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HEIDENHAIN

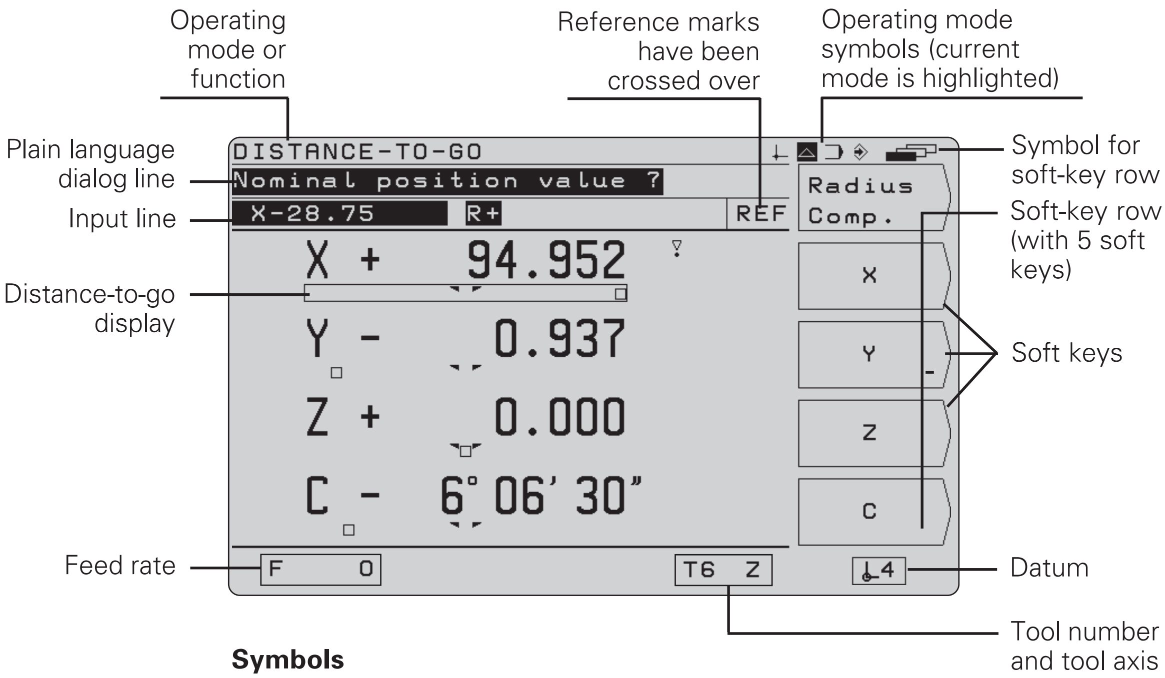
User's Manual

POSITIP 855

for Milling

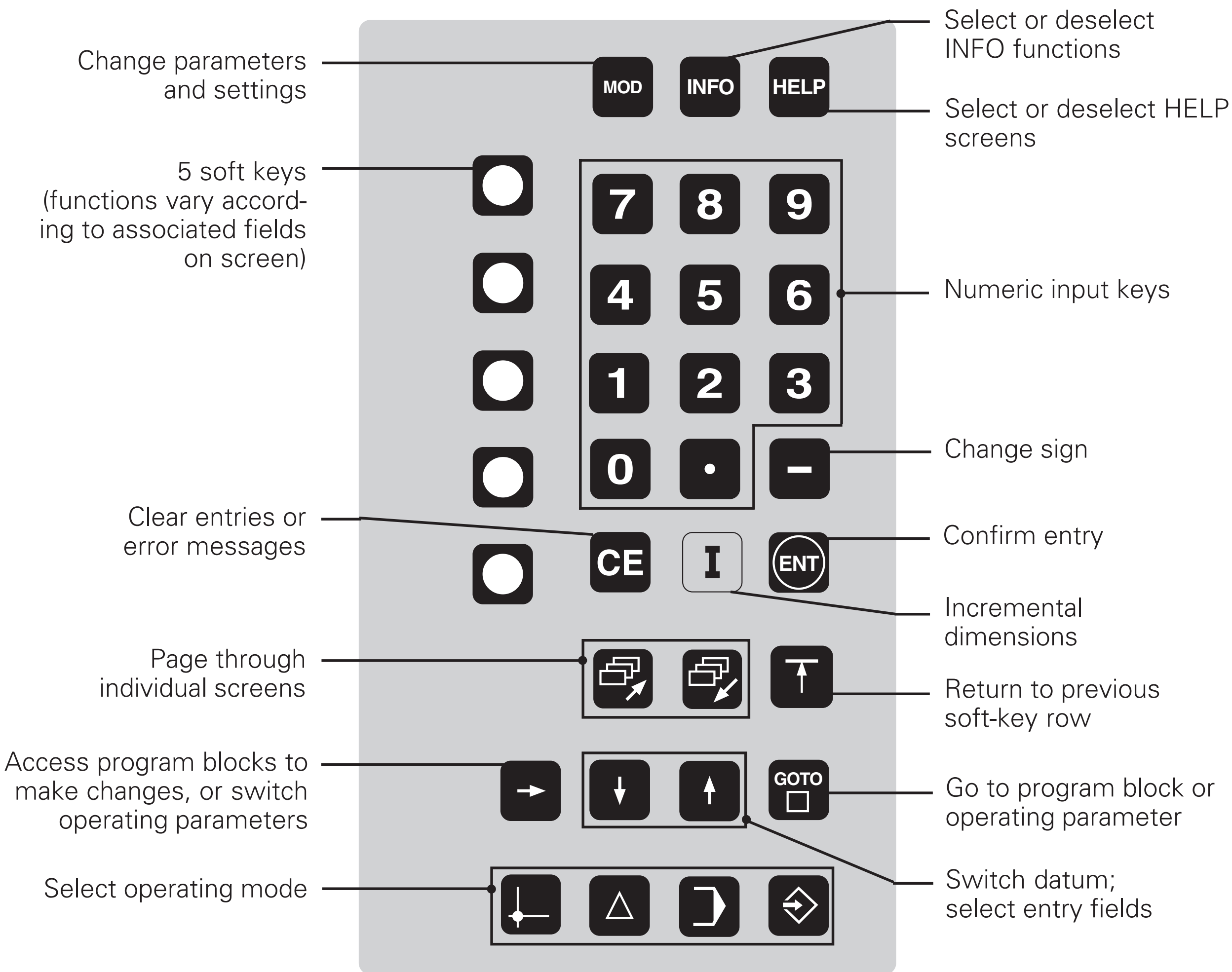
September 1999

Screen



Symbols
Behind the position display:
∇: Scaling factor or oversize active
Ø: Diameter display

Keyboard



Software version

This User's Manual is for POSITIP models with the following software version:

246 xxx **05**.

The x's can be any numbers. The software version of your unit is shown on a label on the rear panel.

> This User's Manual covers the functions of the POSITIP 855 for **milling** applications. For **turning** applications, a separate manual is available.

Location for use

This unit corresponds to class A in accordance with EN 55022 and will be used predominantly in industrially zoned areas

About this manual

This manual is divided into two parts:

Operating Instructions

When using the POSITIP in your work, you need only refer to the Operating Instructions (**Part I**).

If you're new to POSITIP, you can use the operating instructions as a step-by-step workbook. This part begins with a short introduction to the basics of coordinate systems and position feedback, and provides an overview of the available features. Each feature is explained in detail, using an example which you can immediately try out on the machine — so you won't get "lost" in the theory. As a beginner you should work through all the examples presented.

If you're already familiar with POSITIP, you can use the operating instructions as a comprehensive review and reference guide. The clear layout and the subject index make it easy to find the desired topics.

Technical Information

If you are interfacing POSITIP to a machine or wish to use the data interfaces, refer to the technical information in **Part II**.

Subject Index

A subject index for both parts of the manual can be found on pages 113 to 115.

Dialog flowcharts

Dialog flowcharts are used for each example in this manual.
They are laid out as follows:

This area shows the **keys** to press.	This area explains the **key function** or **work step**. If necessary, supplementary information will also be included.

Prompt	
This area shows the **keys** to press.	This area explains the **key function** or **work step**. If necessary, supplementary information will also be included.

If there is an arrow at the end of the flowchart, this means that it continues on the next page.

A **prompt** appears with some actions (not always) at the top of the screen. In the flowcharts the prompts always have a gray background.

If two flowcharts are divided by a **broken line**, this means that you can follow the instructions either above or below the broken line.

Some flowcharts also show the screen that will appear after you press the correct keys.

Abbreviated flowcharts
Abbreviated flowcharts supplement the examples and explanations. An arrow (➤) indicates a new input or a work step.

Important Notes in this Manual

The surfaces marked gray contain especially important information. Please pay special attention to these notes.
Neglecting this information can result in e.g. functions not working in the desired way or in causing damage to the workpiece or to the tool.

Symbols within the notes

Every note is marked with a symbol on the left informing about the meaning of the note.

General Information,
e.g. on the behaviour of the POSITIP.

Important Information,
e.g. when a special tool is required for a function.

Electric Shock Warning,
e.g. when opening a housing.

Part I: Operating Instructions

I - 1
Fundamentals of Positioning

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

Coordinate systems

In order to define positions on a surface, a reference system is required. For example, positions on the earth's surface can be defined absolutely by their geographic coordinates of longitude and latitude. The term *coordinate* comes from the Latin word for "that which is arranged." In contrast to the relative definition of a position that is referenced to a known location, the network of horizontal and vertical lines on the globe constitute an absolute reference system.

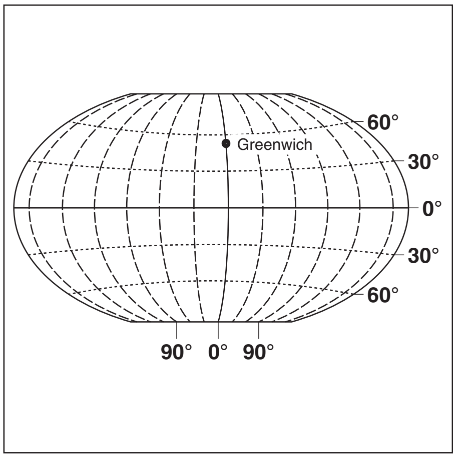


Fig. 1: The geographic coordinate system is an absolute reference system

On a milling machine, workpieces are normally machined according to a workpiece-based Cartesian coordinate system (a rectangular coordinate system named after the French mathematician and philosopher Renatus Cartesius, who lived from 1596 to 1650). The Cartesian coordinate system is based on three coordinate axes designated X, Y and Z which are parallel to the machine guideways.

The figure to the right illustrates the "right-hand rule" for remembering the three axis directions: the middle finger is pointing in the positive direction of the tool axis from the workpiece toward the tool (the Z axis), the thumb is pointing in the positive X direction, and the index finger in the positive Y direction.

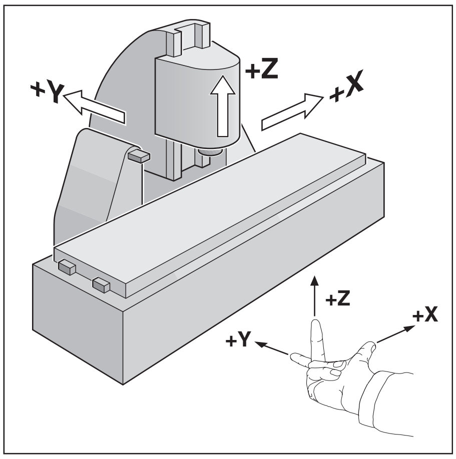


Fig. 2: Designations and directions of the axes on a milling machine

Setting the datum

The workpiece drawing identifies a certain point on the workpiece (usually a corner) as the "absolute datum" and perhaps one or more other points as relative datums. The datum setting procedure establishes these points as the origin of the absolute or relative coordinate systems: The workpiece, which is aligned with the machine axes, is moved to a certain position relative to the tool and the display is set either to zero or to another appropriate value (e.g., to compensate the tool radius).

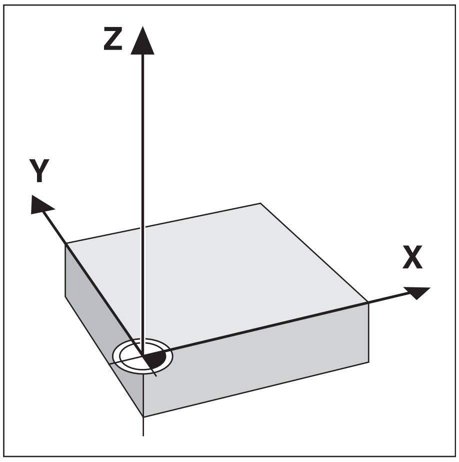
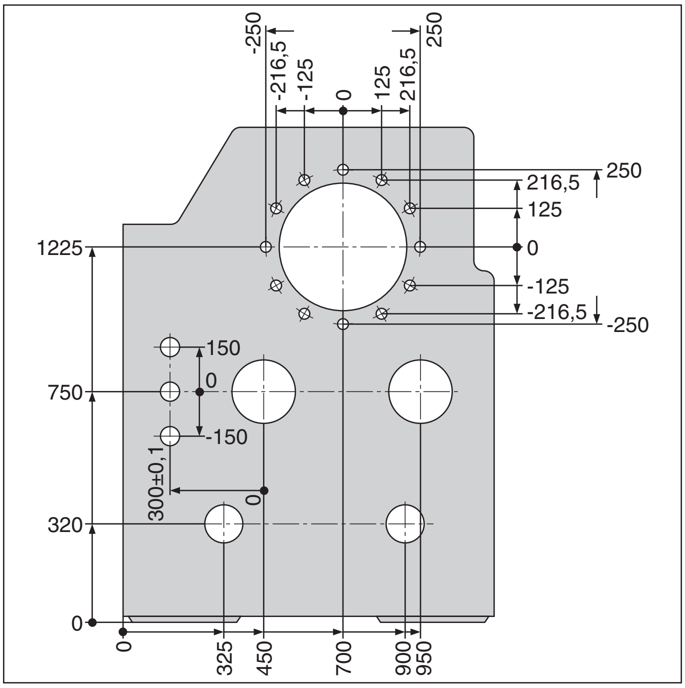


Fig. 3: The workpiece datum represents the origin of the Cartesian coordinate system

Example: Drawing with several relative datums (ISO 129 or DIN 406 Part 11, fig. 171)



Example: Coordinates of hole ① :

X = 10 mm
Y = 5 mm
Z = 0 mm (hole depth: Z = – 5 mm)

The datum of the Cartesian coordinate system is located 10 mm from hole ① in the X axis and 5 mm from it in the Y axis (in negative direction).

The KT Edge Finder from HEIDENHAIN, together with the POSITIP'S edge finding functions, facilitates finding and setting datums.

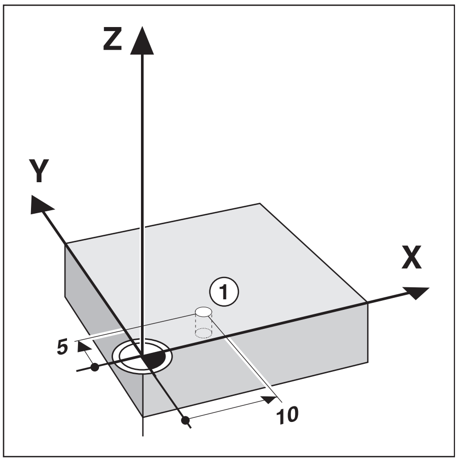


Fig. 4: Hole ① defines the coordinate system

Nominal position, actual position and distance-to-go

The position that the tool is to move to is called the **nominal position**, while the position of the tool 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

The distance-to-go has a **positive sign** if the axis direction from the actual towards the nominal position is negative.
The distance-to-go has a **negative sign** if the axis direction from the actual towards the nominal position is positive.

