HEIDENHAIN
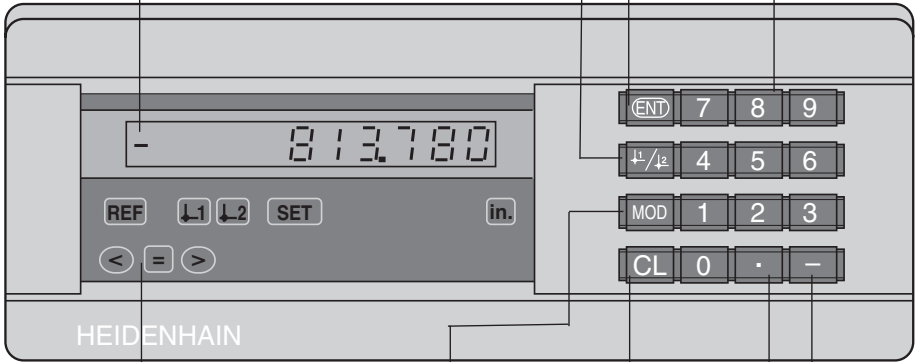
Actual value and input display
(7-segment LED,
9 decades and sign)

- **Select datum**
- Page backward in parameter list

- **Confirm entry value**
- Set display to value from P79 (P80!)

Numeric keypad

Status display

- **Output measured value over data interface (P86!)**
- Go to parameter list after switch-on
- Page forward in parameter list

- **Clear entry**
- Reset to zero (P80!)
- CL plus MOD: parameter list
- CL plus 2-digit number: select parameter
- Clear parameter entry and show parameter number

- **Algebraic sign**
- Decrease parameter value
- **Decimal point**
- Increase parameter value

Indicator	Meaning
REF	If decimal points are blinking: Display is waiting for the reference mark to be crossed over. If decimal points are not blinking: Reference marks crossed over – datum points are now stored in nonvolatile memory. **Blinking:** Waiting for operator to press ENT or CL.
in.	Position values displayed in inches.
$\llcorner$ 1 / $\llcorner$ 2	Datum point 1 / Datum point 2 currently active.
SET	**Blinking:** Waiting for operator to confirm entry values.
< / = / >	**Sorting mode:** Measured value less than lower limit / within tolerances / greater than upper limit.

The ND 231 measured value display unit is designed for use with two HEIDENHAIN linear or rotary encoders with sinusoidal output signals.

Each encoder has one reference mark or several reference marks, which may also be *distance-coded*. When a reference mark is crossed over, it generates a signal identifying that position as a reference point. After switch-on, crossing over the reference marks of both encoders restores the relationship between display values and axis slide positions last established by datum setting.
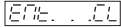
With distance-coded reference marks, a maximum traverse of only 20 mm after switch-on suffices to re-establish the datum.

Switch-On

0 ►1 **Ent...CL**	**Turn on the power** (switch located on rear panel). • Display shows `Ent. . .CL` • REF blinks
(ENT) **5 , 6 9 7**	**Switch on reference mark evaluation.** • The display shows the value last assigned to the reference mark position. • REF glows • Decimal points blink
	Cross over the reference marks in both axes. Move **both** axes until the display becomes active and **no** decimal points blink. The display unit is now ready for operation.

If you do **not** wish reference mark evaluation, press **CL** instead of ENT.

Datum Setting

The datum setting procedure assigns a specific axis position to the associated display value. The datum point refers to one of the two encoders or the sum or difference value (see "Selecting the display").
You can set two separate datum points.

↓1/↓2	**Select datum point** 1 or 2.
4 0 **4 0**	**Enter a numerical value**, such as 40.
(ENT)	**Confirm your entry.**

You can switch from one datum to the other at any time.
Use datum 2 when you want to display incremental dimensions.

Selecting the Display

You select the display for the ND 231 with
- switching inputs (see D-sub connection EXT) **or**
- operating parameter P06 (see list of operating parameters).

If you select the display over the switching inputs, operating parameter P06 has no effect on the display.

If none of the inputs is active for selection of the display (pins 6 to 9) or if more than one of these inputs is active, operating parameter P06 selects the display:
- Position of encoder X1: P06 = $A1$
- Position of encoder X2: P06 = $A2$
- Sum display: P06 = $A1\ Add\ A2$
- Difference display: P06 = $A1\ Sub\ A2$

Sorting and Tolerance Check Mode

In this mode the display value is compared with an upper and lower limit value. Status indicators and the switching outputs on the D-sub connection EXT indicate whether the display value is less than the lower limit, greater than the upper limit, or between the two limit values.

