HEIDENHAIN

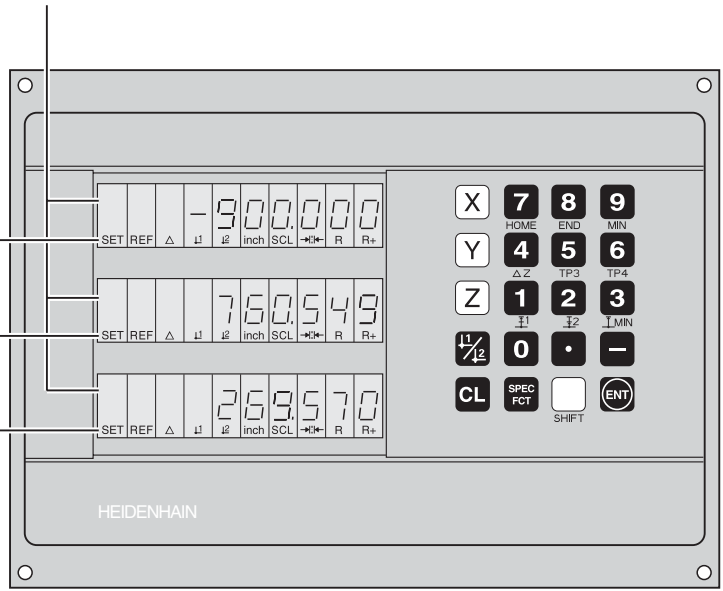
User's Manual

ND 760 E

Position Display Units for EDM

English (en)
1/2002

ND 760 E Position Display Unit
(for 3 axes)



Status display:

SET = Datum setting
REF = Blinking:
Traverse the reference points.
On continuously:
Reference points have been traversed.
Δ = SHIFT function
⊥1 ⊥2 Datum 1 or 2
Inch = Display in inches
SCL = Scaling factor
->II<- = Touch-off / Centerline

Keys

X Y Z	• Select coordinate axis • Select axis-specific operating parameters
7 HOME, 8 END, 9 MIN 4 ΔZ, 5 TP3, 6 TP4 1 ↧1, 2 ↧2, 3 ⌶MIN 0, •	Numerical input
↓1/↓2	• Select datum 1 or 2 • Page backward in the list of special functions • Page backward in the parameter list
CL	• Cancel entry • Reset the operating mode • Zero the selected axis (if activated with P80) • Select parameter: CL plus two-digit number
SPEC FCT	• Select the special functions - Probe for center line - mm/inch switchover - Parameter entry • Page forward in the list of special functions
1 ↧1, 2 ↧2	Trigger points 1 and 2 before reaching the erosion depth
3 ⌶MIN	Trigger point with respect to MIN position
4 ΔZ	Add key for the erosion depth
5 TP3, 6 TP4	TP3, TP4 Additional switching points, defined with respect to the top of the workpiece = 0
7 HOME	Trigger point for start position (HOME)
8 END	Trigger point for the erosion depth
9 MIN	Switchover from actual position display to MIN position display
–	• Change algebraic sign • Call the most recent dialog • In the parameter list: change the parameters
SHIFT	SHIFT key Use of double-function keys
ENT	• Confirm entry • Page forward in the parameter list

This Manual describes the ND 760 E position display unit with the following software number or higher:

ND 760 E for three axes **366 590-01**

About this manual

This manual is divided into two parts:

Part I: Operating Instructions

- Fundamentals of positioning
- ND functions

Part II: Installation and Specifications

- Description of operating parameters
- Switching inputs, switching outputs

Part I Operating Instructions

Fundamentals

The ND 760 E position display unit was conceived for use on electrical discharge machines (EDM).

The following functions support operation with EDMs:

- 7 switching outputs for the EDM axis
- Display of the MIN position, the distance-to-go, and the total depth in the EDM axis. Because of the quick up-and-down motion of the EDM axis, HEIDENHAIN recommends displaying only the last minimum position value.
- Simple compensation of the erosion depth with the aid of an add key.
- Simple setup function for finding the center line between two edges.

You can skip this chapter if you are already familiar with coordinate systems, incremental and absolute dimensions, nominal positions, actual positions and distance-to-go.

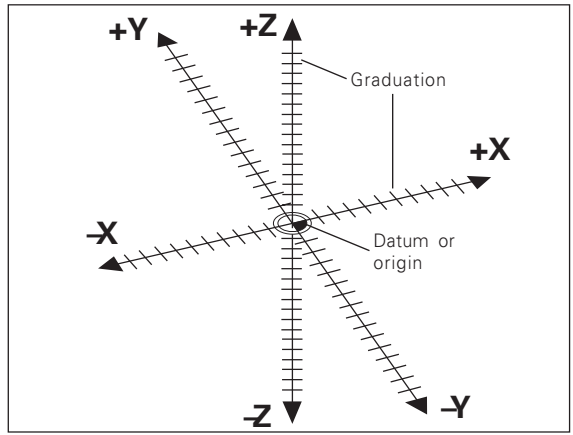
Coordinate system

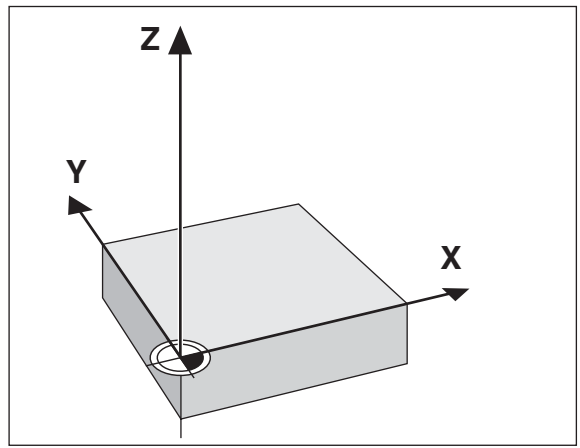
To describe the geometry of a workpiece, the *Cartesian** coordinate system is used. The Cartesian coordinate system consists of three mutually perpendicular axes X, Y and Z. The point of intersection of these axes is called the **datum** or origin of the coordinate system.

Think of the axes as scales with divisions (usually in millimeters) which allow us to fix points in space referenced to the datum.

To determine positions on a workpiece, the coordinate system is "laid" onto the workpiece.

The machine axes are parallel to the axes of the coordinate system. The Z axis is normally the tool axis.