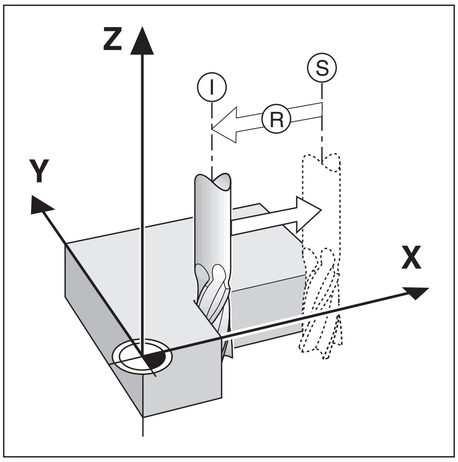


Fig. 5: Nominal position Ⓢ, actual position Ⓘ and distance-to-go Ⓡ

Absolute workpiece positions

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

Example: Absolute coordinates of the position ①:

X = 20 mm
Y = 10 mm
Z = 15 mm

If you are drilling or milling a workpiece according to a workpiece drawing with absolute coordinates, you are moving the tool **to** the value of the coordinates.

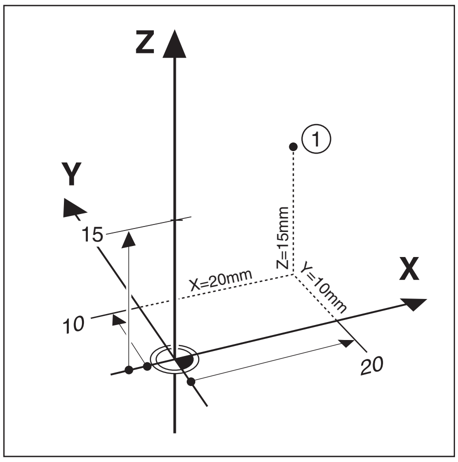


Fig. 6: Position definition through absolute coordinates

Incremental workpiece positions

A position can also be referenced to the preceding nominal position. In this case the relative datum is always the last programmed position. Such coordinates are referred to as **incremental coordinates** (increment = increase). They are also called incremental or chain dimensions (since the positions are defined as a chain of dimensions). Incremental coordinates are designated with the prefix **I**.

Example: Incremental coordinates of position ③ referenced to position ②

Absolute coordinates of position ②:

X = 10 mm
Y = 5 mm
Z = 20 mm

Incremental coordinates of position ③:

IX= 10 mm
IY= 10 mm
IZ= –15 mm

If you are drilling or milling a workpiece according to a drawing with incremental coordinates, you are moving the tool **by** the value of the coordinates.

An incremental position definition is therefore a specifically *relative* definition. Likewise, a position defined by the **distance-to-go** to the nominal position is also a relative position (in this case the relative datum is in the nominal position).

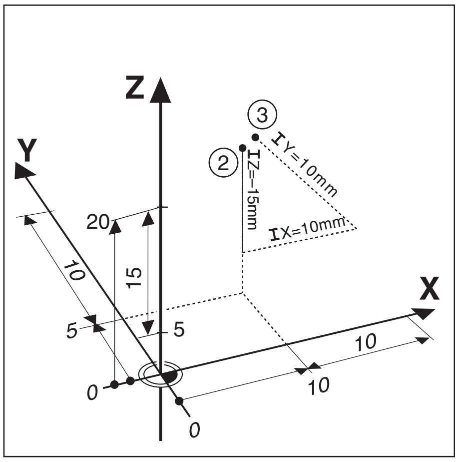
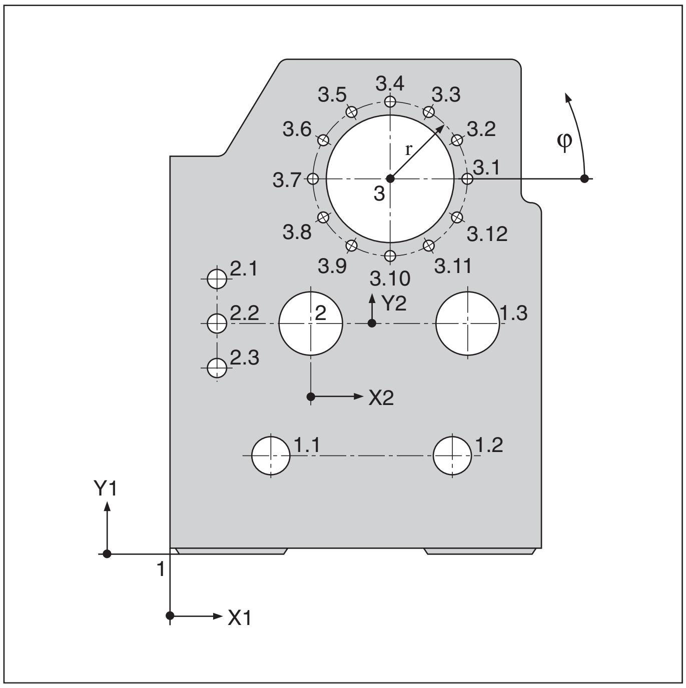


Fig. 7: Position definition through incremental coordinates

Example: Workpiece drawing with coordinate dimensioning (ISO 129 or DIN 406 part 11, fig. 179)



A coordinate list corresponding to this example is useful when working in the operating mode `PROGRAMMING AND EDITING`.

Coordinate origin	Pos.	Dimensions in mm						
		Coordinates						
		X1 X2	Y1 Y2	r	φ	d		
1	1	0	0			–		
1	1.1	325	320			∅	120	H7
1	1.2	900	320			∅	120	H7
1	1.3	950	750			∅	200	H7
1	2	450	750			∅	200	H7
1	3	700	1225			∅	400	H8
2	2.1	– 300	150			∅	50	H11
2	2.2	– 300	0			∅	50	H11
2	2.3	– 300	– 150			∅	50	H11
3	3.1			250	0°	∅	26	
3	3.2			250	30°	∅	26	
3	3.3			250	60°	∅	26	
3	3.4			250	90°	∅	26	
3	3.5			250	120°	∅	26	
3	3.6			250	150°	∅	26	
3	3.7			250	180°	∅	26	
3	3.8			250	210°	∅	26	
3	3.9			250	240°	∅	26	
3	3.10			250	270°	∅	26	
3	3.11			250	300°	∅	26	
3	3.12			250	330°	∅	26	

Position feedback

The position feedback encoders convert the movement of the machine axes into electrical signals. The POSITIP constantly evaluates these signals and calculates the actual positions of the machine axes, which it displays as a numerical value on the screen.

If there is an interruption in power, the calculated position will no longer correspond to the actual position. When power is restored, you can re-establish this relationship with the aid of the reference marks on the position encoders and the POSITIP's reference mark evaluation feature (REF).

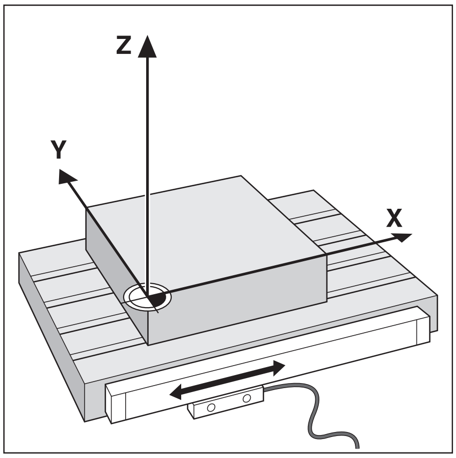


Fig. 8: Linear position encoder, here for the X axis

Reference marks

The scales of the position encoders contain one or more reference marks. When a reference mark is passed over, it generates a signal which identifies that position as the reference point (scale reference point = machine reference point). With the aid of this reference mark the POSITIP's REF feature re-establishes the assignment of displayed positions to machine axis positions which you last defined by setting the datum.

If the position encoders feature **distance-coded** reference marks, each axis need only move a maximum of 20 mm (0.8 in.) for linear encoders, and 20° for angle encoders.

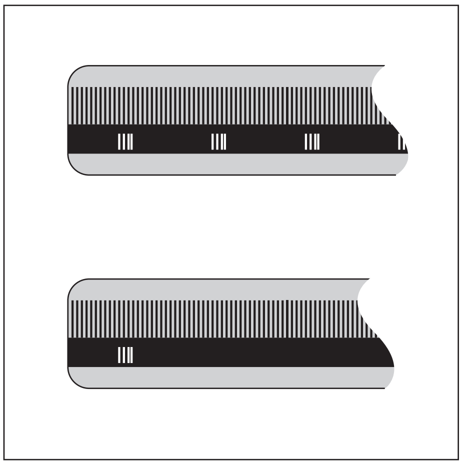


Fig. 9: Linear scales: with distance-coded reference marks *(upper illustration)* and one reference mark *(lower illustration)*

Angle reference axis

For angular positions, the following reference angles are defined:

Plane	Angle reference axis
X Y	+X
Y Z	+Y
Z X	+Z

Positive direction of rotation is counterclockwise if the working plane is viewed in negative tool axis direction (see fig. 10).

Beispiel: Angle in the working plane X / Y

Angle	Corresponds to the...
+ 45°	... bisecting line between +X and +Y
+/– 180°	... negative X axis
– 270°	... positive Y axis

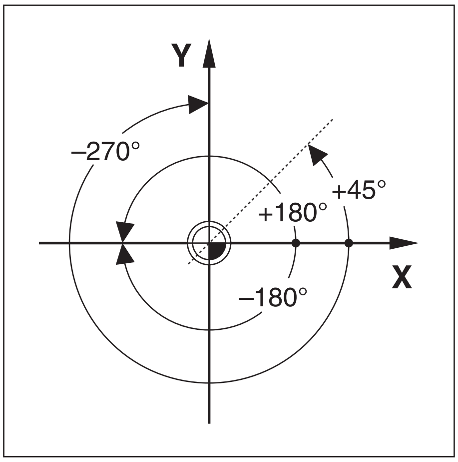


Fig. 10: Angle and the angle reference axis, e.g. in the X / Y plane

NOTES

I - 2
Working with POSITIP – First Steps

Before you start

You can **cross over the reference marks** after every switch-on. The POSITIP's reference mark evaluation feature (REF) automatically re-establishes the relationship between axis slide positions and display values that you last defined by setting the datum.

When you have crossed over all the reference marks, the **REF** indicator appears in the input line at the top of the screen. Setting new datum points automatically stores the new relationship between axis positions and display values.

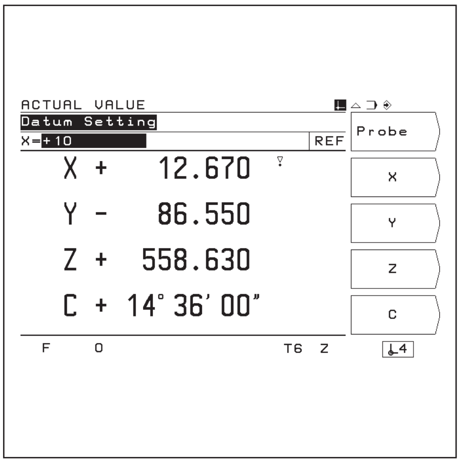


Fig. 11: REF display on screen

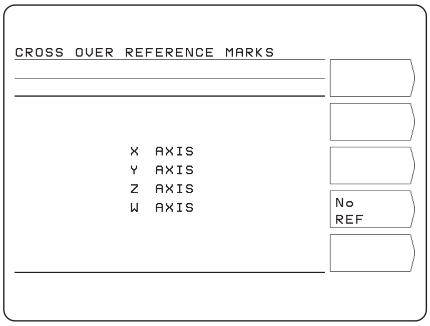
Working without reference mark evaluation

You can also use the POSITIP without crossing over the reference marks — simply press the soft key No REF.

> Note that if you do **not** cross over the reference marks, POSITIP does not store the datum points. This means that it is not possible to re-establish the relationship between axis slide positions and display values after a power interruption (switch-off).

Switch-on

0 ➤ 1	Switch on the power and press any key.



	Cross over the reference marks in all axes (in any order).
No REF	Do **not** cross over the reference marks. Note: In this case the relationship between axis slide positions and display values will be lost after a power interruption.

Your POSITIP is now ready for operation and is in the operating mode ACTUAL VALUE.

Operating modes

Selecting the operating mode determines which functions are available to you.

Available functions	Mode	Key
Position display for workpiece machining; Zero reset; Datum setting – also with edge finder	`ACTUAL VALUE`	
Distance-to-go display; hole patterns; milling and drilling with tool radius compensation	`DISTANCE-TO-GO`	
Storage of work steps for small-lot production	`PROGRAMMING AND EDITING`	
Run programs previously created in the `PROGRAMMING AND EDITING` mode	`EXECUTE PROGRAM`	

You can switch to another operating mode at **any time** by pressing the key for the desired mode.

The HELP, MOD and INFO functions

You can call the HELP, MOD and INFO functions at **any time**.

To **call** a function:
➤ Press the function key for that function.

To **leave** the function:
➤ Press the same function key again.

Available functions	Mode	Key
On-screen operating instructions: graphics and text keyed to the current screen contents	`HELP`	HELP
User parameters: To redefine POSITIP's basic operating characteristics	`MOD`	MOD
Cutting data calculator, stopwatch, pocket calculator	`INFO`	INFO

Selecting soft-key functions

The soft-key functions are grouped into one or more rows. POSITIP indicates the number of rows by a symbol at the upper right of the screen. If no symbol is shown, that means there is only one row for the function. The highlighted rectangle in the symbol indicates the current row.

Function	Key
Page throught soft-key rows: forwards	
Page through soft-key rows: backwards	
Go back one level	

> POSITIP displays the soft keys with the main functions of an operating mode whenever you press the key for that mode.

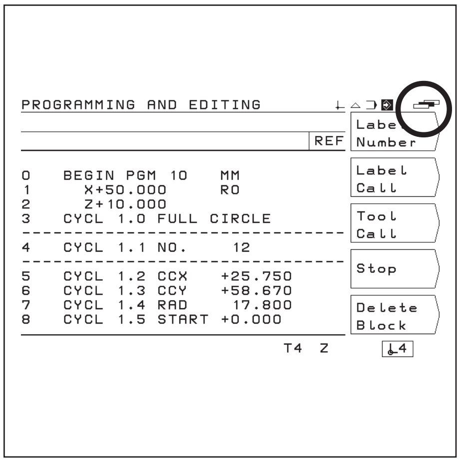


Fig. 12: The symbol for soft-key row is at the top right of the screen. Here, the second row is being displayed.

On-screen operating instructions

The integrated operating instructions provide information and assistance in any situation.

To **call** the operating instructions:

➤ Press the **HELP** key.

➤ Use the paging keys if the explanation is spread over more than one screen page.

To **leave** the operating instructions:

➤ Press the **HELP** key again.

Example: On-screen operating instructions for datum setting with the edge finder (`PROBE CIRCLE CENTER`)

The `PROBE CIRCLE CENTER` function is described in this manual on page 25.

➤ Select the `ACTUAL VALUE` operating mode.

➤ Press the `Probe` soft key.

➤ Press the HELP key.

The first page of the operating instructions for the Probe function appears.

Page reference at the lower right of the screen:
the number in front of the slash is the current page, the number behind the slash is the total number of pages.

The on-screen operating instructions now contains the following information on `ACTUAL VALUE – PROBE` (on three pages):

- Overview of the probing functions (page 1)
- Graphic illustration of all probing functions (pages 2 and 3)

➤ To leave the operating instructions:
Press HELP again.
The screen returns to the selection menu for the probing functions.

➤ Press (for example) the soft key `Circle Center`.

➤ Press HELP.

The screen now displays operating instructions – spread over five pages – on the function `PROBE CIRCLE CENTER` including:

- Overview of all work steps (page 1)
- Graphic illustration of the probing sequence (page 2)
- Information on how POSITIP reacts and on datum setting (page 3)
- Probing function `Circle Center` for tools (pages 4 and 5)

➤ To leave the on-screen operating instructions:
Press HELP.

