0.000 1	20	1	4	0.000 005	20	5	6
			0.000 05	40	5	5	0.000 002	40	2	6
			0.000 02	100	2	5	0.000 001	100	1	6
			0.000 01	200	1	5	0.000 000 5	200	5	7
			0.000 005	400	5	6	0.000 000 2	400	2	7
LIP 101	4	single	0.001	4	1	3	0.000 05	4	5	5
VM 101			0.000 5	8	5	4	0.000 02	8	2	5
			0.000 2	20	2	4	0.000 01	20	1	5
			0.000 1	40	1	4	0.000 005	40	5	6
			0.000 05	80	5	5	0.000 002	80	2	6
			0.000 02	200	2	5	0.000 001	200	1	6
			0.000 01	400	1	5	0.000 000 5	400	5	7
LIF 101	4	single	0.001	4	1	3	0.000 05	4	5	5
LF 401			0.000 5	8	5	4	0.000 02	8	2	5
			0.000 2	20	2	4	0.000 01	20	1	5
			0.000 1	40	1	4	0.000 005	40	5	6
MT xx	10	single	0.001	10	1	3	0.000 05	10	5	5
LID xxx		single	0.000 5	20	5	4	0.000 02	20	2	5
LID xxxC		2 000	0.000 2	50	2	4	0.000 01	50	1	5
LS 103/103C		sgl./1 000	0.000 1	100	1	4	0.000 005	100	5	6
LS 405/405C		sgl./1 000								
ULS xxx/10		single								

Parameter settings for HEIDENHAIN linear encoders *(continued)*

Encoder	Signal period [µm]	Ref. marks P43	Millimeters Disp. step [mm]	Subdiv. P32	Count. P33	Decim. P38	Inches Disp. step [inch]	Subdiv. P32	Count. P33	Decim. P38
LS 106 LS 106C LS 406 LS 406C LS 706 LS 706C ULS/20	20	single 1 000 single 1 000 single 1 000 single	0.01 0.005 0.002 0.001 0.000 5	2 4 10 20 40	1 5 2 1 5	2 3 3 3 4	0.000 5 0.000 2 0.000 1 0.000 05 0.000 02	2 4 10 20 40	5 2 1 5 2	4 4 4 5 5
LIDA 190 LB 101	40	single	0.002 0.001 0.000 5	20 40 80	2 1 5	3 3 4	0.000 1 0.000 05 0.000 02	20 40 80	1 5 2	4 5 5
LIDA 2xx LB 3xx	100	single	0.01 0.005 0.002 0.001	10 20 50 100	1 5 2 1	2 3 3 3	0.000 5 0.000 2 0.000 1 0.000 05	10 20 50 100	5 2 1 5	4 4 4 5
LIM 102	12 800	single	0.1 0.05	128 256	1 5	1 2	0.005 0.002	128 256	5 2	3 3

Example

Your encoder: MT 101
Desired display step: 0.001 mm (1 µm)

Parameter settings:
P01 = mm
P43 = single
P32 = 10
P33 = 1
P38 = 3

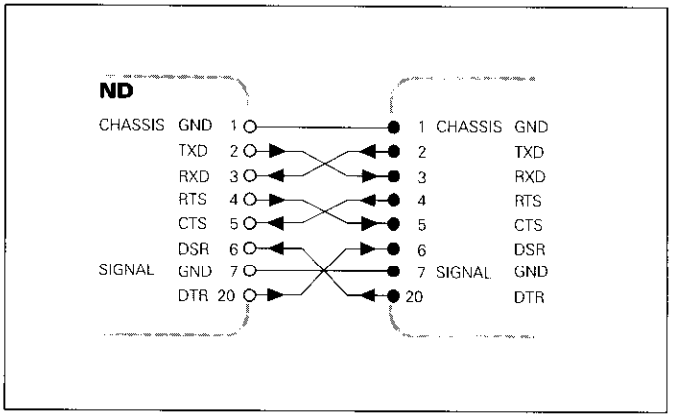
RS-232-C/V.24 Interface (X31)

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.