Indicator	Meaning
=	Measured value is between the limit values
<	Measured value is less than the lower limit value
>	Measured value is greater than the upper limit value

Operating parameters for the sorting mode:
- P17: Sorting on/off
- P18, P19: Limit values

Data Output

There are three ways to output data:

➤ Press the MOD key. This only works when operating parameter P86 is set to `Print On` (see operating parameter list)
➤ Input the command STX (Ctrl B) over the RXD input
➤ Input a latch command over the D-sub connection EXT.

A **connecting cable** (for example to a PC) is available from HEIDENHAIN (Id.-Nr. 274 545 ..). Cables up to 20 m (66 ft) are permitted.

Operating parameters for data output: P50, P51

Wiring and pin layout
Connecting cable is either **fully** wired (left) or only **partially** wired (right).

CHASSIS GND: Chassis Ground **TXD:** Transmitted Data **RXD:** Received Data
RTS: Request To Send **CTS:** Clear To Send **DSR:** Data Set Ready
SIGNAL GND: Signal Ground **DTR:** Data Terminal Ready

Signals	Signal levels "active"	Signal levels "hot active"
TXD, RXD	–3 V to –15 V	+3 V to +15 V
RTS, CTS, DSR, DTR	+3 V to +15 V	–3 V to –15 V

Data transfer format and control characters	
Format	ASCII code
Data word	1 start bit, 7 data bits, parity bit (even parity), 2 stop bits
Control characters	Call measured value: STX (CTRL B), interrupt DC3 (CTRL S), resume DC1 (CTRL Q) Enquire error message: ENQ (CTRL E)
Sequence	• Sign • Numerical value with decimal point • Blank space • Unit (blank space = mm, " = inches, ? = error) • Sorting result (<, >, =; ? if P18 > P19) **or** blank space • Axis designation (1=X1, 2=X2, A=X1+X2, S=X1–X2) • Carriage return • Line feed

Storage and transfer times

The duration of data transfer depends on the selected baud rate and the number of additional line feeds.

Latch signal	STX (CTRL B)	EXT (pulse)	EXT (contact)	PRINT
Storage time	≤ 1 ms	≤ 1 µs	≤ 5 ms	≤ 33[1] ms
Data transfer after	≤ 34[1] ms	≤ 33[1] ms	≤ 38[1] ms	≤ 66[2] ms

[1] These times will increase by 15 ms per compensated axis if linear compensation is active, and by another 28 ms if the comma position, counting mode and subdivision are different.
[2] This time will increase by 30 ms per compensated axis if linear compensation is active, and by another 56 ms if the comma position, counting mode and subdivision are different.

D-sub connection EXT

⚠️ **Danger to internal components!**
Voltage sources from 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.

☝ **Use only shielded cable!**
Connect the shield to the connector housing.

	Pin	Function	Pin	Function
Outputs	15	Meas. value ≥ trigger limit A1 (P62)	1	0 V
	16	Meas. value ≥ trigger limit A2 (P63)	10	0 V
	17	Meas. value < lower sorting limit (P18)	5	Do not assign
	18	Meas. value > upper sorting limit (P19)	12	Do not assign
	19	Error (see "Error Messages")	13	Do not assign
	14	Display value is zero	11	Vacant
Inputs	2	Reset display to zero	20	Vacant
	3	Set display to value in P79	21	Vacant
	4	Ignore reference mark signals (encoder X1)		
	24	Ignore reference mark signals (encoder X2)		
	6	Display position of encoder X1		
	7	Display position of encoder X2		
	8	Display sum X1 + X2		
	9	Display difference X1 – X2		
	22	Pulse: Output the measured value		
	23	Contact: Output the measured value		
	25	Switch off or activate REF mode: (current REF condition is changed)		

Signal levels	Low		High	
Inputs	–0.5 V ≤ U ≤ 0.9 V	I ≤ 6 mA	3.9 V ≤ U ≤ 15 V	
Outputs	U ≤ 0.4 V	I ≤ 100 mA	U ≤ 32 V	I ≤ 10 μA

### Description of input and output signals

Input signals
- Internal 1 kΩ pull-up resistor
- Triggering by make contact against 0 V **or** Low level over TTL logic device
- Delay for zero reset/preset: t_d ≤ 2 ms
- Min. pulse duration for all signals: t_{min} ≥ 33[1] ms

Output signals
- Open collector outputs, active Low
- Signal output delay: t_d ≤ 29 ms[1]
- Duration of zero crossover signal, trigger outputs A1,A2: t_0 ≥ 180 ms
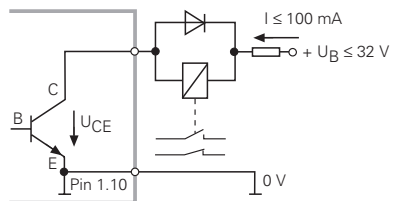
[1] The indicated times will increase
- by 15 ms per compensated axis if linear compensation is active
- by 20 ms if comma position, counting mode and subdivision different
- during external zero reset, preset, latching or data output.