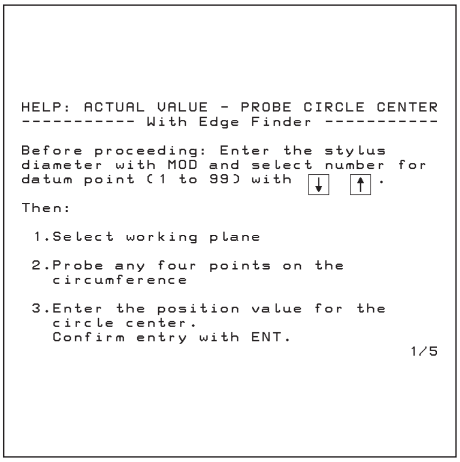


Fig. 13: On-screen operating instructions for `PROBE CIRCLE CENTER`, page 1

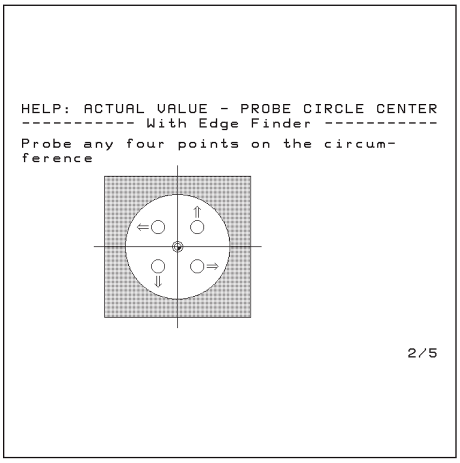


Fig. 14: On-screen operating instructions for `PROBE CIRCLE CENTER`, page 2

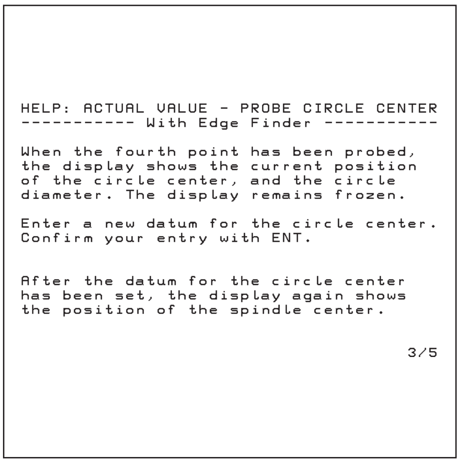


Fig. 15: On-screen operating instructions for `PROBE CIRCLE CENTER`, page 3

Error messages

If an error occurs while you are working with POSITIP, a message will come up on the screen in plain English.

To **call** an **explanation** of the error:
➤ Press the **HELP** key.

To **clear** the error message:
➤ Press the **CE** key.

Blinking error messages

WARNING

Blinking error messages mean that the operational reliability of the POSITIP has been impaired.

If a blinking error message occurs:
➤ Note down the error message displayed on the screen.
➤ Switch off the power to the POSITIP.
➤ Attempt to correct the problem with the power off.
➤ If the blinking error message recurs, notify your customer service agency.

Selecting the unit of measurement

Positions can be displayed in millimeters or inches. If you choose inches, `inch` will be displayed at the top of the screen next to `REF`.

To **change** the unit of measurement:
➤ Press MOD.
➤ Page to the soft key row containing the user parameter `mm` or `inch`.
➤ Choose the soft key `mm` or `inch` to change to the other unit.
➤ Press MOD again.

For more information on user parameters, see chapter I - 7.

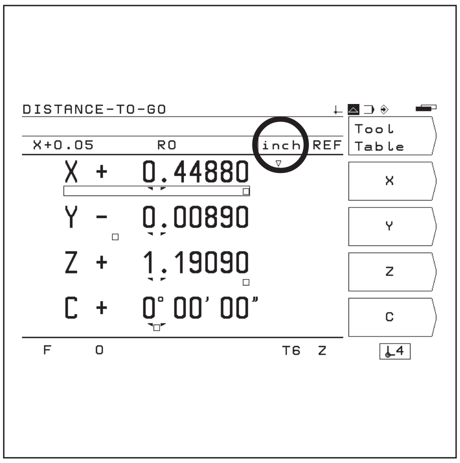


Fig. 16: The `inch` indicator

Selecting the angle format

Angles – such as for a rotary table – can be displayed either as a decimal value or in degrees, minutes and seconds.

To **change** the angle format:
➤ Press MOD.
➤ Go to the soft key row containing the user parameter `Deg/Min/Sec` or `Degrees decimal`.
➤ Choose the soft key `Deg/Min/Sec` or `degrees decimal` to change to the other format.
➤ Press MOD again.

For more information on user parameters, see chapter I - 7.

Entering tool length and diameter

Enter the lengths and diameters of your tools in the POSITIP's tool table. You can enter up to 99 tools.
Before you start machining workpieces, select the tool you are using from the tool table. POSITIP will then take into account the entered diameter and length of the tool.

The tool length is the difference in length ΔL between the tool and the zero tool.

Sign for the length difference ΔL
If the tool is **longer** than the zero tool: ΔL > 0
If the tool is **shorter** than the zero tool: ΔL < 0

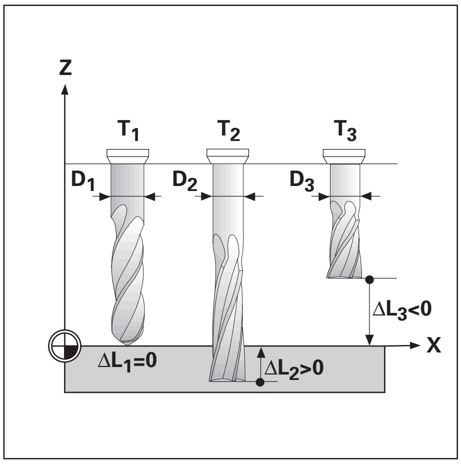
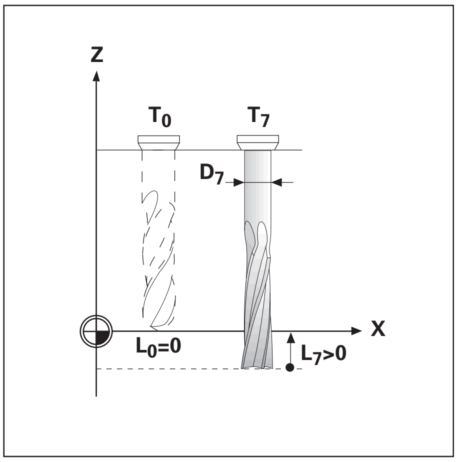


Fig. 17: Tool length and diameter

Example: Entering the tool length and diameter into the tool table

Tool number	7
Tool axis	Z
Tool diameter	D = 8 mm
Tool length	L = 12 mm



MOD	Select the user parameters.
 / 	Go to the soft key row which has `Tool Table`.
Wkz.-Tabelle	Open the tool table.
Tool number ?	
7 ENT	Enter the tool number (such as 7) and confirm your entry with ENT.
→	Go to the column with `Diameter`.
Tool diameter ?	
8 ENT	Enter the tool diameter (such as 8 mm) and confirm your entry with ENT.

Tool length ?	
1 2 ENT	Enter the tool length (12 mm) and confirm your entry with ENT.
Z	Select the tool axis (Z).
MOD	Depart the user parameters.

Calling the tool data

The lengths and diameters of your tools must first be entered into the POSITIP's tool table (see previous page).

Before you start workpiece machining, select the tool you are using from the tool table. POSITIP then takes into account the stored tool data when you work with tool compensation (e.g., with hole patterns).

> You can also call the tool data with the command `TOOL CALL` in a program.

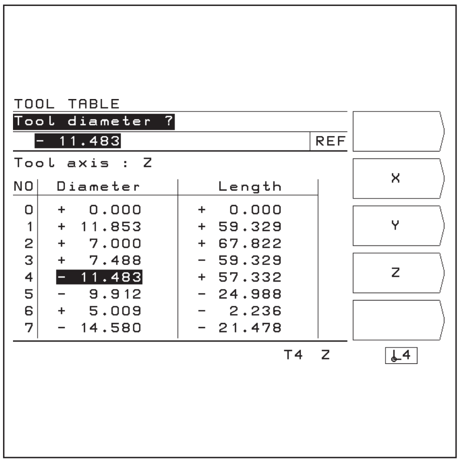


Fig. 18: The tool table on the POSITIP's screen

Calling the tool data

MOD	Select the user parameters.
/	Go to the first soft key row `Tool Table`.
Wkz.- Tabelle	Select the tool table.
Tool number ?	
5 ENT	Enter the tool number (here: 5) and confirm your entry with ENT. The number of the selected tool appears at the bottom of the screen.
MOD	Depart the user parameters.

Datum setting: Approaching positions and entering actual values

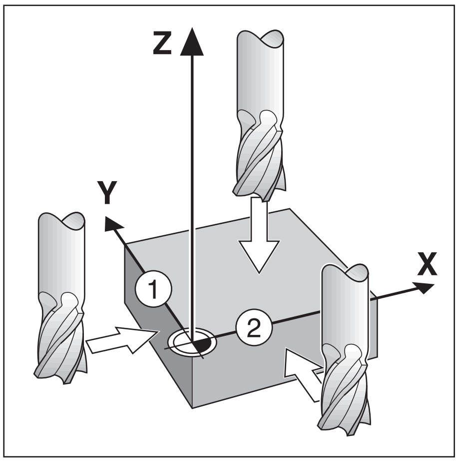
The easiest way to set datum points is to use the POSITIP's probing functions – regardless of whether you probe the workpiece with the HEIDENHAIN KT Edge finder or with a tool. A description of the probing functions starts on page 22.

Of course, you can also set datum points in the conventional manner by touching the edges of the workpiece one after the other with the tool and entering the tool positions as datum points (see examples on this page and the next).

The datum table can hold up to 99 datum points. In most cases this will free you from having to calculate the axis travel when working with complicated workpiece drawings containing several datums.

For each datum point, the datum table contains the positions that the POSITIP assigned to the reference points on the scales (REF values) during datum setting. Note that if you change the REF values in the table, this will move the datum point.

Example: Setting a workpiece datum without the probing function



Working plane:	X / Y
Tool axis:	Z
Tool radius:	R = 5 mm
Axis sequence in this example:	X - Y - Z

Preparation: select the datum

Select the datum with the vertical arrow keys.
POSITIP displays the number of the current datum at the lower right of the screen.

Preparation: call the tool data

Call the tool data for the tool which you are using to touch the workpiece (see previous page).

Operating mode: ACTUAL VALUE

	Touch edge ① with the tool.
X	Select the X axis.
Datum Setting **X = + 0**	
– 5 ENT	Enter the position of the tool center (X = – 5 mm) and transfer the X-coordinate of the datum.
	Touch the workpiece at edge ②.
Y	Select the Y axis.
Datum Setting **Y = + 0**	
– 5 ENT	Enter the position of the tool center (Y = – 5 mm) and transfer the Y-coordinate of the datum.
	Touch the workpiece surface.
Z	Select the Z axis.
Datum Setting **Z = + 0**	
0 ENT	Enter the position of the tool tip (Z = 0 mm) and transfer the Z-coordinate of the datum.

Probing functions for datum setting

The POSITIP's probing functions enable you to set datum points with a HEIDENHAIN KT Edge Finder. The probing functions are also available when you are using a tool instead of an edge finder.

Datum setting with the edge finder

It is particularly easy to set datum points with a HEIDENHAIN KT edge finder. The following probing functions are available:

- Workpiece edge as datum:
  `Edge`
- Centerline between two workpiece edges:
  `Centerline`
- Center of a hole or cylinder:
  `Circle Center`
  With Circle Center, the hole must be in a main plane.
  The three main planes are formed by the axes X / Y, Y / Z and Z / X.

Fig. 19: The HEIDENHAIN KT Edge Finder

> The HEIDENHAIN KT 120 Edge Finder can only be used with electrically conductive workpieces.

Preparation: Enter the stylus diameter and select the datum

➤ Press MOD and go to the soft key row containing the soft key `Edge Finder.`
➤ Select the user parameter `Edge Finder`.
➤ Enter the diameter of the edge finder stylus and confirm with ENT.
➤ Select the user parameter `Datum`.
➤ Enter the number of the desired datum and confirm with ENT.
➤ Press MOD again.
The number of the selected datum is now shown at the lower right of the screen.

In all probing functions, POSITIP takes into account the entered stylus diameter.
For more information on user parameters, see chapter I - 7.

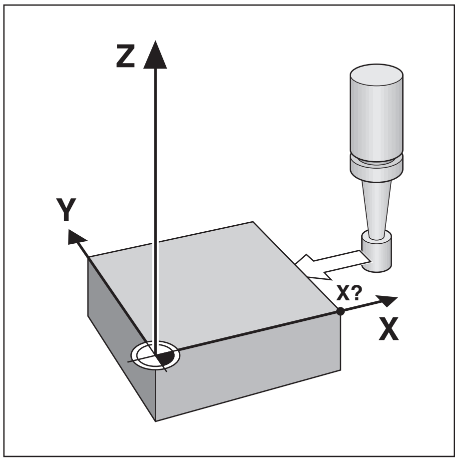
To abort the probing function

While the probing function is active, POSITIP displays the soft key `Escape`. Choose this soft key to return to the opening state of the selected probing function.

Example: Probe workpiece edge, display position of workpiece edge and set the edge as a datum

The probed edge lies parallel to the Y axis.

The coordinates of the datum can be set by probing edges or surfaces and capturing them as datums as described on the next page.



Operating mode: `ACTUAL VALUE`

SNIMAT POLOHU	Select Probe.
HRANA	Select Edge.
X	Select axis for which the coordinate is to be set: X axis.

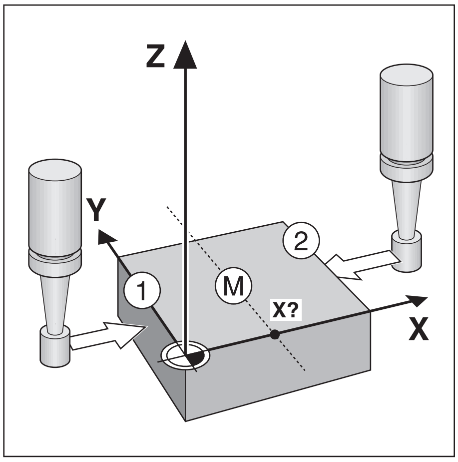
Probe in X axis

	Move the edge finder towards the workpiece until the LEDs on the edge finder light up. The position of the edge on the X axis is displayed on the screen.
	Retract the edge finder from the workpiece.

Enter value for X
+ 0

2 0 ENT	0 is offered as a default value for the coordinate. Enter the desired coordinate for the workpiece edge, for example X = 20 mm and set the coordinate as a datum for this workpiece edge.

Example: Set centerline between two workpiece edges as datum



The position of the centerline Ⓜ is determined by probing the edges ① and ② .

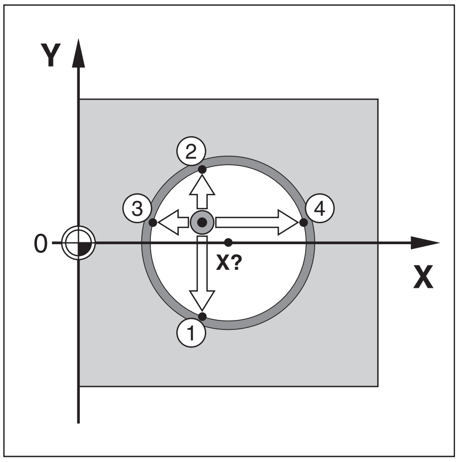
The centerline is parallel to the Y axis.

Desired coordinate
of the centerline: X = 5 mm

Operating mode: `ACTUAL VALUE`

SNIMAT POLOHU	`Select Probe.`
OSA OBROBKU	`Select Centerline.`
X	Select the axis for which the coordinate is to be set: X axis.
`Probe 1st edge in X`	
	Move the edge finder toward workpiece edge ① until the LEDs in the edge finder light up.
`Probe 2nd edge in X`	
	Move the edge finder toward workpiece edge ② until the LEDs in the edge finder light up. The display is frozen and the distance between the two edges appears under the selected axis.
	Retract the edge finder from the workpiece.
`Enter value for X` `+ 0`	
5 ENT	Enter coordinate (X = 5 mm) and transfer coordinate as datum for the centerline.