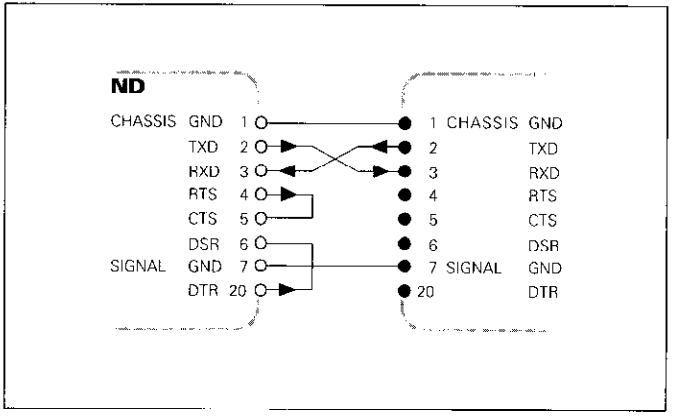
Connecting cable

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 ...). 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 7 data bits Even parity bit 2 stop bits
Control characters	Start STX Interrupt DC3 Continue DC1

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.)
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	U24	Baud rate
P51	U24	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	ACTL
Frozen display: Display is stopped (frozen) and updated by every measured value output signal	HOLD
Frozen/concurrent display: Display is frozen as long as a measured value output signal is present	STOP

To output measured values with the PRINT function:

➤ Press MOD repeatedly,
until the indicator PRINT blinks.
➤ Start measured value output with ENT.

Duration of measured value transfer

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

Indicator preselection

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).

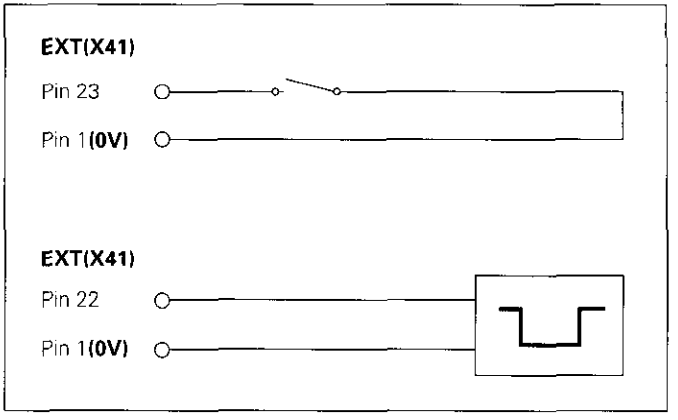
Characteristic times for measured value output

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	$t_3 \geq 0$

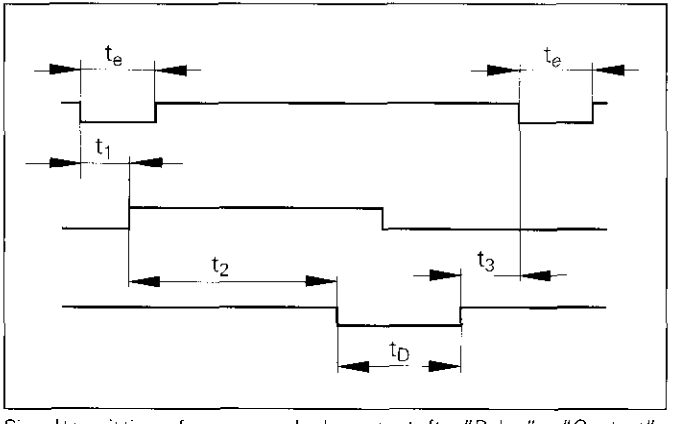
The time for measured value output (t_2) is the longest during a DIFF series of measurements.

Duration of measured value transfer

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



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 after signal "Ctrl B"

If the display unit receives the control character STX (Ctrl B) over the RS-232-C/V.24 interface (X31), it outputs the current measured value over the interface.

➤ Transfer the control character Ctrl B over the RXD line of the RS-232-C/V.24 interface (X31).

Characteristic times for measured value output

Process	Time
Storage delay	$t_1 \leq 1$ ms
Measured value output after	$t_2 \leq 22$ ms
Regeneration time	$t_3 \geq 0$

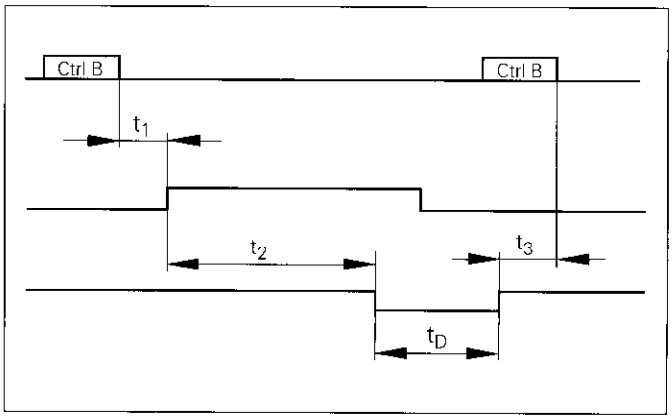
These times are prolonged if functions are active (for example, series of measurements with DIFF value display).