*) Named in honor of the French mathematician and philosopher René Descartes (1596 to 1650)

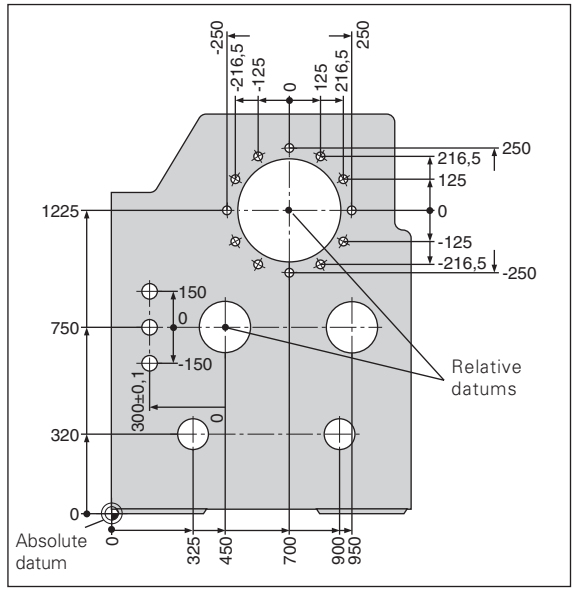
Datum setting

The workpiece drawing is used as the basis for machining the workpiece. To enable the dimensions in the drawing to be converted into traverse distances of machine axes X, Y and Z, each drawing dimension requires a datum or reference point on the workpiece (since a position can only be defined in relationship to another position).

The workpiece drawing always indicates **one** absolute datum (the datum for absolute dimensions). However, it may contain additional relative datums.

In the context of a numerical position display unit, *datum setting* means bringing the workpiece and the tool into a defined position in relation to each other and then setting the axis displays to the value which corresponds to that position. This establishes a fixed relationship between the actual positions of the axes and the displayed positions.

You can set up to 9 absolute datum points and store them in nonvolatile memory.



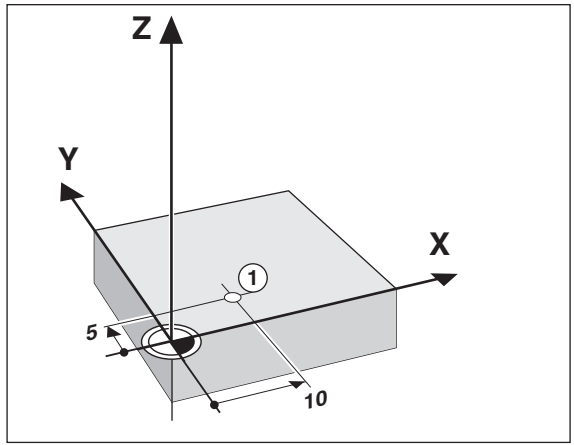
Absolute workpiece positions

Each position on the workpiece is uniquely defined by its absolute coordinates.

Example Absolute coordinates of position ①:

X = 10 mm
Y = 5 mm
Z = 0 mm

If you are working according to a workpiece drawing with absolute dimensions, you are moving the tool **to** the coordinates.



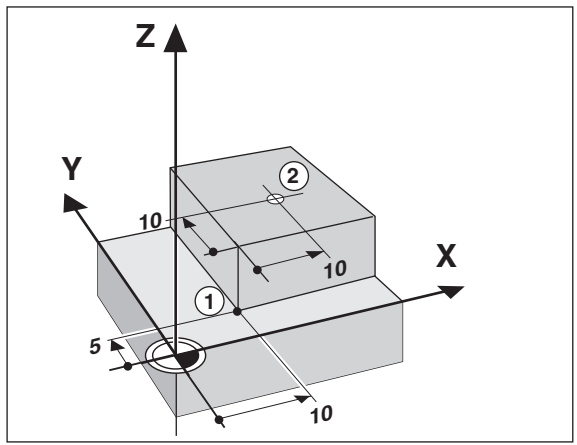
Relative workpiece positions

A position can also be defined relative to the previous nominal position. The datum for the dimension is then located at the previous nominal position. Such coordinates are termed **incremental coordinates** or chain dimensions. Incremental coordinates are indicated by a preceding **I**.

Example Relative coordinate of position ② referenced to position ① :

IX = 10 mm
IY = 10 mm

If you are working according to a workpiece drawing with incremental dimensions, you are moving the tool **by** the dimensions.



Sign for incremental dimensioning

A relative dimension has a **positive** sign when the axis is moved in the positive direction, and a **negative** sign when it is moved in the negative direction.

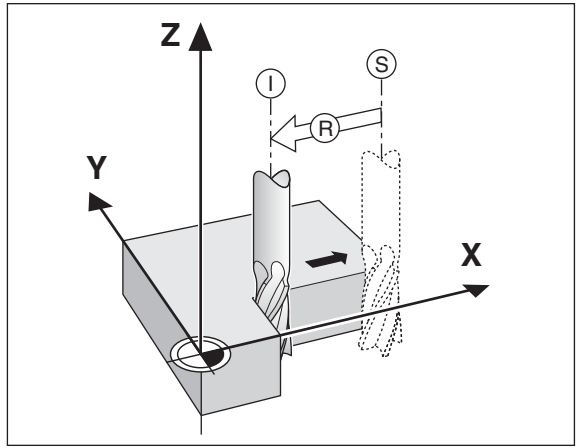
Nominal position, actual position and distance-to-go

The position to which the tool is to move is called the **nominal** position (Ⓢ). The position at which the tool is actually located at any given moment is called the **actual** position (Ⓘ).

The distance from the nominal position to the actual position is called the distance-to-go (Ⓡ).

Sign for distance-to-go

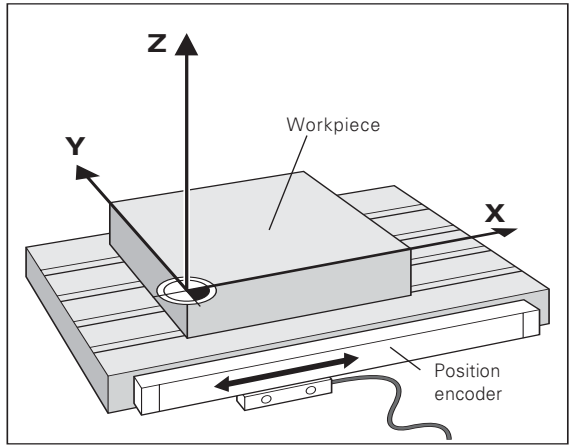
When you are using the distance-to-go display, the nominal position becomes the relative datum (display value 0). The distance-to-go is therefore negative when you move in the positive axis direction, and positive when you move in the negative axis direction.



Position encoders

The position encoders on the machine convert the movements of the machine axes into electrical signals. The ND display unit evaluates these signals, determines the actual position of the machine axes, and displays the position as a numerical value.

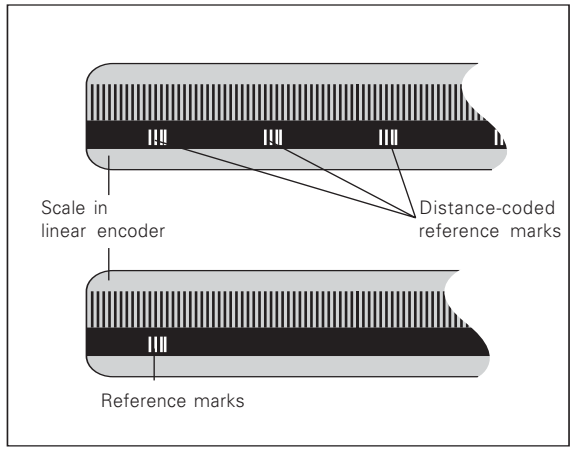
If the power is interrupted, the relationship between the machine axis positions and the calculated actual positions is lost. The reference marks on the position encoders and the REF reference mark evaluation feature enable the ND to quickly re-establish this relationship again when the power is restored.