Example: Probe the circumference of a hole with an edge finder and set the center of the hole as a datum



Main plane	X / Y
Edge finder axis	parallel to the Z axis
X coordinate of the circle center	X = 50 mm
Y coordinate of the circle center	Y = 0 mm

Operating mode: `ACTUAL VALUE`

SNIMAT POLOHU	`Select Probe.`
STRED KRUHU	`Select Circle Center.`
ROVINA X/Y	Select plane containing the circle (main plane): `Plane X/Y.`

`Probe 1st point in X/Y`

	Move edge finder towards first point ① on the circumference until the LEDs on the edge finder light up.
	Retract edge finder from bore hole wall.
	Probe three additional points on the circumference in the same manner. Further instructions appear on the screen.

`Enter center point X`
`X = 0`

5 0 ENT	Enter the first coordinate (X = 50 mm) and transfer coordinate as datum for the circle center.

`Enter center point Y`
`Y = 0`

ENT	Accept default entry Y = 0 mm.

Datum setting with a tool

Even if you use a tool to set datum points, you can still use POSITIP's probing functions described under the section "Datum setting with the Edge Finder" (`Edge`, `Centerline` and `Circle Center`).

Preparation: Enter the tool diameter and select the datum

➤ Press MOD and go to the soft key row containing the soft key `Tool Table`.
➤ Select the user parameter `Tool Table`.
➤ Select the tool you will use to set the datum.
➤ Leave the tool table:
Press MOD again.
➤ Use the vertical arrow keys to select the number of the desired datum. The number of the selected datum is shown at the lower right of the screen.

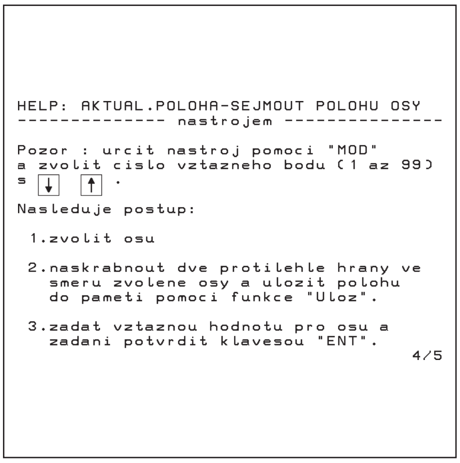
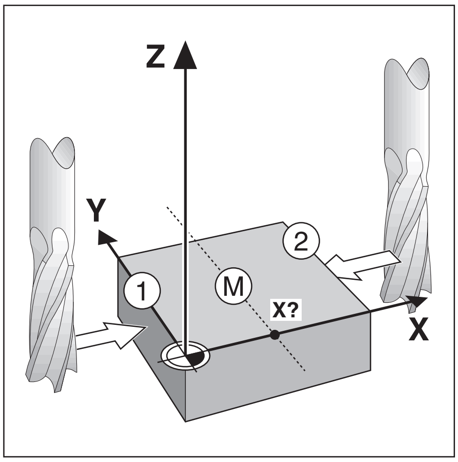


Fig. 20: On-screen operating instructions for probing with a tool

Example: Set centerline between two probed edges as datum

The centerline is parallel to the Y axis.

Desired coordinate
of the centerline: X = 50 mm



Operating mode: `ACTUAL VALUE`

SNIMAT POLOHU	Select `Probe`.
OSA OBROBKU	Select `Centerline`.
X	Select axis for which the coordinate is to be set: X axis.

Probe 1st edge in X	
	Touch the first workpiece edge ① .
OZNAC	Store the position of the edge.
Probe 2nd edge in X	
	Touch the second workpiece edge ② .
OZNAC	Store the position of the edge. POSITIP displays the distance between the two edges.
	Retract the tool from the workpiece.
Enter value for X **+ 0**	
5 0 ENT	Enter coordinate (X = 50 mm) and transfer coordinate as datum for the centerline.

NOTES

Displaying and moving to positions

Distance-To-Go feature

Although it is often sufficient to have POSITIP display the coordinates of the **actual position** of the tool, it is usually better to use the **Distance-To-Go** feature — this enables you to approach nominal positions simply by traversing to display value zero.

Even when working with the Distance-To-Go feature you can enter coordinates in absolute or **incremental dimensions**.

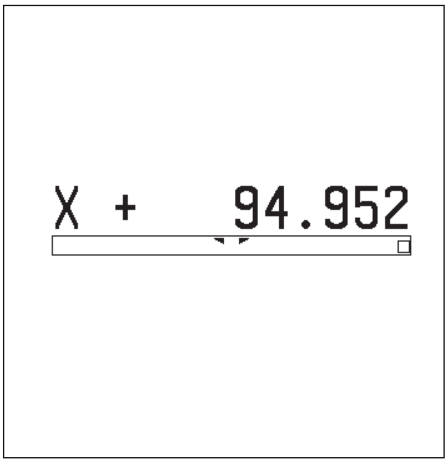


Fig. 21: The graphic positioning aid

Graphic positioning aid

When you are traversing to display value zero, POSITIP displays a graphic positioning aid (see figure 21).

> POSITIP can also show the absolute position instead of the graphic positioning aid. You can switch between these two modes with operating parameter P 91 (see chapter II - 2).

POSITIP displays the graphic positioning aid in a narrow rectangle underneath the currently active axis. Two triangular marks in the center of the rectangle symbolize the nominal position you want to reach.

A small square symbolizes the axis slide. An arrow indicating the direction appears in the square while the axis is moving. You can thus easily tell whether you are moving towards or away from the nominal position.

Note that the square does not begin to move until the axis slide is near the nominal position.

Taking the tool radius into account

POSITIP has a tool radius compensation feature (see figure 22). This allows you to enter workpiece dimensions directly from the drawing. The displayed remaining distance is then automatically lengthened (R+) or shortened (R–) by the value of the tool radius.

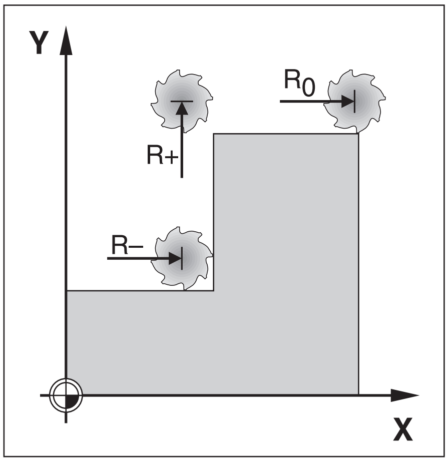


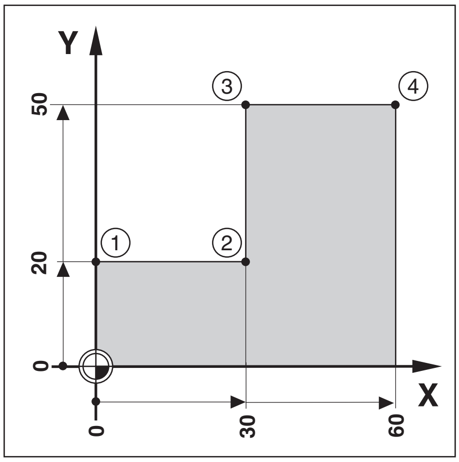
Fig. 22: Tool radius compensation

Entering tool data

Enter tool data with the soft key `Tool Table`.

➤ Press MOD.
➤ Choose the soft key `Tool Table`.
➤ Enter the tool diameter.
➤ Enter the tool length.
➤ Select the tool axis with soft key.
➤ Press ENT.
➤ Press MOD again.

Example: Milling a shoulder by traversing to display value zero



The coordinates are entered as absolute dimensions; the datum is the workpiece zero.

Corner ①	X = 0 mm	Y = 20 mm
Corner ②	X = 30 mm	Y = 20 mm
Corner ③	X = 30 mm	Y = 50 mm
Corner ④	X = 60 mm	Y = 50 mm

Preparation:

➤ Enter the tool data.

➤ Pre-position the tool to an appropriate location (such as X = Y = –20 mm).

➤ Move the tool to milling depth.

Operating mode: `DISTANCE-TO-GO`

Y	Select the Y axis.
Nominal position value ?	
2 0 Radius Comp.	Enter nominal position value for corner point ①: Y = +20 mm and select tool radius compensation R +.
ENT	Transfer the nominal position value. The graphic positioning aid for the Y axis appears.
	Traverse the Y axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.
X	Select the X axis.
Nominal position value ?	
3 0 Radius Comp.	Enter nominal position value for corner point ②: X = +30 mm and select tool radius compensation R –.
ENT	Transfer the nominal position value. The graphic positioning aid for the X axis appears.
	Traverse the X axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.

Y	Select the Y axis.

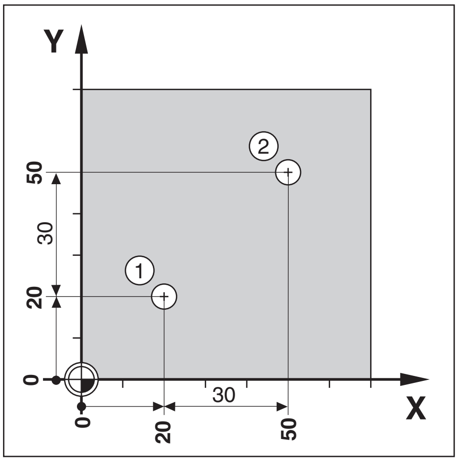
Nominal position value ?

5 0 Radius Comp.	Enter the nominal position value for corner point ③ : Y = +50 mm and select tool radius compensation R +.
ENT	Transfer the nominal position value. The graphic positioning aid for the Y axis is displayed.
	Traverse the Y axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.
X	Select the X axis.

Nominal position value ?

6 0 Radius Comp.	Enter the nominal position value for corner point ④ : X = +60 mm and select tool radius compensation R +.
ENT	Transfer the nominal position value. The graphic positioning aid for the X axis is displayed.
	Traverse the X axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.

Example: Drilling by traversing to display value zero



Enter the coordinates in incremental dimensions. These are indicated in the following (and on the screen) with a preceding **I**. The datum is the workpiece zero.

Hole ① at	X = 20 mm Y = 20 mm
Distance from hole ② to hole ①	**I**X= 30 mm **I**Y= 30 mm
Hole depth	Z =–12 mm

Operating mode: `DISTANCE-TO-GO`

	Pre-position the drill over the first hole.
Z	Select the Z axis.
Nominal position value ?	
– 1 2 ENT	Enter the nominal position value for the hole depth: Z = –12 mm. Confirm your entry. The graphic positioning aid for the Z axis is displayed.
	Drill hole ① : traverse Z axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.
	Retract the drill in the tool axis (Z).
X	Select the X axis.
Nominal position value ?	
3 0 I Radius Comp.	Enter the nominal position value for hole ② : X = 30 mm and mark your input as an incremental dimension. Select tool radius compensation R 0.

ENT	Confirm your entry. The graphic positioning aid for the X axis is displayed.
	Traverse the X axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.
Y	Select the Y axis.
ENT	Transfer the displayed nominal position (**I** +30) directly as nominal value for Y. The graphic positioning aid for the Y axis is displayed.
	Traverse the Y axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.
Z	Select the Z axis.
Nominal position value ?	
– 1 2 ENT	Enter the nominal position value for the hole depth: Z = –12 mm. Confirm your entry. The graphic positioning aid for the Z axis is displayed.
	Drill hole ②: traverse the Z axis until the display value is zero. The square in the graphic positioning aid is now centered between the two triangular marks.
	Retract the drill in the tool axis (Z).

NOTES

I - 3
Hole Patterns and Rectangular Pocket

This chapter describes the hole pattern functions **`Circle Pattern`** and **`Linear Pattern,`** and the **`Milling of Rectangular Pockets`**.

In the operating mode `DISTANCE-TO-GO`, use the soft keys to select the desired hole pattern function or pocket milling, and enter the required data. This data can usually be taken from the workpiece drawing (e.g. hole depth, number of holes, dimensions of the pocket, etc.).

With hole patterns, the **POSITIP** then calculates the positions of all the holes and displays the pattern graphically on the screen. With pocket milling, it calculates all of the traverse paths for the roughing out of the pocket. The graphic positioning aid appears when you begin execution, enabling you to position simply by traversing to display value zero.

Bolt hole circle patterns

Information required:
- Full circle or circle segment
- Number of holes
- Centerpoint coordinates and radius of the circle
- Starting angle (position of first hole)
- Circle segment only: angle step between the holes
- Hole depth

POSITIP calculates the coordinates of the holes which you then move to by traversing to display value zero.
The graphic positioning aid is available for all moving axes. The positioning aid frame for the tool axis is dashed.

The graphic enables verification of the hole pattern before you start machining. It is also useful when:
- selecting holes directly
- executing holes separately
- skipping holes

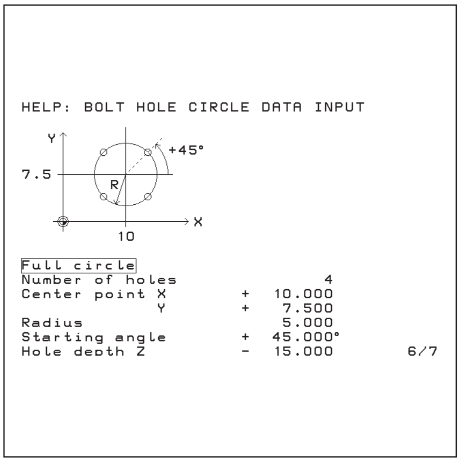


Fig. 23: On-screen operating instructions: bolt hole circle pattern (full circle)

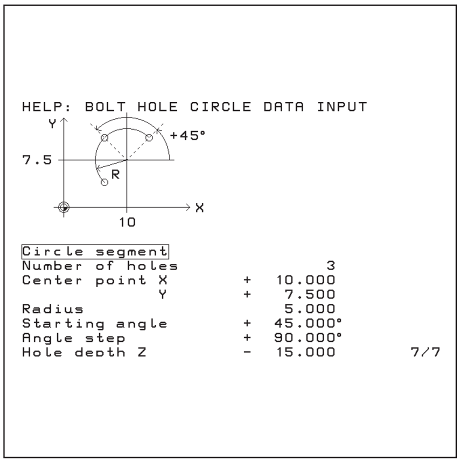


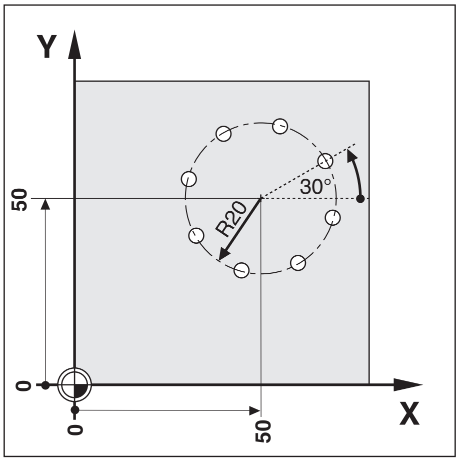
Fig. 24: On-screen operating instructions: graphics for bolt hole circle pattern (circle segment)

Overview of functions

Function	Soft Key/Key
Select full circle	Full Circle
Select circle segment	Circle Segment
Got to next-highest level	↑
Go to next-lowest level	↓
Confirm entry values	ENT
End input	End

Example: Enter data and execute bolt hole circle

Number of holes	8
Center point coordinates	X = 50 mm Y = 50 mm
Bolt circle radius	20 mm
Starting angle: angle between X axis and first hole	30°
Hole depth	Z = –5 mm



1st step: Enter data

Operating mode: `DISTANCE-TO-GO`

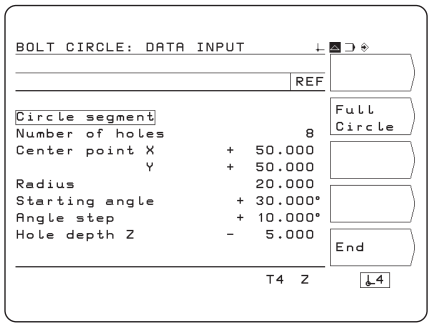
Go to the second soft key row in the operating mode `DISTANCE-TO-GO`.