Duration of measured value transfer

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

```
10  L%=17
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"



Signal transit times for measured value output after "Ctrl B"

Switching Inputs and Outputs EXT (X41)



Danger to internal components!
Voltage sources for external circuitry must conform to the recommendations in VDE 0160, 5.88 for low-voltage electrical separation. Connect inductive loads only with a quenching diode parallel to the inductance.



Only use shielded cable!
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
6	Externally select display value for series of measurements
7	Display MIN value of series of measurements
8	Display MAX value of series of measurements
9	Display difference MAX – MIN
22	Pulse: Output measured value
23	Contact: Output 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.

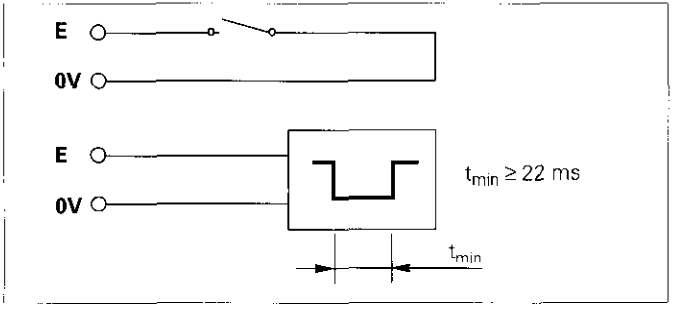
Inputs

Input signals
Internal pull-up resistor 1 kΩ, 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: $t_{min} \geq 22$ ms

The duration of t_{min} is prolonged if functions are active (for example, series of measurements with DIFF value display).

Signal level of inputs

Status	Level
High	+ 3.9 V ≤ U ≤ + 15 V
Low	− 0.5 V ≤ U ≤ + 0.9 V; I ≤ 6 mA



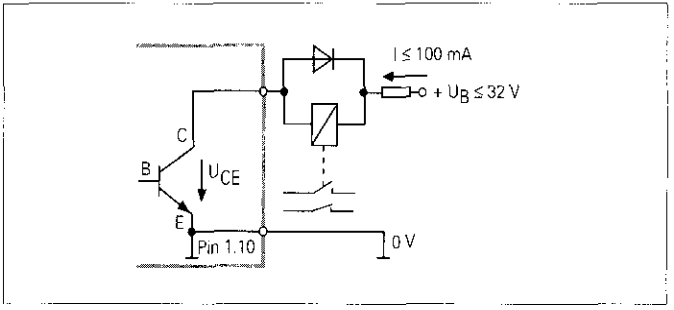
Outputs

Output signals
Open collector outputs, active with low level
Delay until signal output: $t_d \leq 22$ ms
Signal duration of zero crossover signal: $t_0 \geq 180$ ms

The duration of t_d is prolonged if functions are active (for example, series of measurements with DIFF value display).

Signal level of outputs