Reference marks

The scales of the position encoders contain one or more reference marks. When a reference mark is crossed over, a signal is generated which identifies that position as a reference point (scale datum = machine datum).

When these reference marks are crossed over, the ND's reference mark evaluation feature (REF) restores the relationship between axis slide positions and display values which you last defined by setting the datum. If the linear encoders have **distance-coded** reference marks, you need to move the machine axes a maximum of only 20 mm to do this.



Switch-on, Traversing the Reference Marks

0 → 1	Turn on power (switch located on rear panel). REF in the status display starts blinking.
ENT...CL	
ENT	Confirm reference traverse mode. REF indicator stops blinking and stays on. Decimal points blink.
	Cross over the reference marks in all axes (in any sequence). Each axis display becomes active when its reference mark is crossed over.

Crossing over the reference marks stores the most recently defined assignment of display values to axis slide positions for datum points 1 and 2 in nonvolatile memory.

Note that if you choose *not* to traverse the reference marks (by clearing the dialog ENT ... CL with the CL key), this relationship will be lost if the power is interrupted or when the unit is switched off.

If you wish to use multipoint axis error compensation, you must traverse the reference marks (see "Multipoint axis error compensation")!

Datum Setting

If you want to save the datum points in nonvolatile memory, you must first cross over the reference marks.

Only after crossing over the reference marks can you set new datums or activate existing ones.

In P70, you can select:
- Two datum points: The selected datum point is displayed via ⌊1 or ⌊2
- Nine datum points: The selected datum point is displayed in the uppermost axis via d1 to d9.

You set a datum by first pressing the corresponding axis key and then entering a numerical value. To transfer the new datum, press the ENT key. The CL key can be used to clear an incorrect entry.

To call a datum you have set, proceed as follows:

You have set two datum points in P70:

	Select datum 1 or 2.

You have set nine datum points in P70:

	Press the datum key (“d” starts blinking).
	Enter a datum number (1 to 9).

Probing workpiece edges to find a centerline datum

The edges to be probed run parallel to the Y axis.

Follow the procedure below for all centerlines between two edges.

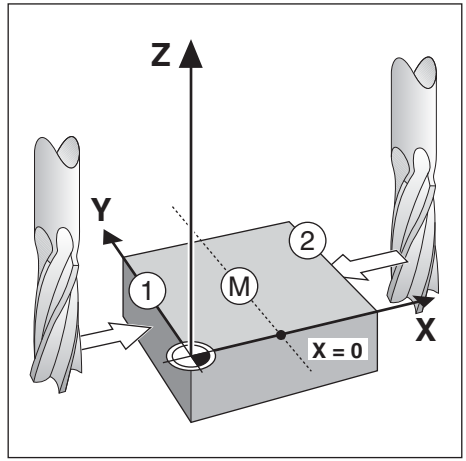
1/2	Select a datum number (see page 13).
SPEC FCT	Select the special functions.

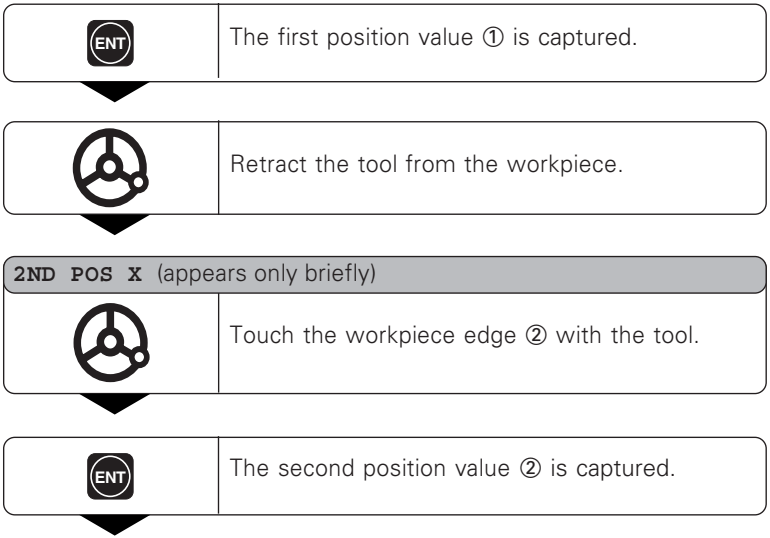
PROBE MIDP.

ENT	Confirm the "probe centerline" function. SET" lights.
X	Select the X axis (if not already selected). The >‖<- status symbol starts blinking.

1ST POS X (appears only briefly)

	Touch the workpiece edge ① with the tool.





After the second position has been transferred, the center line between the two edges is calculated and set as a datum. The current position (2nd position probed) in relation to the center line is displayed. Then the function is automatically terminated.

The function is always effective for the currently active axis (it is possible to switch the axis before the 1st position has been transferred).

Working with a Scaling Factor

Scaling factors enable you to increase or decrease the display values based on the actual traverse distance. The display values are changed symmetrically about the datum.

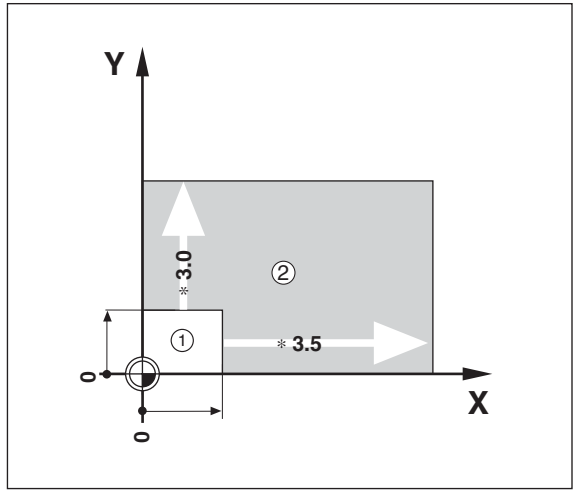
Enter scaling factors separately for each axis in parameter P12.

Parameter P11 activates and deactivates the scaling factors in all axes (see "Operating Parameters").

Example for enlarging a workpiece:

P12.1	3.5
P12.2	3.0
P11	ON

This results in a larger workpiece as shown in the illustration at right: ① is the original size, ② is with axis-specific scaling factors.



If a scaling factor is active, SCL lights in the status display.