`Circle Pattern`

Select `Circle Pattern`.

`Data Input`

Select `Data Input`.



`Full Circle`

If necessary, select data input for full circle.
`Full Circle` is shown in a frame above the data.
The soft key changes to `Circle Segment`.

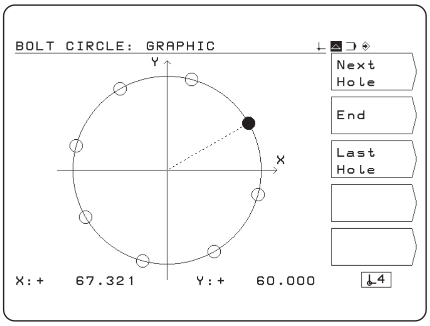
Enter the data and call the dialog.

Number of holes ?	
8 ENT	Enter the number of holes (8). Confirm your entry.
Center point X ?	
5 0 ENT	Enter the X coordinate of the center of the bolt hole circle (X = 50 mm). Confirm your entry.
Center point Y ?	
5 0 ENT	Enter the Y coordinate of the center of the bolt hole circle (Y = 50 mm). Confirm your entry.
Radius ?	
2 0 ENT	Enter the radius of the bolt hole circle (20 mm). Confirm your entry.
Starting angle ?	
3 0 ENT	Enter the starting angle from the X axis to the first hole (30°). Confirm your entry.
Hole depth ?	
– 5 ENT	Enter the hole depth Z (–5 mm). Confirm your entry.
End	End data entry.

2nd step: Display graphic

The graphic makes it easy to verify the entered data.
The solid circle represents the currently selected hole.

Graphic	POSITIP displays the bolt hole circle graphically on the screen. Here, a full circle with 8 holes is shown. The first hole is at 30°. The coordinates of the hole are given at the bottom of the screen.



The bolt hole circle graphic can be influenced with operating parameters P 88 and P 89 (see chapter II - 2)
Parameter P 88 (direction of turn) also influences working on the bolt hole circle.

3rd step: Drill

Start	Start the bolt hole circle function.
	Move to hole: Traverse each coordinate of the working plane to display value zero. The frame of the positioning aid is a solid line for these axes.
	Drill: Traverse to display value zero in the tool axis. The frame of the positioning aid is a dashed line for this axis.
	After drilling, **retract** in the tool axis.

Functions for drilling and graphic

Function	Soft Key
Go to next hole	Next Hole
Return to last hole	Last Hole
End drilling	End

Linear hole patterns

Information required:

- Coordinates of the first hole
- Number of holes per row
- Spacing between holes on a row
- Angle between the first row and the X axis
- Number of rows
- Spacing between rows

POSITIP calculates the coordinates of the holes which you then move to simply by traversing to display value zero.
The graphic positioning aid is available for all moving axes. The positioning aid frame for the tool axis is dashed.

The graphic enables verification of the hole pattern before you start machining. It is also useful when:

- selecting holes directly
- executing holes separately
- skipping holes

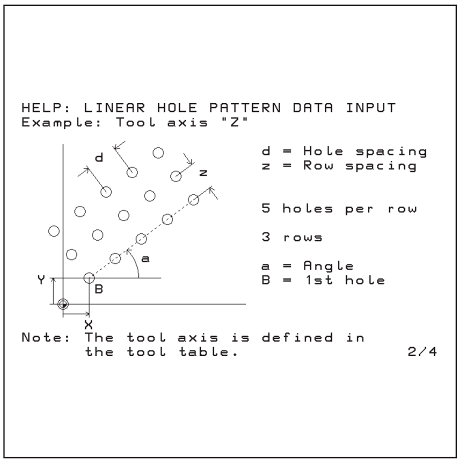
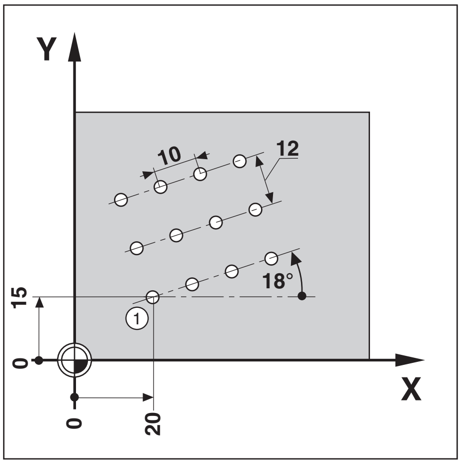


Fig. 25: On-screen operating instructions: graphic for linear hole pattern

Function	Soft Key/Key
Go to next-highest input line	↑
Go to next-lowest input line	↓
Confirm entry values	ENT
End input	End

Example: Entering data and executing rows of holes

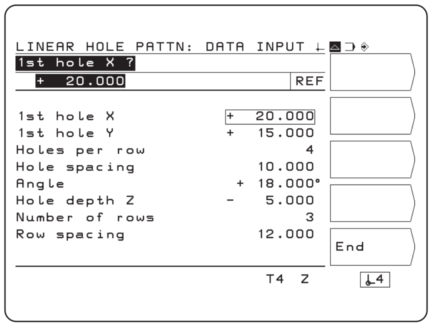
X coordinate of hole ①	X = 20 mm
Y coordinate of hole ①	Y = 15 mm
Number of holes per row	4
Hole spacing	10 mm
Angle between rows and X axis	18°
Hole depth	Z = –5 mm
Number of rows	3
Row spacing	12 mm



1st step: Enter data

Operating mode: DISTANCE-TO-GO

	Go to the second soft key row in the operating mode DISTANCE-TO-GO
Linear Pattern	Select Linear Pattern.
Data Input	Select Data Input.

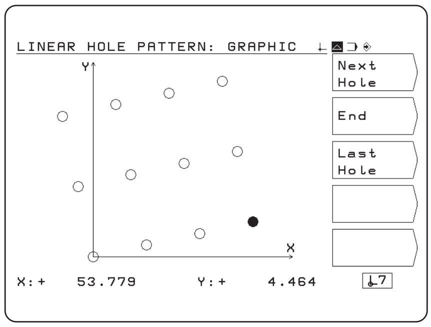


1st hole X ?	
2 0 ENT	Enter the X coordinate of hole ① (X = 20 mm). Confirm your entry.
1st hole Y ?	
1 5 ENT	Enter the Y coordinate of hole ① (Y = 15 mm). Confirm your entry.
Holes per row ?	
4 ENT	Enter the number of holes per row (4). Confirm your entry.
Hole spacing ?	
1 0 ENT	Enter the spacing between holes in the row (10 mm). Confirm your entry.
Angle ?	
1 8 ENT	Enter the angle between the X axis and the hole pattern (18°). Confirm your entry.
Hole depth ?	
– 5 ENT	Enter hole depth Z (–5 mm). Confirm your entry.
Number of rows ?	
3 ENT	Enter the number of rows (3). Confirm your entry.
Row spacing ?	
1 2 ENT	Enter the spacing between rows (12 mm). Confirm your entry.
End	End data entry.

2nd step: Display graphic

The graphic makes it easy to verify the entered data.
The solid circle represents the currently selected hole.

Graphic	POSITIP displays the pattern graphically on the screen. Here, 3 rows of 4 holes are shown. 1st hole at X=20 mm, Y=10 mm Hole spacing: 10 mm Angle between rows and X axis: 18° Row spacing: 12 mm Coordinates of the current hole are shown at the bottom of the screen.



> The graphic is influenced by operating parameter P 89 (see chapter II - 2).

3rd step: Drill

Start	Start linear hole pattern function.
	Move to hole: Traverse each coordinate of the working plane to display value zero. The frame of the positioning aid is a solid line for these axes.
	Drill: Traverse to display value zero in the tool axis. The frame of the positioning aid is a dashed line for this axis.
	After drilling, **retract** in the tool axis.
	Drill the remaining holes in the same manner.

Functions for drilling and graphic

Function	Softkey
Go to next hole	Next Hole
Return to last hole	Last Hole
End drilling	End

Milling a rectangular pocket

In the operating mode DISTANCE-TO-GO you can use the POSITIP for milling a rectangular pocket.

The information for rectangular pocket milling can also be written to a machining program as a "cycle" (see Chapter I-4).

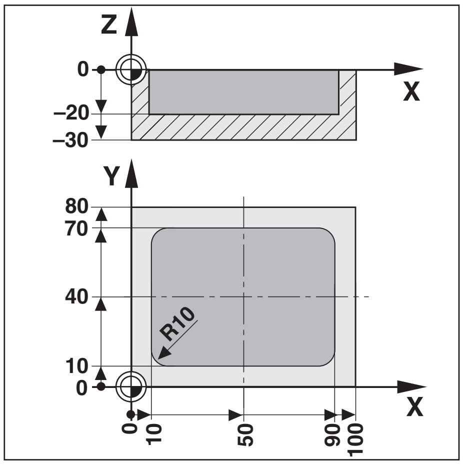
You select the cycle with the soft key "Pocket Milling" (second soft-key row), and enter the required data. This data can usually be taken quite easily from the workpiece drawing (e.g. the side lengths and the depth of the pockets).

The POSITIP calculates the rough-out paths and offers graphic positioning aid.

Data input and execution of rectangular pocket
See Chapter I-4.

Example: Enter data and mill a rectangular pocket

Starting position:	2	mm
Milling depth:	– 20	mm
Pocket center in X:	50	mm
Pocket center in Y:	40	mm
Side length in X:	80	mm
Side length in Y:	60	mm
Direction :	0: CLIMB	
Finishing allowance:	0.5	mm



1st step: Enter data for rectangular pocket

Operating mode: `DISTANCE-TO-GO`

/	Go to the second soft-key row.
`Pocket Milling`	Select `Pocket Milling` cycle.
`Data Input`	Select `Data Input`.

`Starting position ?`

2 ENT	Enter the `starting position` (2 mm). Confirm your entry.

`Milling depth ?`

– 2 0 ENT	Enter the `milling depth` (– 20 mm). Confirm your entry.

.
.
.

`End`	End data entry.

2nd step: Mill rectangular pocket

`Start`	After you have entered all of the required data, start the `Rectangular Pocket` cycle and position the axes by "traversing to zero". The pecking depth in the tool axis does not have to be preset.

.
.
.

`End`	End the cycle after the pocket has been fully roughed-out.

I - 4
Programming POSITIP

Operating mode PROGRAMMING AND EDITING

The available functions in the operating mode PROGRAMMING AND EDITING are divided into four groups:

- Programming mode
  for entering and editing programs
- Teach-In mode
- External mode
  for transferring programs to an external data carrier
- Deleting programs

Programs contain the work steps for workpiece machining. You can edit programs, add work steps to them and run them as often as you wish.
POSITIP can store a maximum of 20 programs with a total of 2000 blocks. A single program can contain a maximum of 1000 blocks.

The External mode enables you to store programs with the HEIDENHAIN FE 401 Floppy Disk Unit and load them into POSITIP again on demand – you don't need to retype them. You can also transfer programs to a personal computer or printer.

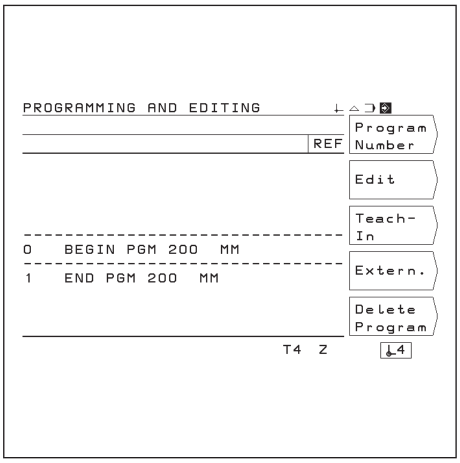


Fig. 26: The first soft key row in the operating mode PROGRAMMING AND EDITING

Programmable functions

- Nominal position values
- Interrupt program
- Bolt hole circles and linear hole patterns
- Rectangular pocket milling
- Program section repeats:
  A section of a program only has to be entered once and can then be run up to 999 times in succession.
- Subprograms:
  A section of a program only has to be entered once and can then be run at various points in the program.
- Tool call

Transfer position: Teach-In mode

This mode allows you to transfer the actual positions of the tool directly into a program. The nominal positions for workpiece machining and the positions you probe with the HEIDENHAIN KT Edge Finder can also be transferred into a program.
In many cases the Teach-In function will save you considerable keying effort.

What happens with finished programs?

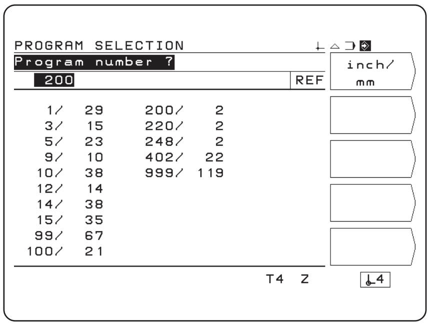
For workpiece machining, programs are run in the operating mode EXECUTE PROGRAM. See chapter I - 5 for an explanation of this mode.

Program number

Each program is identified by a number between 0 and 9999 9999 which you assign it.

Operating mode: `PROGRAMMING AND EDITING`

`Program Number`	Go to the program directory.



`Program number ?`

5	Select an existing program, such as program number 5.
1 1	Create a new program: Give it a number which is not yet in the directory, such as 11.
`inch/ mm`	Choose the unit of measurement.
ENT	Confirm your entry. The selected program can now be entered or edited.

> When you select the unit of measurement with the soft key `inch/mm`, POSITIP overwrites operating parameter P 01 mm/inch.

Program directory

The program directory appears when you choose the soft key `Program Number`. The number in front of the slash is the program number, the number behind the slash is the number of blocks in the program.

A program always contains at least two blocks.

Deleting programs

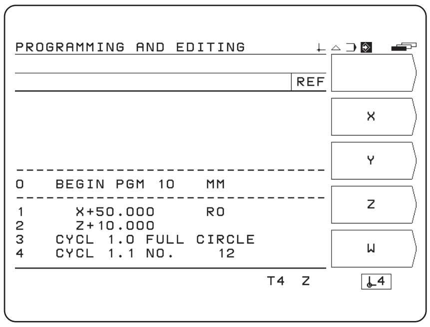
If you no longer wish to keep a program in memory, you can delete it:

➤ In the operating mode `PROGRAMMING AND EDITING`, press the soft key `Delete Program` in the first soft key level.
➤ Enter the program number.
➤ Press ENT to delete the program.

Editing programs

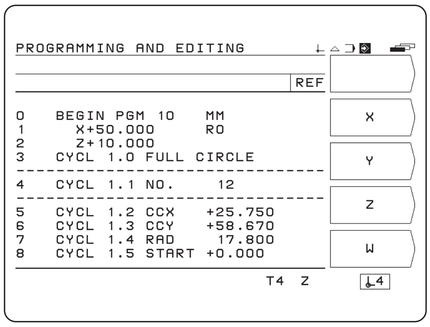
Operating mode: `PROGRAMMING AND EDITING`

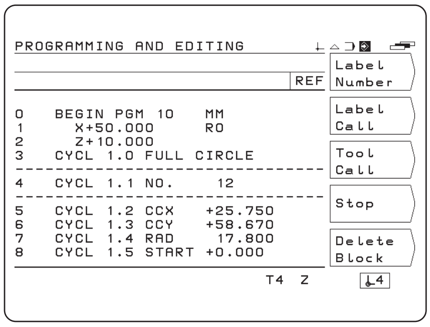
Edit	Edit the last program selected with `Program Number`, such as program number 10.

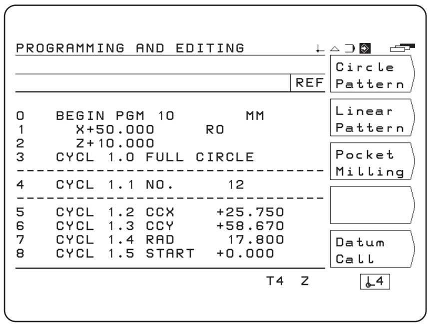


Use the paging keys to display the programmable **functions** in the different soft key rows. The screens shown at the right already contain some program blocks. Turn to the next page of this manual to learn how program blocks are entered.