Display Freeze by Measured Value Output Signal

The effect of the signal for measured value output on the display is defined in user parameter P23.

➤ **Concurrent display:** No display freeze. The unit shows the current measured value ($RCEL$).
➤ **Frozen display:** The display is frozen and is updated with each signal for measured value output ($HOLd$).
➤ **Frozen/concurrent display:** The display freezes only as long as the signal is present ($5EOP$).

Error Messages

To clear error message

When you have removed the cause of the error,
➤ press $\boxed{Error}$

Message	Cause and effect
$Error$ 01	Last measured value not yet latched[1]
$Error$ 02	External device not ready for data transfer[1] ($Error$ 02 only appears once)
$Error$ 03	Data interface: Parity error or wrong transfer format[1]
$Error$ 10	Incorrect input value
$Error$ 11	Overflow caused by external preset
$Error$ 13	Overflow, trigger limit 1
$Error$ 14	Overflow, trigger limit 2
$Error$ 15	Overflow, lower sorting limit
$Error$ 16	Overflow, upper sorting limit
$Error$ 17	Sum or difference cannot be displayed
$Error$ 50.1 $Error$ 50.2	Signal from encoder input X1 or X2 too small[1] (encoder may be contaminated)
$Error$ 51.1 $Error$ 51.2	Input frequency for too high for input X1 or X2[1] (can occur when the traverse speed is too high)
$Error$ 53	Internal counter overflow[1]
$Error$ 55	Error while crossing over reference marks[1]
$Error$ 80 $Error$ 83 $Error$ 84 $Error$ 86	To clear the error message: **Switch off the display unit.** Should any of these error codes recur, contact your HEIDENHAIN service agency.
$Error$ 94	Offset compensation values for encoder signals have been erased: contact your HEIDENHAIN service agency.
$Error$ 99	Erase the operating parameters.

If all decimal points light up, the measured value is too large or too small. In this case, set a new datum **or** retract.

If all sorting indicators light up, the upper sorting limit is less than the lower sorting limit.

[1] These errors are significant for a connected device.
The error signal (pin 19) at the D-sub connection EXT is active.

Operating Parameters

The parameters are divided into "user parameters" and "protected operating parameters," which can only be accessed by entering a code number.

User parameters
User parameters are operating parameters that you can change **without** entering the code number: They are designated P00 to P30, P50, P51, P79, P86

Calling user parameters
To call user parameters **immediately after switch-on**:
➤ Press the MOD key as long as $\boxed{E\Pi\underline{t}. \quad .\underline{C}L}$ is visible in the display.

To call user parameters **during operation**:
➤ Press and hold the CL key, then press MOD.
To go **directly** to a specific user parameter:
➤ Press and hold the CL key, then press the first digit of the parameter number.
➤ Release both keys and press the second digit.

Protected operating parameters
Before you can change protected operating parameters you must enter the **code number 95 148** through $\boxed{P\underline{00} \quad C\underline{O}dE}$: They **remain** accessible until you switch off the position display.

To page through the parameter list
➤ **Forward** paging: Press the MOD key.
➤ **Backward** paging: Press the ⊥1 /⊥2 key.
  By paging on, you automatically enter any change you've made in a parameter.

To change operating parameters
➤ Increase the parameter value with the decimal point key, **or**
➤ Decrease the parameter value with the minus key, **or**
➤ Enter the numerical value for the operating parameter, e.g. for P41 ($\boxed{\text{SET}}$ blinks).

To correct your entries and show the parameter designation
➤ Press the CL key.

To exit the operating parameters
➤ Press ENT. All changes made become effective.