MIN position display in the EDM axis:

Since the EDM axis moves up and down very rapidly during the EDM process, it is difficult to read the attained erosion depth from the position display. The ND 760 E therefore allows you to select an operating mode which displays the last position value in the EDM axis.

Sequence of keys:

SHIFT 9 MIN	Call the MIN position display.

The MIN position display is active if the leftmost decimal points light in all axes. The MIN position is internally updated every 5 ms. However, the display is updated only approx. every 30 ms in the MIN position display mode.

In this operating mode, the two other axes indicate the final erosion depth and the distance-to-go (with respect to the final erosion depth).

	EDM axis	**X**	**Y**	**Z (standard)**
Display value	Distance-to-go in EDM axis (probe symbol lights)	Y	X	X
	Final erosion depth	Z	Z	Y
	MIN position of EDM axis	X	Y	Z

In this operating mode, you cannot set any datums.

SHIFT 9 MIN	Exit the MIN position display mode.

Programming the Trigger Points:

1st trigger point before MIN position:

MIN. TP. 1	
SHIFT + 3 MIN	Switching output A1 Input range: 0 to 99 999.9999 mm

1st trigger point before reaching the erosion depth:

TRIG. PNT. 1	
SHIFT + 1	Switching output A3 Input range: 0 to 99 999.9999 mm

2nd trigger point before reaching the erosion depth:

TRIG. PNT. 2	
SHIFT + 2	Switching output A4 Input range: 0 to 99 999.9999 mm

Additional trigger point TP3:

TRIG. PNT. 3	
SHIFT + 5 TP3	Switching output A6 (depends on parameter P21) Input range: -99 999.9999 to 99 999.9999 mm

Additional switching point TP4:

TRIG. PNT. 4	
SHIFT + 6 TP4	Switching output A7 (depends on parameter P21) Input range: -99 999.9999 to 99 999.9999 mm

Trigger point for erosion depth:

ER. DEPTH	
SHIFT + 8 END	Switching output A5 Input range: -99 999.9999 to 99 999.9999 mm

Start position (HOME position):

START POS.	
SHIFT + 7 HOME	Switching output A6 (depends on parameter P21) Input range: -99 999.9999 to 99 999.9999 mm

After the respective trigger point has been called, the currently valid value is displayed in the Y axis. You can enter a new value with the numerical keys and transfer it with the ENT key. To cancel this operating mode, press the SHIFT or the CLkey.

The second trigger point before the MIN position is programmed in parameter P17 (or P18).

Add key

COMP. DEPTH	
SHIFT + 4 (ΔZ)	Input range: -99 999.9999 to 99 999.9999 mm

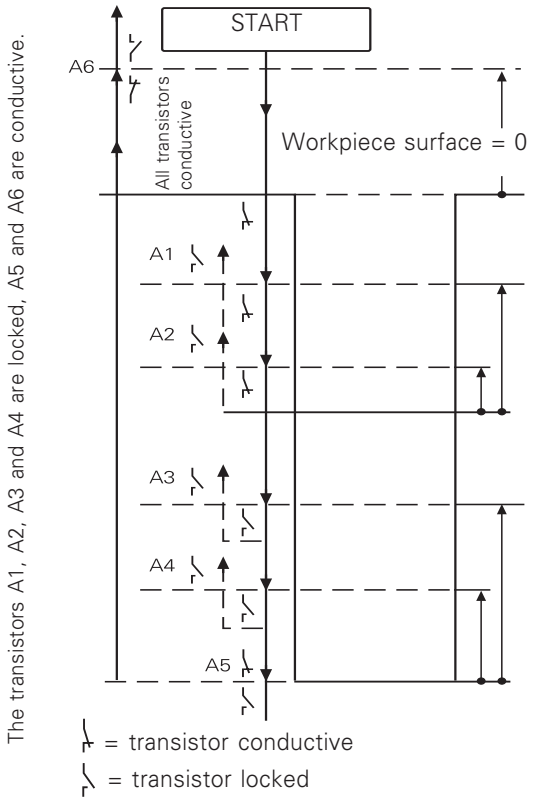
After the compensation value has been called, the currently valid value is displayed in the Y axis. You can enter a new value with the numerical keys and transfer it with the ENT key.

The compensation value is used to calculate a new erosion depth. If no value is entered, the displayed value is used for the calculation.

To cancel this operating mode, press the SHIFT or the CL key (the displayed value is then not used for the calculation).

Description of Switching Output Functions (Settings in parameter P21: "STANDARD")

After an EDM process, the transistors A1, A2, A3, A4 and A6 are locked. A5 is conductive.



A1, A2, A5, A6 switch whenever the the trigger point is traversed.
A3, A4 switch only once, i.e. when the trigger point is traversed for the first time.

Start position (HOME) referenced to display value 0, programmable with the SHIFT 7 HOME keys.

Trigger points before MIN position

1st trigger point before MIN position, programmable with the SHIFT 3 MIN keys.

2nd trigger point before MIN position, programmable in parameter 17 which is protected by a code number.

Trigger points with respect to erosion depth

1st trigger point before reaching the erosion depth, programmable with the SHIFT 1 keys.

2nd trigger point before reaching the erosion depth, programmable with the SHIFT 2 keys.

Trigger point for erosion depth, programmable with the SHIFT 8 END keys.

Description of functions:

Start position (HOME)

After an EDM process, when the EDM axis has returned to the start position, the transistors A1, A2, A3, A4 and A6 are locked (high-level outputs). A5 is conductive (low-level output). The start position is referenced to the defined workpiece datum of the EDM axis and is programmable with the 

keys.

If the EDM generator and the start position are traversed in the negative direction, the transistors for the outputs A1, A2, A3, A4 and A6 become conductive (low-level outputs).

Trigger points before MIN position:

The ND 760 E can be switched from the standard actual value display mode to the MIN position display mode, i.e. the EDM axis always displays the minimum position value. Due to the quick up-and-down motion of the EDM axis, HEIDENHAIN recommends using this display mode for EDM processes. You can define two trigger points that are referenced to the MIN position value. The first trigger point is defined with the 

keys.

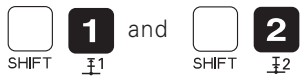
The user can easily change this trigger point. The trigger point can be used as a signal for reversing the direction of movement during cyclic retraction (used to improve the flushing process).

The second trigger point before the MIN position value is defined in parameter P17 (or P18). This trigger point can be used for functions whose trigger point must not be changed by the operator. It could be used, for example, for changing the switching functions for the speed controller for the EDM axis so that the electrode retracts rapidly during the cyclic retraction process in order to enable the controller to switch back to the standard speed before the MIN position value has been reached.

The transistors for both switching outputs are locked when the electrode is retracted along the programmed path. The transistor becomes conductive again as soon as the electrode is located within the programmed path during the downward motion.