/	The first soft key row provides functions for entering and changing coordinates.
/	The second soft key row provides the following functions: • Enter labels for subprograms and program section repeats • Call tool data • Interrupt program • Delete program blocks
/	The third soft key row provides functions for entering bolt hole circles, linear hole patterns or rectangular pockets.







Entering program blocks

Current block

The current block is shown between the two dashed lines. New blocks are inserted behind the current block. When the `END PGM` block is between the dashed lines, no new blocks can be inserted.

Function	Soft Key/Key
Go up one block	↑
Go down one block	↓
Clear numerical entry	CE
Delete current block	Delete Block

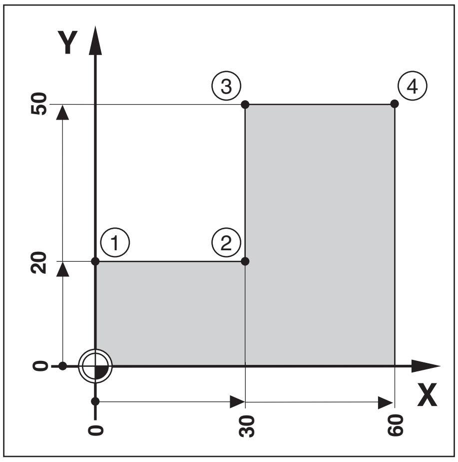
Going directly to a program block

Scrolling to the desired block with the arrow keys can be time-consuming with long programs. A quicker way is to use the GOTO function. This enables you to move directly to the block you wish to change or add new blocks behind.

Operating mode: `PROGRAMMING AND EDITING`

Edit	Select `Edit`.
GOTO	Press the GOTO key.
Block number ?	
5 8	Enter a block number, such as 58.
ENT	Confirm your entry. Block number 58 is now the currently selected block.

Example: Milling a shoulder



The coordinates are programmed in absolute dimensions.
The datum is the workpiece zero.

Corner	①	X = 0 mm	Y = 20 mm
Corner	②	X = 30 mm	Y = 20 mm
Corner	③	X = 30 mm	Y = 50 mm
Corner	④	X = 60 mm	Y = 50 mm

Summary of all programming steps

➤ In the main menu `PROGRAMMING AND EDITING` use the `Program Number` soft key to access the program directory.
➤ Key in the number of the program you want to work on, and press ENT.
➤ Select `Edit` In the main menu `PROGRAMMING AND EDITING`.
➤ Enter the nominal positions.

Running a finished program

When a program is finished it can be run in the `EXECUTE PROGRAM` mode (see chapter I - 5).

Example of entry: Entering a nominal position into a program (block 6 in this example)

X	Select the coordinate axis (X axis).
Nominal position value ?	
3 0 Radius Comp.	Enter the nominal position value, for example 30 mm and select tool radius compensation R –.
ENT	Confirm the entry. The nominal position is now the current block (between the dashed lines).

Program blocks

0	BEGIN PGM 10	MM	Start of program, program number and unit of measurement
1	Z+20.000		Clearance height
2	X–20.000	R0	Pre-position the tool on the X axis
3	Y–20.000	R0	Pre-position the tool on the Y axis
4	Z–10.000		Move tool to milling depth
5	Y+20.000	R+	Y coordinate, corner ①
6	**X+30.000**	**R–**	X coordinate, corner ②
7	Y+50.000	R+	Y coordinate, corner ③
8	X+60.000	R+	X coordinate, corner ④
9	Z+20.000		Clearance height
10	END PGM 10	MM	End of program, program number and unit of measurement

Calling the tool data in a program

Chapter I - 2 explained how to enter the length and diameter of your tools in the tool table.

The tool data stored in the table can also be called from a program. Then if you change the tool during program run you don't need to select the new tool data from the tool table every time.

The `TOOL CALL` command automatically pulls the tool length and diameter from the tool table.

You define the tool axis for program run in the program.

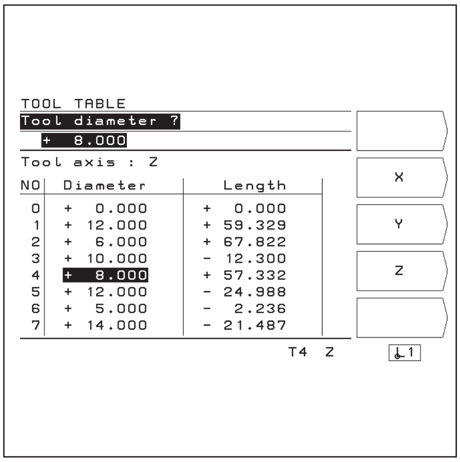


Fig. 27: The tool table on the POSITIP screen

> If you enter a different tool axis in the program than is stored in the table, POSITIP stores the new tool axis in the table.

Operating mode: `PROGRAMMING AND EDITING`

Tool Call	Call tool data from the tool table.
Tool number ?	
4 ENT	Enter the tool number (such as 4) under which the tool data are stored in the tool table. Confirm entry.
Tool axis ?	
Z	Enter the tool axis (such as Z). The program contains the tool call block `TOOL CALL 4 Z`.
No Entry	Choose `No Entry` for the `Tool axis` if the program already contains a `TOOL CALL` block with tool data.

Calling datum points

The POSITIP can store up to 99 datum points in a datum table. You can call a datum point from the datum table during program run by simply pressing the soft key `Datum Call` and entering the block `DATUM XX`. This automatically calls the datum point entered for XX during program run.

Operating mode: `PROGRAMMING AND EDITING`

/	Go to the third soft-key row.
Datum Call	Call a datum point from the table.
Datum number?	
5 ENT	Enter the datum number (such as 5). Confirm entry. Input range: 1 to 99.

Transferring positions: Teach-in mode

Teach-in programming offers the following three options:

- Enter nominal position, transfer nominal position to program, move to positions by traversing to display value zero:
  `TEACH-IN / DISTANCE TO GO`
- Move to a position and transfer the actual value to a program:
  `TEACH-IN / ACTUAL POSITION`
- Probe workpiece edges and transfer probed positions:
  `TEACH-IN / EDGE FINDER`

You can change transferred position values with `TEACH-IN / PROGRAM`.

Preparation

➤ With `Program number` select the program you want to transfer positions into.

➤ Select the tool data from the tool table.

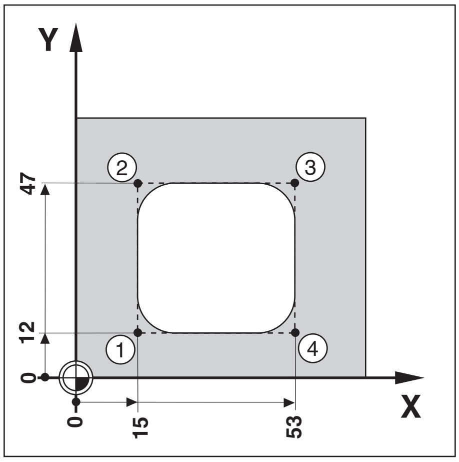
or

➤ Enter the length and diameter of the edge finder stylus.

Overview of functions

Function	Soft Key/Key
Abort and return to the Teach-In main menu	Escape
Go to the previous program block	↑
Go to the next program block	↓
Delete the current block	Delete Block

Programming example for `TEACH-IN / DISTANCE TO GO :`
Generate a program while machining a pocket



With Teach-in you first machine a workpiece according to the workpiece drawing dimensions. POSITIP then transfers the coordinates directly into the program. Pre-positioning and retraction movements can be selected as desired and entered like drawing dimensions.

Corner point ①	X = 15 mm Y = 12 mm
Corner point ②	X = 15 mm Y = 47 mm
Corner point ③	X = 53 mm Y = 47 mm
Corner point ④	X = 53 mm Y = 12 mm
Pocket depth	Z = –10 mm (for example)

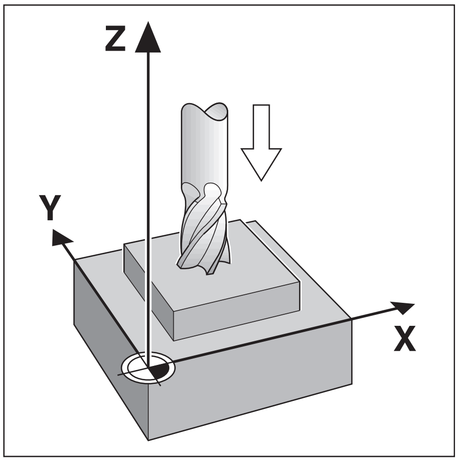
Operating mode: `PROGRAMMING AND EDITING`

Teach-In	Select `Teach-In`. The functions for `TEACH-IN / DISTANCE TO GO` are available immediately in the first soft key row.

Example: Transfer the Y coordinate of corner point ③ into a program

Y	Select coordinate axis (Y axis).
Nominal position value ?	
4 7 Radius Comp.	Enter the nominal position value (such as 47 mm) and select tool radius compensation R –.
ENT	Confirm entry: `Y + 47.000 R -` POSITIP displays the positioning aid for traversing to zero.
	Traverse the entered axis until the display value is zero. Then enter and transfer any other coordinates.

Programming example for `TEACH-IN / ACTUAL POSITION`
Touch island with tool and transfer positions to program



With `TEACH-IN / ACTUAL POSITION` you can generate a program containing the actual positions of the tool.

When you then **run** the program:

➤ Use a tool which has the same diameter as the tool you used during the Teach-In process.

➤ If you use a different tool, you must enter all program blocks with radius compensation. Then enter the difference between the radii of the two tools as the tool radius for machining:

	Radius of the tool for machining
–	Radius of the tool for Teach-In
=	Tool radius to be entered for machining

Operating mode: `PROGRAMMING AND EDITING`

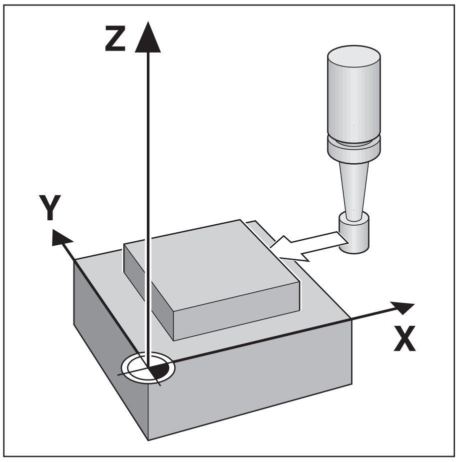
Teach-In	Select `Teach-In`.
/	Go to `TEACH-IN / ACTUAL POSITION`.

Example: Transfer Z coordinate (workpiece surface) to a program

	Move the tool until it touches the workpiece surface.
Z	Select the tool axis (Z).
`Transfer actual value Z ?`	
ENT	Transfer the actual value for the Z axis into the program.

Programming example for `TEACH-IN / EDGE FINDER` :
Probe island and transfer positions to a program

Probe the positions on a workpiece with a HEIDENHAIN KT Edge Finder. The function `TEACH-IN / EDGE FINDER` transfers the probed positions into a program.



> The Edge Finder transfers the *actual* workpiece positions into the program.

Operating mode: `PROGRAMMING AND EDITING`

Teach-In	Select `Teach-In`.
/	Go to `TEACH-IN / EDGE FINDER`.

Example: Probe and transfer position on the X axis

	Pre-position the Edge Finder near position you wish to probe.
X	Select the coordinate axis for which the value is to be transferred: X.
Radius Comp.	Select radius compensation for later machining.
`Probe in X axis`	
	Move the Edge Finder against the workpiece edge until the LEDs light up. The coordinate of the probed position is now stored in the program.
	Retract the Edge Finder. Probe and transfer any further positions in the same manner.

Changing nominal positions after they have been transferred

Positions which you have transferred into a program with Teach-In can be changed. It is not necessary to leave the Teach-in mode to do so.

Enter the new value in the input line.

Example: Change a block transferred with Teach-in

Operating mode: `PROGRAMMING AND EDITING, Teach-In`

/	Go to `TEACH-IN / PROGRAM`.
/	With the arrow keys (or GOTO), move to the block you wish to change.
	Select the block.
Nominal position value ?	
3 0 Radius Comp.	Enter a new nominal position value (such as 30 mm) and change the tool radius compensation.
ENT	Confirm your changes.

Functions for changing a Teach-In program

Function	Soft Key
Abort and return to main menu `PROGRAMMING AND EDITING`	Escape
Delete current block	Delete Block

Hole patterns in programs

The information for hole patterns can also be written to a program. Each piece of information is then stored in a separate program block. These blocks are identified by `CYCL` after the block number, followed by a number.

The cycles contain all information required by POSITIP for machining a hole pattern.

There are three cycles for hole patterns:

- `CYCL 1.0 FULL CIRCLE`
- `CYCL 2.0 CIRCLE SEGMENT`
- `CYCL 4.0 LINEAR HOLE PATTN`

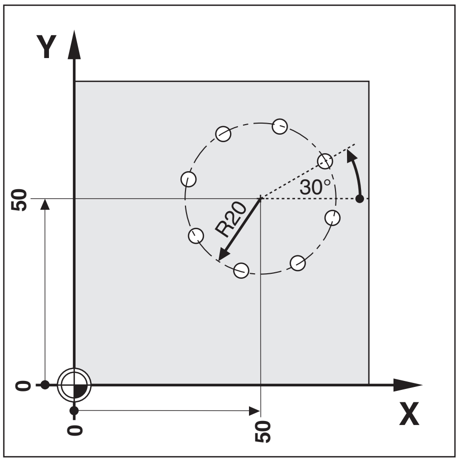
Do not delete any blocks from the cycle because this will result in the error message `CYCLE INCOMPLETE` when the program is executed.

Hole pattern graphics

The hole patterns in a program can be displayed graphically.

Programming example: Bolt hole circle (full circle)

Number of holes	8
Coordinates of center	X = 50 mm Y = 50 mm
Bolt circle radius	20 mm
Starting angle between X axis and first hole	30°
Hole depth	Z = –5 mm



Example: Entering bolt circle data into a program

Operating mode: `PROGRAMMING AND EDITING`

Edit	Select `Edit`.
/	Go to the third soft key row.
Circle Pattern	Select `Circle Pattern`. The soft key row changes.

Type of bolt circle ?

Full Circle	Select `Full Circle`. POSITIP calculates the hole positions on a full circle.

Number of holes ?	
8 ENT	Enter the number of holes (NO. = 8). Confirm your entry.
Center point X ?	
5 0 ENT	Enter the X coordinate of the bolt circle center (CCX = 50 mm). Confirm your entry.
Center point Y ?	
5 0 ENT	Enter the Y coordinate of the bolt circle center (CCY = 50 mm). Confirm your entry.
Radius ?	
2 0 ENT	Enter the radius of the bolt circle (RAD = 20 mm). Confirm your entry.
Starting angle ?	
3 0 ENT	Enter the starting angle from the X axis to the first hole (START = 30°). Confirm your entry.
Hole depth ?	
– 5 ENT	Enter the hole depth (DEPTH = –5 mm). Confirm your entry.
No Entry	Choose No entry for the hole depth if (for example) the holes will be drilled to different depths.