Status	Level
High	U ≤ + 32 V; I ≤ 10µA
Low	U ≤ + 0.4 V; I ≤ 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
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) a new series of measurements only by external signal over the switching inputs.

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").

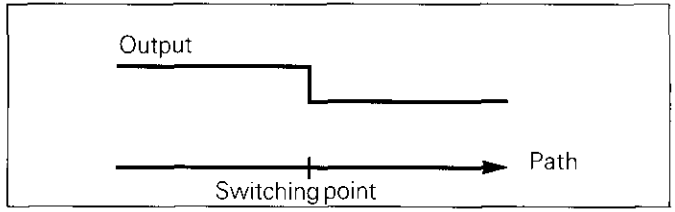
Signals for sorting and tolerance checking

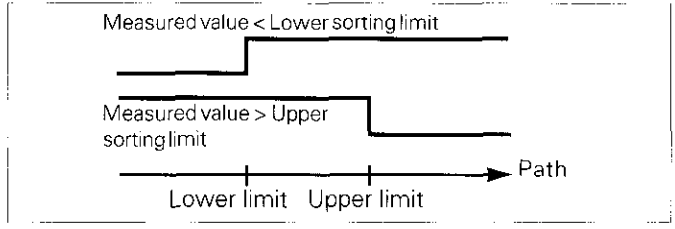
If the sorting limits defined in parameters are exceeded, the corresponding outputs (pins 17, 18) are activated.

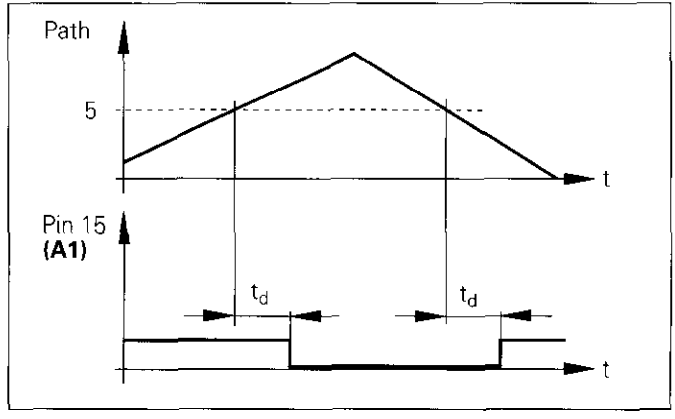
Signals	Operating parameters	Pin
Switching signals	P62, switching limit 1	15
	P63, switching limit 2	16
Sorting signals	P18, lower sorting limit	17
	P19, upper sorting limit	18

Zero crossover

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





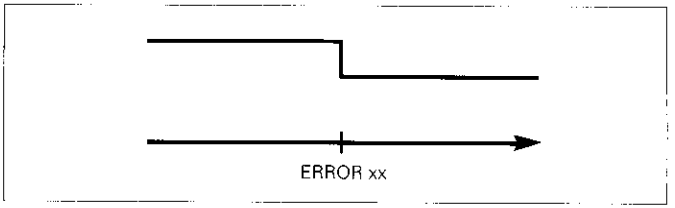


Time curve of a signal at pin 15 for trigger limit (A1) = 5 mm , $t_d \leq$ 22 ms

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.



Operating Mode for Displaying Distance-To-Go

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.**

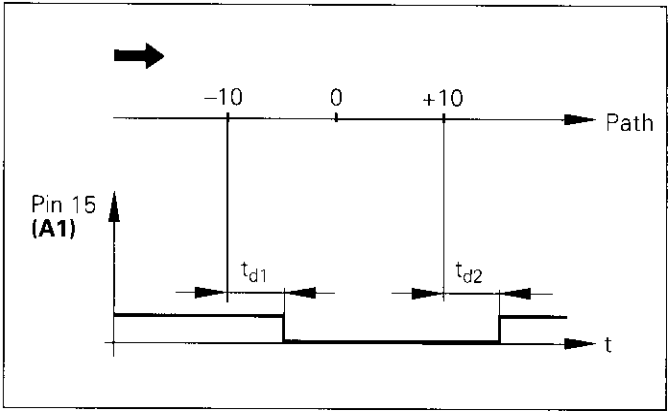
Display	Meaning
dELtA OFF	Distance-to-go display not active
dELtA On	Distance-to-go display active

"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.

Function of switching outputs A1 and A2

In the operating mode for displaying distance-to-go, 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.

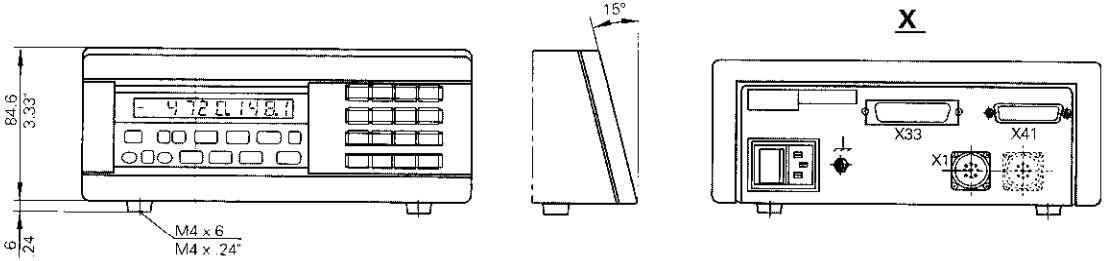


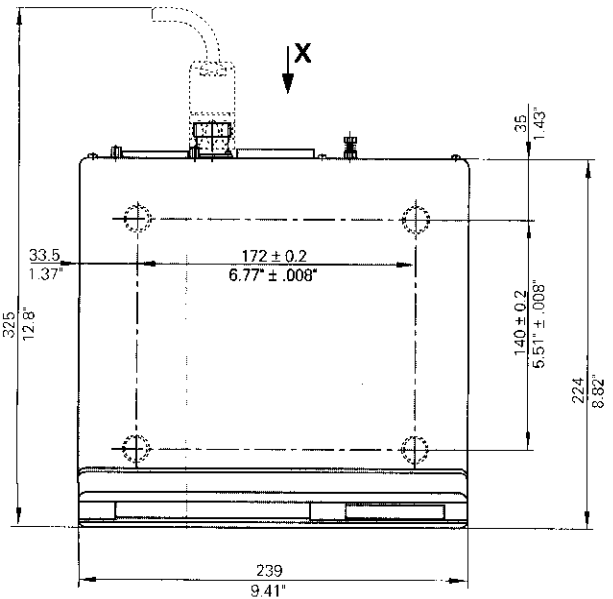
Time curve of a signal for switching limit (A1) = 10 mm , $t_{d1} \leq$ 22 ms, $t_{d2} \leq$ 180 ms