Operating Parameter List

Parameter	Meaning	Function / Effect	Setting
P00 CODE	To change a protected operating parameter, enter **code number 95 148**.		
P01 INCH	**Unit of measure**	Display in millimeters	OFF
		Display in inches	On
P08 d ISP	**Select display mode**	Display for encoder at X1	A1
		Display for encoder at X2	A2
		Sum display X1 + X2	A1 Add A2
		Difference display X1 – X2	A1 Sub A2
P17 CLSS **Classification**	**Sorting mode**	Sorting on	CLSS On
		Sorting off	CLSS OFF
P18 CLSS	**Lower sorting limit** (ensure that P18 < P19)		
P19 CLSS	**Upper sorting limit** (ensure that P19 > P18)		

Parameter	Meaning	Function / Effect	Setting
P23 *d ISP* ***Disp**lay*	**Display freeze with measured value output**	Concurrent display, no freeze	
		Frozen display / update with signal	
		Frozen/concurrent display	
P30.✱ *d ir* ***Dir**ection*	**Counting direction**	Normal (***Pos**itive*)	*POS*
		Inverse (***Neg**ative*)	*nEG*
P32.✱ *SUbd* ***Subd**ivision*	**Subdivision of 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.✱ *StEP* **Counting mode**	**Counting mode**	0 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 0	*1*
		0 - 2 - 4 - 6 - 8 - 0	*2*
		0 - 5 - 0	*5*
P38.✱ *dEC* ***Dec**imal point*	**Places after decimal** 2 / 3 / 4 / 5 / 6 (up to 8 with inch display)		
P41.✱ *COMP* ***Comp**ensation*	**Linear error compensation**[1] – 99 999,9 < P41 < + 99 999,9 [µm/m]		
P43.✱ *rEF*	**Reference marks**	One reference mark	*5 InGLE*
		Distance-coded with 500 • SP (SP = signal period)	*500*
		Distance-coded with 1000 • SP (e.g. for LS 303 C / LS 603 C)	*1000*
		Distance-coded with 2000 • SP	*2000*
		Distance-coded with 5000 • SP	*5000*
P44.✱ *rEF*	**Reference mark evaluation**	Evaluation	*rEF On*
		No evaluation	*rEF OFF*
P45.✱ *EnCd* ***Enc**oder*	**Encoder monitoring**	No monitoring (***Alar**m **Off***)	*ALAr. OFF*
		Contamination	*ALAr. C*
		Frequency	*ALAr. F*
		Contamination and frequency	*ALAr. CF*
P50 *U24*	**Baud rate** *bAUd* 110, 150, 300, 600, 1200, 2400, 4800, 9600		
P51 *U24*	**Additional line feeds** *L InEFd. (**Linef**eed)* 0 to 99		
P62 *A1*	**Trigger limit 1**	Enter numerical value	
P63 *A2*	**Trigger limit 2**	Enter numerical value	
P79 *PrSt* ***Pre**set*	**Value for datum**	Enter numerical value for datum setting over switching input or with ENT key	
P80 *SEt*	**Reset/Preset**	No zero reset/preset with CL/ENT	*SEt OFF*
		Zero reset with CL (***Set Zero***), no preset with ENT	*SEt 2Ero*
		Zero reset with CL and preset with ENT to value in P79	*PrESEt*
P82 *nESG* ***Mess**age*	**Behavior after switch-on**	〔*Ent. . .CL*〕 message displayed	*nESG On*
		〔*Ent. . .CL*〕 message not displayed	*nESG OFF*
P85 *rEF*	**External REF**	REF over D-sub connection EXT	*EHt. On*
		No REF over EXT connection	*EHt. OFF*
P86 *nOd* ***Mod**e*	**PRINT via MOD key**	PRINT inhibited	*Pr Int OFF*
		PRINT not inhibited	*Pr Int On*

✱: Enter parameter separately for each encoder

1) Example entry value for P41 Displayed length: L_d = 620.000 mm; Actual length (determined e.g. with a comparator system VM 101 from HEIDENHAIN): L_a = 619.876 mm; Length difference: $\Delta L = L_a - L_d = -124$ µm Compensation factor: $k = \Delta L / L_d = -124$ µm / 0.62 m = **–200** [µm/m]