Trigger points with respect to the erosion depth:

Before the erosion depth is reached, two trigger points can be entered with the following keys:



These trigger points refer to the erosion depth. If the electrode reaches the programmed distance from the erosion depth, the corresponding transistor is locked. The transistor remains locked even if the electrode is retracted along the programmed path by the controller.

Trigger point for erosion depth

The trigger point for the erosion depth switches the EDM generator off. The electrode automatically moves up to the start position.

End of the EDM process

As soon as the start position (HOME) has been reached or crossed over in the positive direction, the transistor for the start position is locked (depends on P21). All transistors, except A5, are then locked and the initial condition is restored. At this stage, a new EDM process can be started.

Example of input for switching outputs

Switching output:	Input:
Start position (HOME)	+ 10.000 mm
1st trigger point before MIN position	3.000 mm
2nd trigger point before MIN position (P17 or P18)	0.100 mm
1st trigger point before reaching the erosion depth	2.000 mm
2nd trigger point before reaching the erosion depth	1.000 mm
Trigger point for erosion depth (END)	- 20.000 mm

Error Messages

Message	Cause and Effect
`SIGNAL X`	Encoder signal is too weak, e.g. when an encoder is contaminated.
`ERR. REF. X`	The spacing of the reference marks as defined in P43 is not the same as the actual spacing.
`FRQ. X`	The input frequency for this encoder input is too high. This can occur when the scale is moved too fast.
`ERR. MEMORY`	Checksum error: Check the datum, operating parameters and compensation values for multipoint axis error compensation. If the error recurs, contact your service agency!

To erase error messages:
After you have removed the cause of error:
➤ Press the CL key.

Part II Installation and Specifications

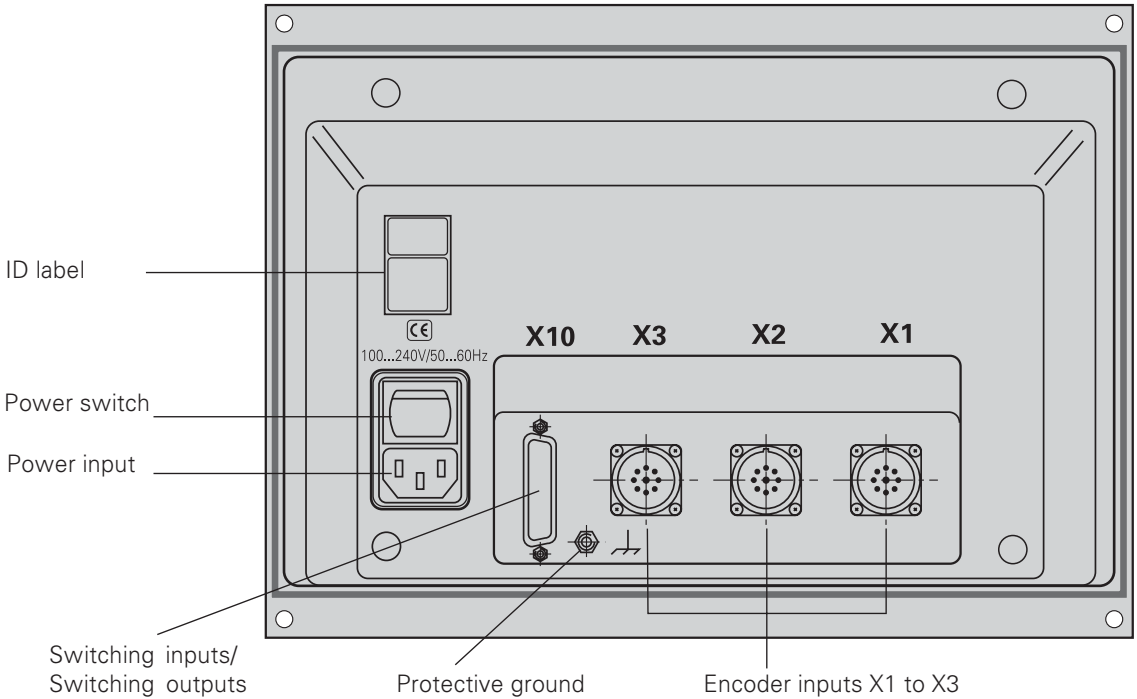
Items Supplied

- **ND 760 E**

- **Power connector** Id. Nr. 257 811-01

- **User's Manual**

Connections on Rear Panel



The interfaces X1, X2, X3, and X10 comply with the requirements for electrical separation according to EN 50178!

Power Connection

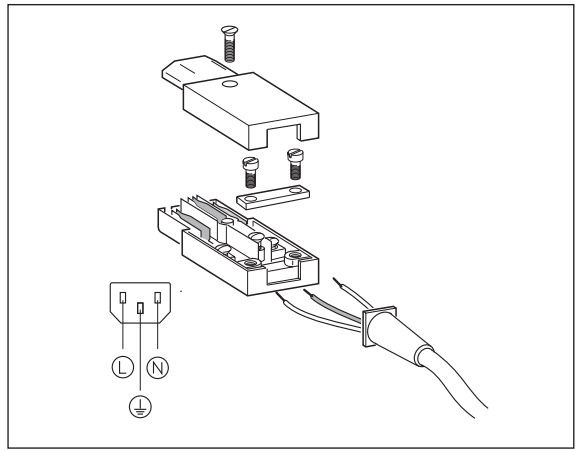
Power leads: Ⓛ and Ⓝ,
Connect protective ground to ⏚ !

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

A voltage selector is not necessary.

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

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).



Connecting the Encoders

Your display unit will accept all HEIDENHAIN linear encoders with sinusoidal output signals (7 to 16 μA_{pp}) and distance-coded or single reference marks.

Assignment of the encoder inputs

Encoder input X1 is for the X axis
Encoder input X2 is for the Y axis
Encoder input X3 is for the Z axis

Encoder monitoring system

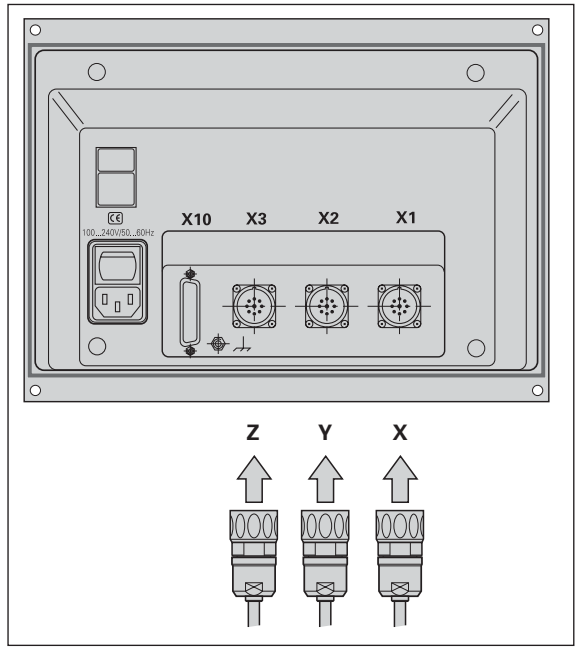
Your display unit features a monitoring system for checking the amplitude and frequency of the encoder signals. If it detects a faulty signal, one of the following error messages will be generated:

```
SIGNAL X
FRQ. X
```

Encoder monitoring can be activated with parameter P45.