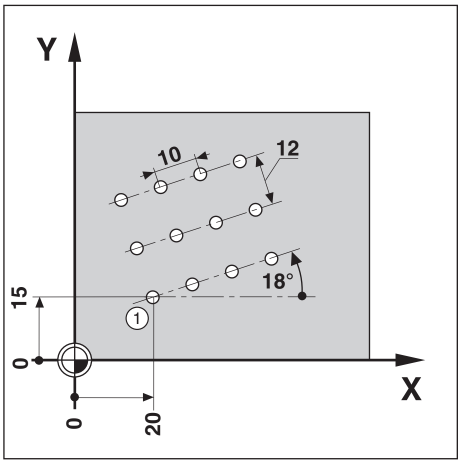
Program blocks

0	BEGIN PGM 20 MM	Start of program, program number, unit of measurement
1	Z+20.000	Clearance height
2	**CYCL 1.0 FULL CIRCLE**	Cycle data for a full circle follow
3	**CYCL 1.1 NO. 8**	Number of holes
4	**CYCL 1.2 CCX +50.000**	X coordinate of the center of the bolt circle
5	**CYCL 1.3 CCY +50.000**	Y-coordinate of the center of the bolt circle
6	**CYCL 1.4 RAD 20.000**	Radius
7	**CYCL 1.5 START +30.000**	Starting angle of first hole
8	**CYCL 1.6 DEPTH -5.000**	Hole depth
9	Z+20.000	Clearance height
10	END PGM 20 MM	End of program, program number, unit of measurement

For a **circle segment** (CYCL 2.0 CIRCLE SEGMENT) you also enter the angle step (STEP) between the holes (after the starting angle).

The bolt hole circle is then executed in the operating mode EXECUTE PROGRAM.

Programming example: Linear hole pattern (row of holes)



X coordinate of the first hole	X = 20 mm
Y coordinate of the first hole	Y = 15 mm
Number of holes per row	4
Hole spacing	10 mm
Angle between hole row and X axis	18°
Hole depth	Z = – 5 mm
Number of rows	3
Row spacing	12 mm

Example: Enter data for linear hole pattern into a program

Operating mode: `PROGRAMMING AND EDITING`

`Edit`	Select `Edit`.
/	Go to the third soft key row.
`Linear Pattern`	Select `Linear Pattern`.
`1st hole X ?`	
2 0 ENT	Enter the X coordinate of hole 1 (`POSX = 20` mm). Confirm your entry.
`1st hole Y ?`	
1 5 ENT	Enter the Y coordinate of hole 1 (`POSY = 15` mm). Confirm your entry.
`Holes per row ?`	
4 ENT	Enter the number of holes per row (`NO.HL = 4`). Confirm your entry.

Hole spacing ?	
1 0 ENT	Enter the hole spacing (`HLSPC = 10` mm). Confirm your entry.
Angle ?	
1 8 ENT	Enter the angle between the X axis and the rows of holes (`ANGLE = 18°`). Confirm your entry.
Hole depth ?	
– 5 ENT	Enter the hole depth (`DEPTH = -5` mm). Confirm your entry.
No Entry	Select `No Entry` for `Hole depth` if, for example, holes are to be drilled to different depths.
Number of rows ?	
3 ENT	Enter the number of rows (`NO.RW = 3`). Confirm your entry.
Row spacing ?	
1 2 ENT	Enter the row spacing (`RWSPC = 12` mm). Confirm your entry.

Program blocks

0	BEGIN PGM 80 MM	Start of program, program number, unit of measurement
1	Z+20.000	Clearance height
2	**CYCL 4.0 LINEAR HOLE PATTN**	Cycle data for linear hole pattern follow
3	**CYCL 4.1 POSX +20.000**	X coordinate of first hole
4	**CYCL 4.2 POSY +15.000**	Y coordinate of first hole
5	**CYCL 4.3 NO.HL 4**	Number of holes per row
6	**CYCL 4.4 HLSPC +10.000**	Distance between holes on the row
7	**CYCL 4.5 ANGLE +18.000**	Angle between the rows and the X axis
8	**CYCL 4.6 DEPTH -5.000**	Hole depth
9	**CYCL 4.7 NO.RW 3**	Number of rows
10	**CYCL 4.8 RWSPC +12.000**	Spacing between rows
11	Z+20.000	Clearance height
12	END PGM 80 MM	End of program, program number, unit of measurement

The hole pattern is then executed in the operating mode `EXECUTE PROGRAM`.

Rectangular pocket milling in programs

The POSITIP makes the roughing out of rectangular pockets simple: You just enter the dimensions for the pocket, and POSITIP calculates the rough-out paths.

Execution of cycle

The execution of the cycle is represented in Figs 7.6, 7.7 and 7.8.

`I`:
The POSITIP gives the distances-to-go for positioning the tool at the starting position Ⓐ : first in the tool axis, and then in the machining plane to the center of the pocket.

`II`:
Roughing out the pocket in accordance with the path indicated in the diagram (Fig. 7.8 shows climb milling). In the working plane the stepover distance is equal to the tool radius Ⓡ. The pecking depth in the tool axis is random.

`III`:
This procedure repeats itself until the entered depth Ⓑ is reached.

Input into cycle `5.0 RECTANGULAR POCKET`

- Starting position - `STARTPOS.` Ⓐ
  (enter absolute value, referenced to datum)
- Milling depth - `DEPTH` Ⓑ
  (enter absolute value, referenced to datum)
- Pocket center in X - `POSX` MX
  Center of the pocket in the main axis of the working plane.
- Pocket center in Y - `POSY` MY
  Center of the pocket in the secondary axis of the working plane.
- Side length in X - `LENGTH X` Ⓧ
  Length of the pocket in the direction of the main axis.
- Side length in Y - `LENGTH Y` Ⓨ
  Length of the pocket in the direction of the secondary axis.
- Direction `DIR.`
  Input value 0: Climb milling (Fig. 7.8: anticlockwise)
  Input value 1: Up-cut milling (clockwise)
- Finishing allowance - `FIN.AL`
  Finishing allowance in the working plane.

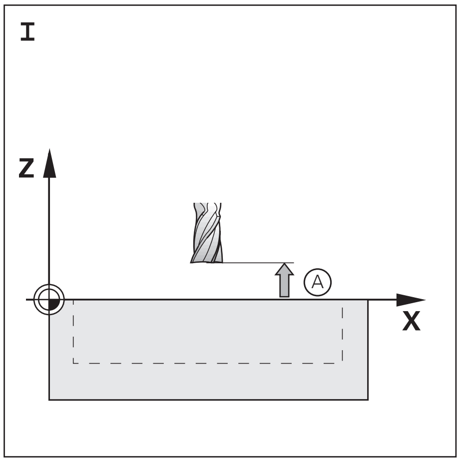


Fig. 7.6: Step `I` in cycle `5.0 RECTANGULAR POCKET`

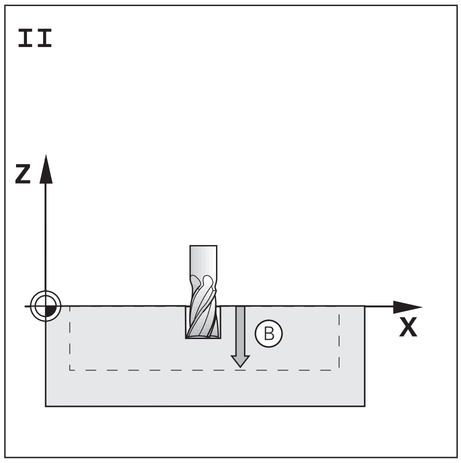


Fig. 7.7: Step `II` in cycle `5.0 RECTANGULAR POCKET`

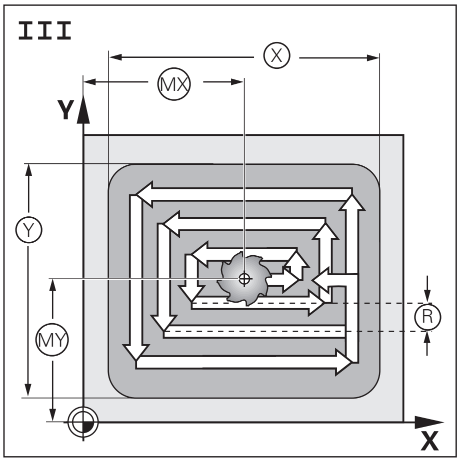
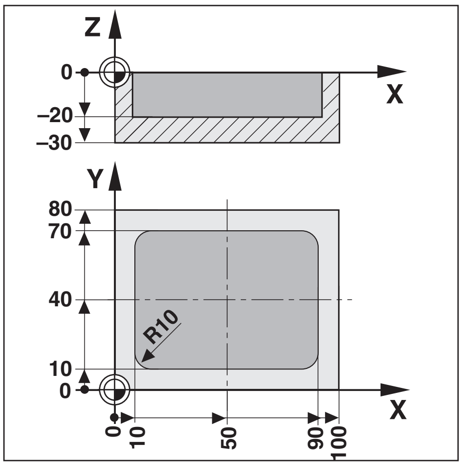


Fig. 7.8: Step `III` in cycle `5.0 RECTANGULAR POCKET`

Programming example: Mill rectangular pocket

Starting position:	2 mm
Milling depth:	– 20 mm
Pocket center in X:	50 mm
Pocket center in Y:	40 mm
Side length in X:	80 mm
Side length in Y:	60 mm
Direction:	0: CLIMB
Finishing allowance:	0.5 mm



Example: Entering rectangular pocket data into a program

Operating mode: `PROGRAMMING AND EDITING`

Edit	Select `EDIT`.

/	Go to the third soft-key row.
Pocket Milling	Select cycle `5.0 POCKET MILLING`.
Starting position ?	
2 ENT	Enter the `starting position` (`2` mm). Confirm your entry.
Milling depth ?	
– 2 0 ENT	Enter the `milling depth` (`- 20` mm). Confirm your entry.

.
.
.

Rectangular pocket milling in programs

Program blocks	
0 BEGIN PGM 55 MM	Start of program, program number, unit of measurement
1 CYCL 5.0 RECT. POCKET	Cycle data for cycle 5.0 RECTANGULAR POCKET
2 CYCL 5.1 START 2	Starting position above the workpiece surface
3 CYCL 5.2 DEPTH - 20	Milling depth
4 CYCL 5.3 POSX + 50	Pocket center in X
5 CYCL 5.4 POSY + 40	Pocket center in Y
6 CYCL 5.5 LGTHX 80	Side length in X
7 CYCL 5.6 LGTHY 60	Side length in Y
8 CYCL 5.7 DIR. 0 :CLIMB	Climb milling
9 CYCL 5.8 FIN.AL 0.5	Finishing allowance
10 END PGM 55 MM	End of program, program number, unit of measurement

Cycle `5.0 RECTANGULAR POCKET` is then run in the operating mode `EXECUTE PROGRAM` (see Chapter I-5).

Entering program interruptions

You can divide a program into sections with stop marks. POSITIP then only executes the next block when you press the soft key `Next Block`.

Operating mode: `PROGRAMMING AND EDITING`

Edit	Choose `Edit`.
/	Go to the second soft key row.
Stop	Press `Stop` to insert a program interruption.

Subprograms and program section repeats

Subprograms and program section repeats only need to be entered once in the program. You can then run them up to 999 times.

Subprograms can be run at any point in the program, while program section repeats are run several times in succession.

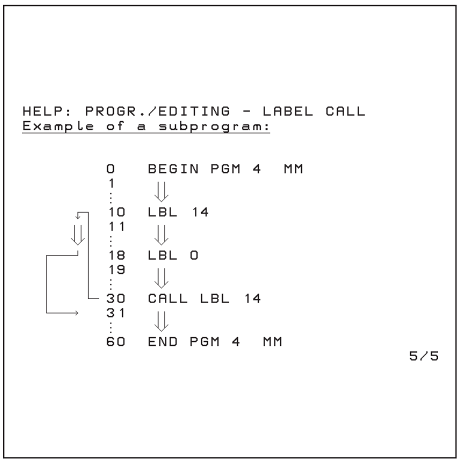


Fig. 28: On-screen operating instructions for subprograms *(page 5 shown)*

Inserting program marks (labels)

You identify subprograms and program section repeats with labels (abbreviated in the program to `LBL`).

Labels 1 to 99
Labels 1 to 99 identify the beginning of a subprogram or a program section which is to be repeated.

Label 0
Label 0 is used only to identify the end of a subprogram.

Label call
In the program, subprograms and program sections are called with the command `CALL LBL`.
The command `CALL LBL 0` is not allowed.
Subprograms:
After a `CALL LBL` block in the program, POSITIP executes the called subprogram.
Program section repeats:
POSITIP repeats the program section located before the `CALL LBL` block. You enter the number of repeats with the `CALL LBL` command.

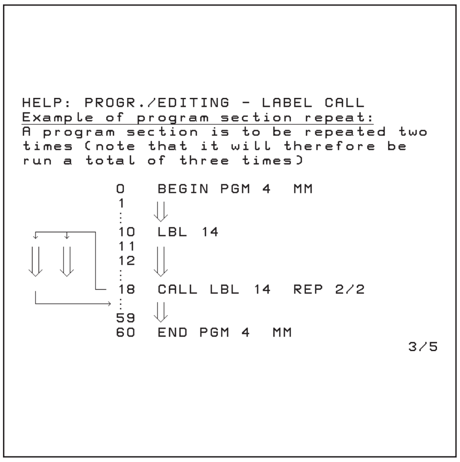


Fig. 29: On-screen operating instructions for program section repeats *(page 3 shown)*

Nesting program sections

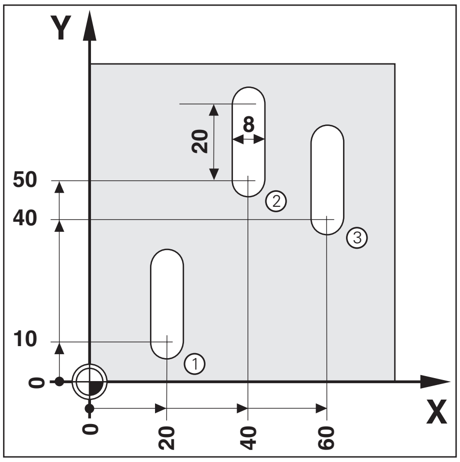
Subprograms and program section repeats can also be "nested." For example, a subprogram can in turn call another subprogram.

Maximum nesting depth: 8 levels.

Subprogram

Programming example: Subprogram for slots

Slot length: 20 mm + tool diameter
Slot depth: – 10 mm
Slot diameter: 8 mm (= tool diameter)
Coordinates of the recess point
Slot ① X = 20 mm Y = 10 mm
Slot ② X = 40 mm Y = 50 mm
Slot ③ X = 60 mm Y = 40 mm



> ⚠ A centre cut end mill
> (DIN 844) is required for carrying out this example!

Example: Insert label for subprogram

Operating mode: `PROGRAMMING AND EDITING`

Edit	Select `Edit`.
/	Go to the second soft key row.
Label Number	Insert a label (`LBL`) for a subprogram. POSITIP offers the lowest available label number.
`Label number ?`	
ENT	Accept the default label number.
1 ENT	Enter a label number (here, 1). Confirm your entry. The current block now contains the label `LBL 1`.

The beginning of a subprogram (or a program section repeat) is now marked with the label. Enter the program blocks for the subprogram after the `LBL` block.

Label 0 (`LBL 0`) is used **only** to identify the **end** of a subprogram.

Example: Enter a subprogram call: `CALL LBL`

/	Go to the second soft key row.
Label Call	Call the label. POSITIP offers the label number which was last set.

Label number ?

ENT	Accept the default label number.
1 ENT	Enter a label number (here, 1). Confirm your entry. The current block now contains the called label: `CALL LBL 1`.
Sub-program	For subprograms you can ignore the question `"Repeat REP ?"`. Press the soft key to confirm that a subprogram is being called.

After the `CALL LBL` block in the operating mode `EXECUTE PROGRAM`, POSITIP executes those blocks in the subprogram that are located between the `LBL` block with the called number and the next block containing `LBL 0`.

Note that the subprogram will be executed at least once even without a `CALL LBL` block.