Parameter Settings for HEIDENHAIN Linear Encoders

Model	Signal period [µm]	Reference marks	P 43	Display step (unit: P01) mm	inches	Subdivision P32	Count. mode P33	Decimal places P38
CT MT xx01 LIP 401	2	one	single	0,0005	0,00002	4	5	4
		none	-	0,0002	0,00001	10	2	4
		one	single	0,0001	0,000005	20	1	4
				0,00005	0,000002	40	5	5
				Recommended only for LIP 401				
				0,00002	0,000001	100	2	5
				0,00001	0,0000005	200	1	5
				0,000005	0,0000002	400	5	6
LF 103 LF 401 LIF 101 LIP 501 LIP 101	4	one dist.c.	single 5000	0,001	0,00005	4	1	3
				0,0005	0,00002	8	5	4
				0,0002	0,00001	20	2	4
				0,0001	0,000005	40	1	4
		one	single	0,00005	0,000002	80	5	5
				Recommended only for LIP 101				
				0,00002	0,000001	200	2	5
				0,00001	0,0000005	400	1	5
MT xx	10	one	single	0,0005	0,00002	20	5	4
				0,0002	0,00001	50	2	4
				0,0001	0,000005	100	1	4
LS 303 LS 603	20	one dist.c.	single 1000	0,01	0,0005	2	1	2
				0,005	0,0002	4	5	3
LS 106 LS 406 LS 706 ST 1201	20	one dist.c.	single 1000	0,001	0,00005	20	1	3
				0,0005	0,00002	40	5	4
		none	-					
LB 302 LIDA 10x	40	one dist.c.	single 2000	0,005	0,0002	8	5	3
				0,002	0,0001	20	2	3
				0,001	0,00005	40	1	3
				0,0005	0,00002	80	5	4
				Recommended only for LB 302				
				0,0002	0,00001	200	2	4
				0,0001	0,000005	400	1	4
LB 301	100	one dist.c.	single 1000	0,005	0,0002	20	5	3
				0,002	0,0001	50	2	3
				0,001	0,00005	100	1	3
LIM 102	12800	one	single	0,1	0,005	128	1	1
				0,05	0,002	256	5	2

Example: Set parameters for any encoder
Linear encoder with signal period s = 10 µm
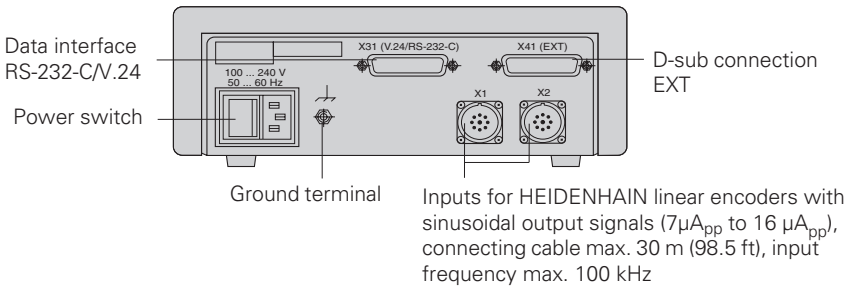Desired display step a = 0.000 1 mm
Subdivision P32 **= 0.001 · s / a =** 100
Counting mode P33 = 1 (display counts 1, 2, 3 ...)
**Decimal places** of a: P38 = 4

Rear Panel

Data interface RS-232-C/V.24

Power switch

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

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

X1   X2

D-sub connection EXT

Ground terminal

Inputs for HEIDENHAIN linear encoders with sinusoidal output signals ($7\mu A_{pp}$ to $16\ \mu A_{pp}$), connecting cable max. 30 m (98.5 ft), input frequency max. 100 kHz

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

Installation

You can mount the display unit to a flat surface with M4 bolts (see illustration at right).

The units can also be stacked. Adhesive inserts (included in delivery) prevent them from sliding.

172 ± 0.2
$6.77 \pm .008"$

140 ± 0.2
$5.51 \pm .008"$
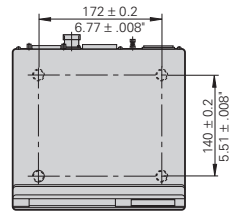
Power Supply and Connection

Danger of electrical shock!
Unplug the power cord before opening the housing.
Connect a protective ground. This connection must never be interrupted.

Danger to internal components!
Do not engage or disengage any connections while the unit is under power.
Use only original replacement fuses.

Primary-clocked power supply.
Voltage range: 100 V to 240 V (– 15 % to + 10 %) **Frequency:** 48 Hz to 62 Hz
Power consumption: typ. 8 W **Line fuse:** F 1 A (in unit)
Minimum cross-section of the power line: 0.75 mm²

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

Ambient Conditions

Temperature range	Operation: 0° C to 45° C (32° F to 113° F) Storage: –30° C to 70° C (–22° F to 158° F)
Rel. humidity	Annual average: < 75 %; maximum: < 90 %
Weight	1.5 kg