If you are using linear encoders with distance-coded reference marks, the encoder monitoring system also checks whether the spacing of the reference marks as defined in parameter P43 is the same as the actual spacing on the scales. If it is not, the following error message will be generated:

```
ERR. REF. X
```



Operating Parameters

Operating parameters allow you to modify the operating characteristics of your display unit and define the evaluation of the encoder signals. Operating parameters that can be changed by the user are called user parameters, and can be accessed with the SPEC FCT key and the dialog "PARAMETER" (user parameters are identified as such in the parameter list). The full range of parameters can only be accessed through the dialog "CODE" and by entering 95148.

Operating parameters are designated by the letter P and a number. Example: **P11**. The parameter designation is shown in the X display when you select it with the DATUM and ENT keys. The parameter setting is shown in the Y display.

Some operating parameters have separate values for each axis. Such parameters have an additional index number from 1 to 3

Example: P12.1 scaling factor, X axis
P12.2 scaling factor, Y axis
P12.3 scaling factor, Z axis

The operating parameters are preset before the unit leaves the factory. These factory default settings are indicated in the parameter list in **boldface type**.

Entering and changing operating parameters

To access the operating parameters

- ➤ Press the SPEC FCT key.
- ➤ Press the SPEC FCT key or ↓1 ↓2 , until "PARAMETER" appears in the X display.
- ➤ Confirm your selection by pressing ENT.

To select protected operating parameters

- ➤ Press the ↓1 ↓2 key to select the P00 CODE user parameter.
- ➤ Enter the code number 95148.
- ➤ Confirm with the ENT key.

To page through the operating parameters

- ➤ Page forwards by pressing the ENT key.
- ➤ Page backwards by pressing the ↓1 ↓2 key.

To change parameter settings

- ➤ Press the minus key or enter the value and confirm with the ENT key.

To correct an entry

- ➤ Press CL: the old value reappears in the input line and becomes effective again.

To exit the operating parameters

- ➤ Press the SPEC FCT or CL key.

To exit the operating parameters

- ➤ Press the SPEC FCT or CL key.

P00 CODE Enter code number

9 51 48:	Change protected operating parameters
66 55 44:	Display the software version (in the X axis)
	Display the date of release (in the Y axis)
10 52 96:	Multipoint axis error compensation

P01 Unit of measure [1)]

Display in millimeters	**MM**
Display in inches	INCH

P03.1 to P03.3 Radius/diameter display [1)]

Display position value as radius	**RADIUS**
Display position value as diameter	DIAMETER

P11 Activate scaling factor [1)]

Active	SCALING ON
Not active	**SCALING OFF**

P12.1 to P12.3 Define scaling factor [1)]

Enter a scaling factor separately for each axis:
Entry value > 1: workpiece will "grow"
Entry value = 1: workpiece will remain the same size
Entry value < 1: workpiece will "shrink"

Input range:	0.100000 to 9.999999
Default setting:	**1.000000**

P13.1 to P13.3 Shrinkage compensation

Input range (µm):	-99999 to +99999
Default setting:	**0**

Example: Input value = 2% corresponds to 20 000 µm/m
Please note: If you use the shrinkage compensation in addition to the linear compensation, the compensation values will superimpose each other multiplicatively.

P17 MIN.P2.1

2nd trigger point before MIN position, switching output A2

Input range:	0 to + 99999.9999 mm
Default setting:	**0**

P 18 MIN.P2.2

2nd trigger point for output A2

Input range:	0 to + 99999.9999 mm
Default setting:	**0**

In parameter P20, you select the trigger point to be effective for output A2 (trigger point defined in P17 or P18).

[1)] User parameter

P20 E1-E3

Define the functions of the switching inputs E1, E2, E3.

EXT. SET TO ZERO (default setting)
The axes X, Y, or Z are set to zero with a switching pulse (0V at inputs E1, E2 or E3).

AXIS SELECTION
Depending on the condition of the switching inputs E1 and E2, the EDM axis varies.

E1	E2	EDM axis
Low	Low	Z
High	Low	Y
Low	High	X
High	High	Z

The input E3 allows you to select the trigger point to be effective for the output A2 (trigger point defined in P17 or P18).

E3	Trigger point off
Low	P18
High	P17

The axes can no longer be set to zero.

P21 DEF.TP

Define the functions of the trigger points.

STANDARD (default setting)
Standard switching function
(switching functions TP3 and TP4 are not used)

TP3 + 4
The output A6 is assigned to switching point TP3 (no longer to HOME). The output A7 is assigned to switching point TP4. Both trigger points are referenced to workpiece datum = 0 (they can be used, for example, to change the generator settings).

TP3 + 4 CODE
Function as described above (TP3 + 4).
The trigger points at the outputs A3, A4, A6, and A7 are transmitted in coded form:

Output	Code	Value
A3	Bit 0	$2^0 = 1$
A4	Bit 1	$2^1 = 2$
A6	Bit 2	$2^2 = 4$
A7	Bit 3	$2^3 = 8$

The assignment of code values to trigger points is described in parameters P22 to P25.

P22 CODE 1

Code value for trigger point TP3.
Input range: 0 to 15
Default setting: **0**

P23 CODE 2

Code value for trigger point TP4.
Input range: 0 to 15
Default setting: **0**

P24 CODE 3

Code value for trigger point A3 (1st trigger point before erosion depth)
Input range: 0 to 15
Default setting: **0**

P25 CODE 4

Code value for trigger point A4 (2nd trigger point before erosion depth)
Input range: 0 to 15
Default setting: **0**

Example: 1st trigger point before erosion depth P24 = 10;

Value	8	4	2	1	
Binary value	1	0	1	0	= decimal value 10
Output	A7	A6	A4	A3	
Transistor conductive		X		X	
Transistor locked	X		X		

Definition: Bit = 0 .....output transistor conductive
Bit = 1 .....output transistor locked

P30.1 to P30.3 Counting direction

Positive counting direction with positive direction of traverse **DIRECT. POS**

Negative counting direction with positive direction of traverse DIRECT. NEG

P31.1 to P31.3 Signal period of the encoder

Input range: 0.00000001 to 99999.9999 µm
Default setting: **10 µm**

P33.1 to P33.3 Counting mode

0 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9
0 - 2 - 4 - 6 - 8
0 - 5

P38.1 to P38.3 Decimal places

2 / 3 / **4** / 5 / 6 / 7 / 8 (up to 8 with inch display)

P40.1 to P40.3 Select type of axis error compensation

No axis error compensation **COMP. OFF**

Linear error compensation active, multipoint error comp. not active COMP. LIN

Multipoint error compensation active, linear error compensation not active COMP. MULTI