Specifications

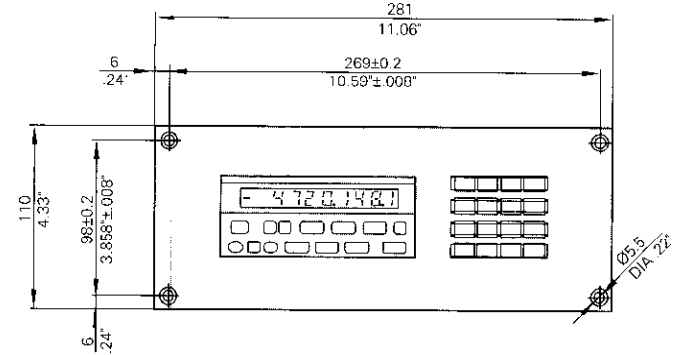
Housing	**ND 281** Bench-top design, cast-metal housing 239 x 84.6 x 224 mm (W x H x D)
	NDP 281 For panel mounting using supplied mounting frame, cast-metal housing 281 x 110 x 196 mm (W x H x D)
Operating temperature	0° to 45° C (32° to 113° F)
Storage temperature	–30° C to 70° C (–22° to 158° F)
Weight	Approx. 1.5 kg
Relative humidity	< 75 % annual average < 90 % in rare cases
Power supply	Primary-clocked power supply 100 V to 240 V (–15% to +10%) 48 Hz to 62 Hz Surge voltage rating: class 2 according to VDE 0160, 5.88
Line fuse	Γ 1 A inside the housing
Power consumption	Typ. 8 W
Electromagnetic compatibility	Class B according to EN 55022
Noise immunity	As per IEC 801-4, intensity 4
Protection	IP40 according to IEC 529
Encoder inputs	For encoders with sinusoidal output signals (7 to 16 μA_{PP}); Reference mark evaluation for distance-coded and single reference marks
Input frequency	Max. 100 kHz with 30 m cable
Display step	Adjustable (see "Linear Encoders")
Datum points	Two
Functions	• Series of measurements • Sorting and tolerance checking • Switching and sorting signals • Set display and reset display to zero with external signal • Measured value output
RS-232-C/V.24 Interface	Baud rates: 110, 150, 300, 600, 1200, 2400, 4800, 9600 baud

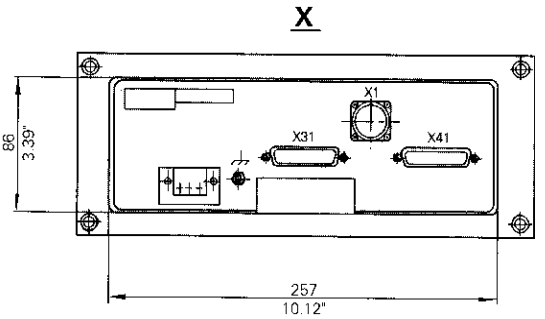
ND 281: Dimensions in mm/inches

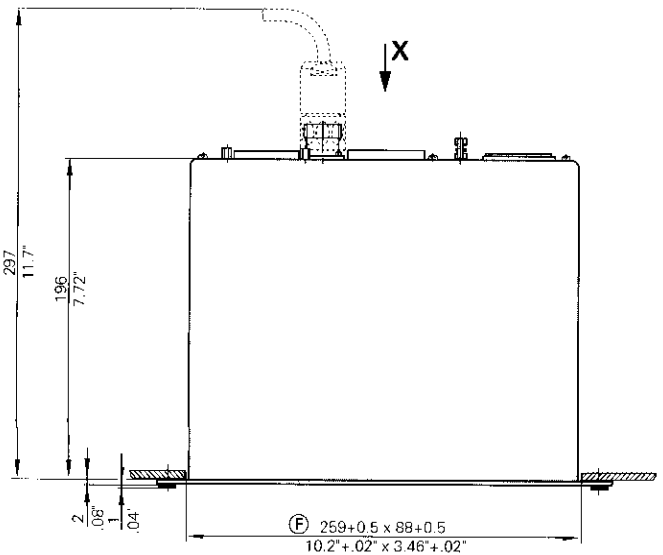




NDP 281: Dimensions in mm/inches







Opening for panel mounting Ⓕ
Minimum installation depth 297 mm (11.7 in.)



HEIDENHAIN

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