P41.1 to P41.3 Linear axis error compensation

Input range (µm): –99999 to +99999
Factory default setting: **0**

Example: Displayed length L_d = 620.000 mm
Actual length (as determined for example with the VM 101 from HEIDENHAIN)
L_a = 619.876 mm
Difference $\Delta L = L_a - L_d = -124$ µm
Compensation factor k:
$k = \Delta L/L_d = -124$ µm/0.62 m = **– 200** [µm/m]

P43.1 to P43.3 Reference marks

One reference mark	**SINGLE REF. M.**
Distance-coded with 500 • SP	500 SP
Distance-coded with 1000 • SP	1000 SP
Distance-coded with 2000 • SP	2000 SP
Distance-coded with 5000 • SP	5000 SP

(SP: signal period)

P44.1 to P44.3 Reference mark evaluation

Evaluation	**REF. X ON**
No evaluation	REF. X OFF

P45.1 to P45.3 Encoder monitoring

Amplitude and frequency monitoring	**ALARM ON**
No monitoring	ALARM OFF

P48.1 to P48.3 Activate axis display

Axis display active	**AXIS ON**
Not active	AXIS OFF

P70 Number of datum points

2 datum points	**2 DATUM PT.**
9 datum points	9 DATUM PT.

Function of the CL key

Set to zero with CL	CL....RESET
No set to zero with CL	**CL......OFF**

P98 Conversational language [1)]

German	**LANGUAGE DE**
English	LANGUAGE EN
French	LANGUAGE FR
Italian	LANGUAGE IT
Dutch	LANGUAGE NL
Spanish	LANGUAGE ES
Danish	LANGUAGE DA
Swedish	LANGUAGE SV
Finnish	LANGUAGE FI
Czech	LANGUAGE CS
Polish	LANGUAGE PL
Hungarian	LANGUAGE HU
Portuguese	LANGUAGE PT

[1)] User parameter

Linear Encoders

The display unit is designed for connection of photoelectric encoders with sinusoidal signals of 7 µA$_{PP}$ to 16 µA$_{PP}$.

Selecting the display step with linear encoders

To select a certain display step, you must define 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 parameters.

Parameter settings for HEIDENHAIN linear encoders with 11 μA_{PP}

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

Parameter settings for HEIDENHAIN linear encoders with 11 μA_{PP} (continued)

Model	Signal period [µm]	Reference mark	Millimeters			Inches		
			Display step [mm]	Counting mode	Decimal places	Display step [inch]	Counting 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
			Recommended 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

Multipoint Axis Error Compensation

If you want to use the multipoint axis error compensation feature, you must
- activate this 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 drivescrew errors. Such deviations are usually measured with a comparator measuring system (such as the HEIDENHAIN VM 101).

You can, for example, determine the screw pitch error X=F(X) for the X axis.

An axis can only be corrected in relation to **one** axis that has an error. In each axis, a compensation value table with 64 compensation values can be generated. You can select the compensation table with the SPEC FCT key and the "PARAMETER\CODE" dialog.

To determine the compensation values (e.g. with a VM 101), the REF display must be selected after selecting the compensation-value table.

SHIFT	Select the REF display.

The decimal point in the left display field indicates that the displayed values are referenced to the reference point. If the decimal point blinks, the reference marks have not been traversed.

Entries in the compensation-value table

- Axis to be corrected: X, Y or Z
- Axis causing the error: X, Y or Z
- Datum for the axis to be corrected:
  Here you enter the point starting at which the axis with error is to be corrected. This point indicates the absolute distance to the reference point.

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

- Spacing of the compensation points
  The spacing of the compensation points is expressed as 2^X [µm].
  Enter the value of the exponent *x* into the compensation value table.
  Minimum input value: 6 (= 0.064 mm)
  Maximum input value: 20 (= 1048.576 mm)
  23 (= 8388.608 mm)

  Example: 900 mm traverse and 15 compensation points results in 60.000 mm spacing between points.
  Nearest power of two: 2^{16} [µm] = 65.536 mm
  Entry in compensation value 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.

Selecting the compensation table, entering an axis correction

SPEC FCT	Select the special functions.
SPEC FCT or ↓1 ↓2	Select the "parameter" function if required, by repeatedly pressing the ↓1 ↓2 key.
PARAMETER	
ENT ↓1 ↓2	Select dialog for entering the code number.
CODE	
1 0 5 2 9 6 ENT	Enter code number 105296 and confirm with ENT.
AXIS X	
X ENT	Select axis to be corrected, e.g. X. Confirm with ENT.
X FCT. X	
X ENT	Enter the axis causing the error, e.g. X (screw pitch error), and confirm with ENT.
• •	
DATUM X	
2 7 ENT	Enter the active datum for the error on the axis to be corrected (e.g. 27 mm) and confirm with ENT.
SPACING X	
1 0 ENT	Enter the spacing of the compensation points on the axis to be corrected, for example 2^{10} µm (equals 1.024 mm) and confirm with ENT.
27.000	
ENT 0 • 0 1 ENT	Compensation point no. 1 is displayed. Enter the associated compensation value (e.g. 0.01 mm) and confirm with ENT.
• •	

28.024	
ENT, ↓1/↓2	Enter all further compensation points. If you press the minus key, the number of the current compensation point will be shown in the X display. Direct selection of compensation points: Press the minus key together with the number (two-digit) of the desired compensation point.

SPEC FCT or CL	Conclude entry.

Deleting a compensation-value table

SPEC FCT	Select the special functions.
SPEC FCT or ↓1/↓2	Select the "parameter" function.
PARAMETER	
ENT, ↓1/↓2	Select the dialog for entering the code number.
CODE	
1 0 5 2 9 6 ENT	Enter the code number 105296 and confirm with ENT.
AXIS X	
Z CL	Select the compensation value table (e.g., for the Z axis), and delete the table.
DELETE Z	
ENT	Confirm with ENT, or cancel with CL.
SPEC FCT	Conclude entry.

Switching Inputs/Switching Outputs X10

Danger to internal components!
The voltage of external electric circuits must meet the requirements for functional extra-low voltage with electrical separation according to EN 50 178. When connecting inductive loads, be sure to connect a suppressor diode in parallel with the inductance.

Use only shielded cables!
Connect the shield to the connector housing.

Inputs at the D-sub connection X10

Pin	Function	
1	E1	Set X axis to zero
9	E2	Set Y axis to zero
2	E3	Set Z axis to zero
3	0 volt	
10	0 volt	

The axis that has been set to zero becomes the active axis (SET symbol lights).

During parameter input, it is not possible to externally set the axis to zero.

Outputs at the D-sub connection X10

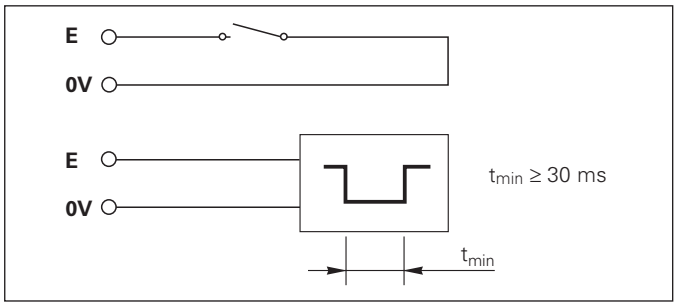
Pin	Function	
8	A0	Non-functional
7	A1	1st trigger point 1 before MIN position value
6	A2	2nd trigger point before MIN position value
5	A3	1st trigger point before erosion depth
15	A4	2nd trigger point before erosion depth
14	A5	Erosion depth
13	A6	Start position (Home) or TP3 (P21)
12	A7	TP4
4	0 volt	
11	0 volt	

Inputs

Input signals
Internal "pull-up" resistor 1 kΩ, active low
Triggered by contact closure against 0 V or low-level voltage via TTL module
Minimum pulse duration: $t_{min} \geq 30$ ms

Signal level of inputs

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

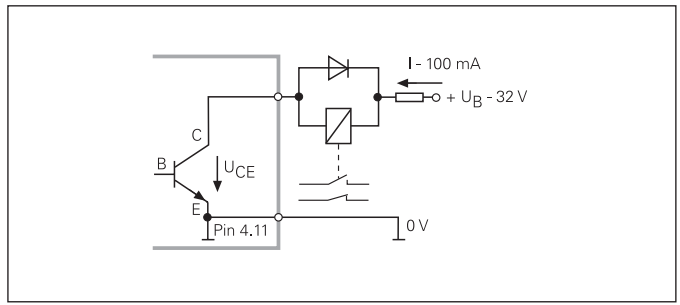


Outputs

Output signals
Open collector outputs, active low
Delay time for signal output: $t_v \leq 30$ ms

Signal level of outputs

Status	Level
High	U ≤ + 32 V; I ≤ 10 µA
Low	U ≤ + 0.4 V; I ≤ 100 mA

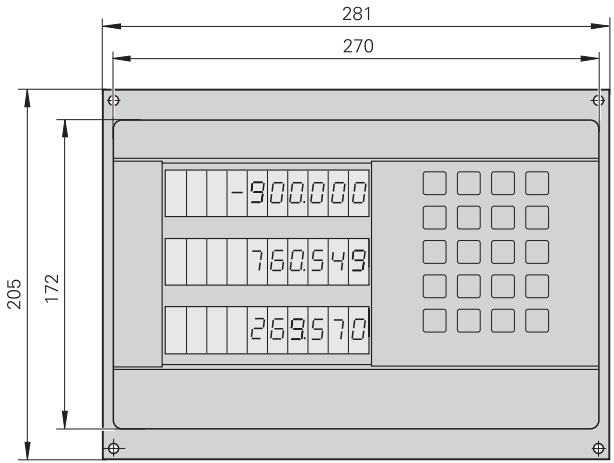


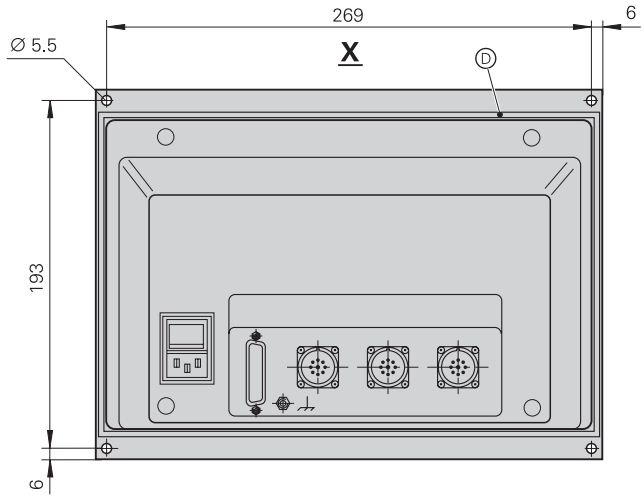
Specifications

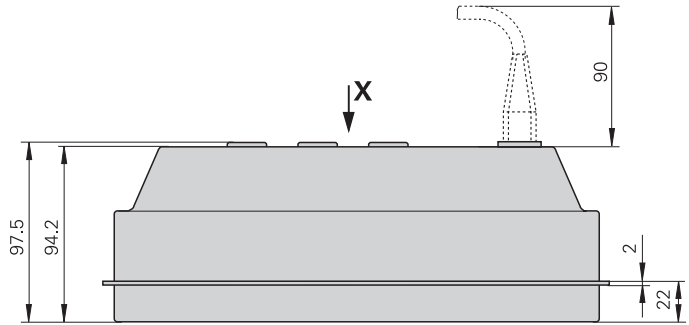
Housing	ND 760 E Cast-metal housing Dimensions (W • H • D) 281 mm • 205 mm • 97.5 mm
Oper. temperature	0° to 45° C (32° to 113° F)
Storage temperature	–20° to 70° C (–4° to 158° F)
Weight	Approx. 2.3 kg (5 lb)
Relative humidity	<75% annual average <90% in rare cases
Power supply	100 Vac to 240 Vac (-15 % to +10 %) 50 Hz to 60 Hz (± 2 Hz)
Power consumption	15 W
Protection	IP40 as per EN 60 529

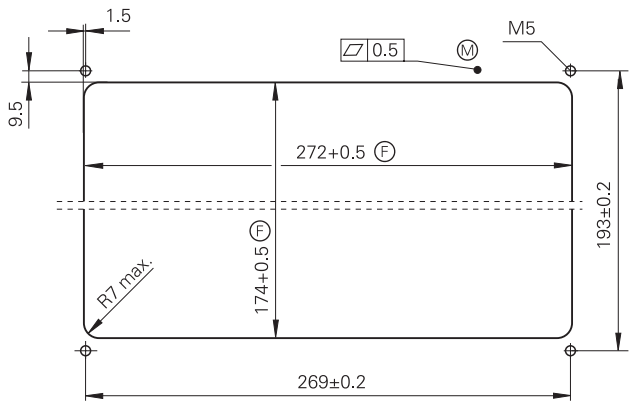
Encoder inputs	For encoders with 7 to 16 μA_{PP} Grating period 2, 4, 10, 20, 40, 100, 200 µm and 12.8 mm Reference mark evaluation for distance-coded and single reference marks
Input frequency	Max. 100 kHz for 30 m (98.5 ft) cable length
Display step	Adjustable (see "Linear Encoders")
Datums	9 (nonvolatile)
Functions	– 7 switching outputs – Scaling factor – Probing functions – MIN position display – Add key for erosion depth – External set to zero

Dimensions in mm









Ⓕ = Opening for panel mounting Ⓜ = Mounting surface
Ⓓ = Complete seal

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