Program blocks

0	BEGIN PGM 30	MM	Start of program, program number, unit of measurement
1	Z+20.000		Clearance height
2	X+20.000	R0	X coordinate of recess point slot ①
3	Y+10.000	R0	Y coordinate of recess point slot ①
4	CALL LBL 1		Call subprogram 1: execute blocks 12 to 16
5	X+40.000	R0	X coordinate of recess point slot ②
6	Y+50.000	R0	Y coordinate of recess point slot ②
7	CALL LBL 1		Call subprogram 1: execute blocks 12 to 16
8	X+60.000	R0	X coordinate of recess point slot ③
9	Y+40.000	R0	Y coordinate of recess point slot ③
10	CALL LBL 1		Call subprogram 1: execute blocks 12 to 16
11	Z+20.000		Clearance height
12	**LBL 1**		Start of subprogram 1
13	**Z-10.000**		Recess to slot depth
14	**IY+20.000**	**R0**	Mill slot
15	**Z+2.000**		Retract
16	**LBL 0**		End of subprogram 1
17	END PGM 30	MM	Program end, program number and measuring unit

Program section repeats

A program section repeat is entered like a subprogram. The end of the program section is identified simply by the command to repeat the section.

Label 0 is therefore not set.

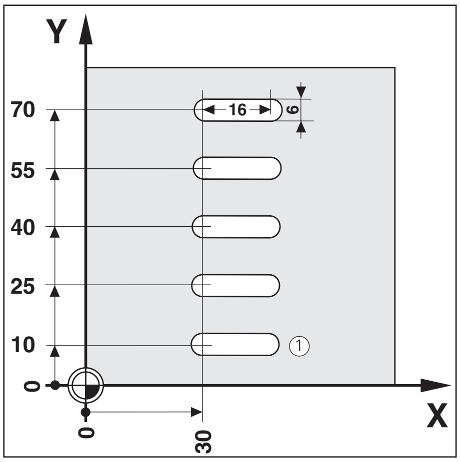
Display of the `CALL LBL` block with a program section repeat

The screen displays (for example): `CALL LBL 1  REP  10 / 10 .`

The two numbers with the slash between them indicate that this is a program section repeat. The number in front of the slash is the number of repeats you entered. The number behind the slash is the number of repeats remaining to be performed.

Programming example: Program section repeat for slots

Slot length: 16 mm +tool diameter
Slot depth: – 12 mm
Incremental offset of the recess point: 15 mm
Slot diameter: 6 mm (= tool diameter)
Coordinates of the recess point
Slot ① : X = 30 mm Y = 10 mm



A centre cut end mill (DIN 844) is required for carrying out this example!

Example: Insert a label for a programs section repeat

Operating mode: `PROGRAMMING AND EDITING`

Edit	Select `Edit`.
(soft key row keys) /	Go to the second soft key row.
Label Number	Set a program mark (`LBL`) for a program section repeat. POSITIP offers the lowest available label number as a default.
Label number ?	
ENT	Accept the default label number.
1 ENT	Enter a label number (here, 1). Confirm your entry. The current block now contains the set label: `LBL 1`.

Enter the blocks for the program section repeat after the `LBL` block.

Example: Entering a program section repeat: `CALL LBL`

[key] / [key]	Go to the second soft key row.
Label Call	Call label. POSITIP offers the label number that was last set.
Label number ?	
ENT	Accept the default label number.
1 ENT	Enter a label number (here, 1) and confirm your entry. The called label is now in the current block: `CALL LBL 1`.
Repeat REP ?	
4 ENT	Enter the number of repeats (here, 4) and confirm your entry.

After a `CALL LBL` block in the operating mode `PROGRAMMING AND EDITING`, POSITIP repeats those program blocks that are located **behind** the LBL block with the called number and **before** the `CALL LBL` block.
Note that the program section will always be executed one more time than the programmed number of repeats.

Program blocks

0	BEGIN PGM 70	MM	Start of program, program number, unit of measurement
1	Z+20.000		Clearance height
2	X+30.000	R0	X coordinate recess point slot ①
3	Y+10.000	R0	Y coordinate recess point slot ①
4	**LBL 1**		Start of program section 1
5	**Z-12.000**		Recess
6	**IX+16.000**	**R0**	Mill slot
7	**Z+2.000**		Retract
8	**IX-16.000**	**R0**	Position in X
9	**IY+15.000**	**R0**	Position in Y
10	**CALL LBL 1 REP 4 / 4**		Repeat program section 1 four times
11	Z+20.000		Clearance height
12	END PGM 70	MM	End program, program number, unit of measurement

Editing existing programs

You can edit existing programs, for example to correct keying errors. POSITIP supports you with plain language dialogs — just as when you are creating a new program.

Program numbers can be changed by selecting the BEGIN or END block and entering a new program number.

Confirm your changes

You **must** confirm each change with the ENT key for it to become effective.

Example: Editing a program block

↑ / ↓	Move to the block you wish to edit.
→	Select the block.
2 0	Edit the block, for example enter a new nominal position value (here, 20).
ENT	Confirm the change.

Function	Key
Select the next-lowest program block	↓
Select the next-highest program block	↑
Go directly to program block number	GOTO
Select program block to edit	→
Confirm change	ENT

Deleting program blocks

You can delete any blocks in existing programs except the `BEGIN` and `END` blocks.

When a block is deleted, POSITIP automatically renumbers the remaining blocks. The block **before** the deleted block then becomes the current block.

Example: Deleting a program block

Operating mode: `PROGRAMMING AND EDITING`

Edit	Select `Edit`.
↑ / ↓	Move to the block you wish to delete (or use the GOTO key).
/	Go to the second soft key row.
Delete Block	Press `Delete Block`.

It is also possible to delete an entire **program section**:

➤ Select the last block of the program section.

➤ Press the soft key `Delete Block` repeatedly until all blocks in the program section have been deleted.

Transferring programs over the data interface

The RS-232-C interface on the rear panel allows you to utilize a device such as the HEIDENHAIN FE 401 floppy disk unit or a PC for external data storage.
Programs can also be archived on diskette and loaded back into POSITIP again as required.

Pin layout, wiring and connections for the data interface are described in chapter II - 4.

Function	Soft Key/key
Directory of programs stored in POSITIP	POSITIP PGM Dir
Directory of programs stored on the FE	FE 401 PGM Dir
Abort data transfer	Escape
• Switch FE – EXT • Show further programs	→

Example: Transferring a program into POSITIP

Operating mode: `PROGRAMMING AND EDITING`

Extern.	Select `Extern`.
Program number ?	
5	Enter the program number (here, 5).
← / →	Select external device (for diskette unit or PC with HEIDENHAIN data transfer software TNC.EXE use FE setting; for PC without TNC.EXE use EXT setting).
Start Input	Press `Start Input` to transfer the program to POSITIP. The message `Loading program:` appears on the POSITIP screen

If you are transferring programs into POSITIP from a PC (EXT setting), the PC must **send** the programs.

If POSITIP's memory already contains a program with the same number as that being transferred, the error message `PROGRAM ALREADY EXISTS` will appear on the screen.

In this case, before you can transfer the program you must either **rename** or **delete** the program in POSITIP.

For program output, POSITIP automatically displays all programs in its memory.

Example: Reading a program out of POSITIP

Operating mode: `PROGRAMMING AND EDITING`

Extern.	Select `Extern.`
/	Go to `EXTERNAL OUTPUT.`
Program number ?	
1 0	Enter the program number (here, 10).
→	Select the external device. For diskette unit or PC with HEIDENHAIN data transfer software TNC.EXE use FE setting; for PC without TNC.EXE (or printer) use EXT setting.
Start Output	Press `Start Output` to transfer the program to the external device. The message `Reading out program:` appears.

CAUTION

A program on the external device with the same number as that being read out will be overwritten. No confirmation to overwrite will be requested.

To read all programs out of POSITIP:

➤ Press soft-key `Output All PGM`

I - 5
Executing Programs

Programs are run in the operating mode `EXECUTE PROGRAM`. The current program block is displayed at the top of the screen.

There are two ways to run programs:

`Single Block`
When you have moved the axis to the displayed position, call the next block with the soft key `Next Block`. It is recommended that you use `Single Block` when running a program for the first time.

`Automatic`
Here the display automatically shows the next program block as soon as you have moved to the displayed position. Use `Automatic` when you are sure the program contains no errors and you want to run it quickly.

Preparation

➤ Mount the workpiece on the machine table-.
➤ Set the reference point for the work piece.
➤ Select the program with `Program number` in the main menu `EXECUTE PROGRAM`.

Single Block

Operating mode: `EXECUTE PROGRAM`

Single Block	Select `Single Block`. The program block and the graphic positioning cursor appear.
	Position by "traversing to zero."
Next Block	Call next program block.

Continue positioning and calling blocks with `Next Block` until machining is complete.

An overview of functions is shown on the next page.

Automatic

Operating mode: `EXECUTE PROGRAM`

Auto-matic	Select `Automatic`. The program block and the graphic positioning cursor appear.
	Position by traversing to display value zero.

The display automatically shows the next program block as soon as you have moved to the displayed position. The positioning aid automatically switches to the coordinate axis of the new block.

Function	Soft key/Key
Start with the block before the current block	↑
Start with the block after the current block	↓
Select the starting block directly	GOTO
Enter the tool data	Tool Table
With hole patterns: Display pattern graphically	Graphic
After starting: Abort – return to menu	Escape

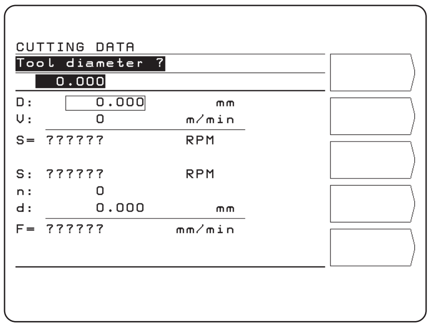
I - 6
The INFO Functions: Pocket Calculator, Stopwatch and Cutting Data Calculator

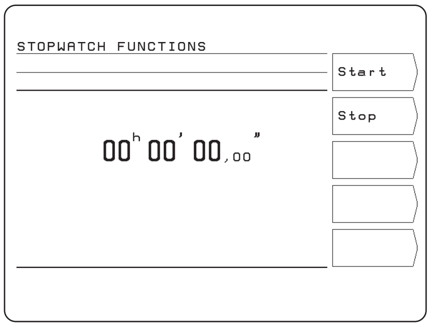
Press the INFO key to access the following functions:

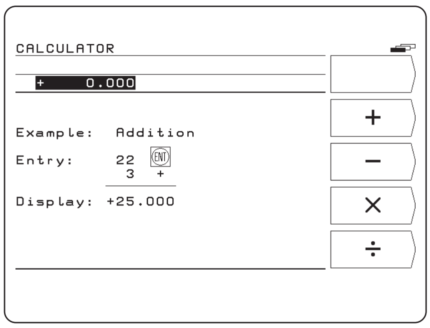
- **Cutting data calculator**
  Calculates the spindle speed from the tool diameter and the cutting speed;
  Calculates the feed rate from the spindle speed, the number of teeth and the depth of cut per tooth.
- **Stopwatch**
- **Pocket calculator**
  Basic arithmetic + , − , ×, ÷ ;
  Trigonometric functions (sin, cos, tan, arc sin, arc cos, arc tan)
  Square roots
  x^2
  Reciprocals (1/x)
  π (3.14159...)

To access the INFO functions

INFO	Press the INFO key.
Cutting Data	`Cutting Data` for milling
Stop-watch	Select `Stopwatch`.
Calc.	Select `Calculator` functions







Cutting data: Calculate spindle speed S and feed rate F

POSITIP can calculate the spindle speed S and the feed rate F for you. As soon as you conclude an entry with ENT, POSITIP prompts you for the next entry.

Entry values

- For the spindle speed S in rpm:
  Enter the tool diameter D in mm and the cutting speed V in m/min.
- For the feed rate F in mm/min:
  Enter the spindle speed S in rpm,
  the number of teeth n of the tool and
  the permissible depth of cut per tooth d in mm.

For calculation of the feed rate, POSITIP automatically offers the spindle speed it just calculated. You can enter a different value, however.

Function	Key
Confirm entry and continue dialog	ENT
Go to the next-higher input line	↑
Go to the next-lower input line	↓

Example: Entering the tool diameter

You can be in any operating mode. Select `Cutting Data`.

Tool diameter ?	
8 ENT	Enter the tool diameter (8 mm) and transfer it into the box behind the letter D.

Stopwatch

The stopwatch shows the hours (h), minutes ('), seconds ('') and hundredths of a second.
The stopwatch continues to run even when you leave the INFO function. When the power is interrupted (switch-off), POSITIP resets the stopwatch to zero.

Function	Soft Key
Reset the stopwatch to zero and start	Start
Stop timing	Stop

Pocket calculator

The pocket calculator functions are spread over three soft key rows:

- Basic arithmetic (first soft key row)
- Trigonometry (second row)
- Square root, x^2, 1/x, π (third row)

Use the paging keys to go from one soft key row to the next.
POSITIP always shows an example entry — you don't have to press the HELP key.

Transferring the calculated value

The calculated value remains in the input line even after you leave the pocket calculator function.
This allows you to transfer the calculated value directly into a program as a nominal position — without having to reenter it.

Entry logic

For calculations with **two** operands (addition, subtraction, etc.):

➤ Key in the first value.
➤ Confirm the value by pressing ENT.
➤ Key in the second value.
➤ Press the soft key for the desired operation.
POSITIP displays the result of the operation in the input line.

For calculations with **one** operand (sine, reciprocal, etc.):

➤ Key in the value.
➤ Press the soft key for the desired operation.
POSITIP displays the result of the operation in the input line.

Example: See the next page.

Example: (3 × 4 + 14) ÷ (2 × 6 + 1) = 2

3 ENT	Key in the first value in the first parenthesis: 3; confirm entry. The display shows `+3.000`.
4 ×	Key in the second value in the first parenthesis: 4 and combine the second value with the first value: ×. The display now shows `+12.000`.
1 4 +	Key in the third value in the first parenthesis: 14 and combine the third value with the displayed value 12.000: +. The display now shows `+26.000`.
2 ENT	Key in the first value in the second parenthesis: 2; confirm entry. This automatically closes the first parenthesis. The display shows `+2.000`.
6 ×	Key in the second value in the second parenthesis: 6 and combine the second value with the first value: ×. The display now shows `+12.000`.
1 +	Key in the third value in the second parenthesis: 1 and combine the third value with the displayed value 12.000: +. The display now shows `+13.000`.
÷	Close the second parenthesis and simultaneously combine with the first parenthetical expression: ÷. The display now shows the result: `+2.000`.

I - 7

User Parameters: The MOD Function

User parameters are operating parameters which you can change without having to enter a code number.
The machine builder determines which operating parameters are available to you as user parameters as well as how the user parameters are arranged in the soft keys.

The functions of user parameters are described in chapter II - 2.

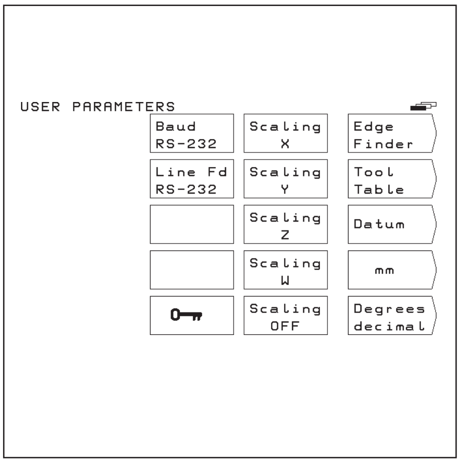


Fig. 30: The user parameters on the POSITIP screen

To access the user parameter menu

➤ Press MOD.
The user parameters appear on the screen.
➤ Go to the soft key row with the desired user parameter.
➤ Press the soft key for the desired user parameter.

To leave the user parameter menu

➤ Press MOD.

Scaling factors

The user parameter `Scaling Factor` enables you to increase or decrease the size of workpieces. POSITIP divides the displayed value by the scaling factor you entered.
Scaling factors change the workpiece size symmetrically about the workpiece datum. The workpiece datum should therefore be located at an edge when you are working with scaling factors.

Input range: 0.1 to 9.999 999

To activate scaling factors

➤ Switch the user parameter `Scaling Factor OFF / ON` to `ON`.

To deactivate scaling factors

➤ Switch the user parameter `Scaling Factor OFF / ON` to `OFF`.

Please see next page for instructions on entering scaling factors.

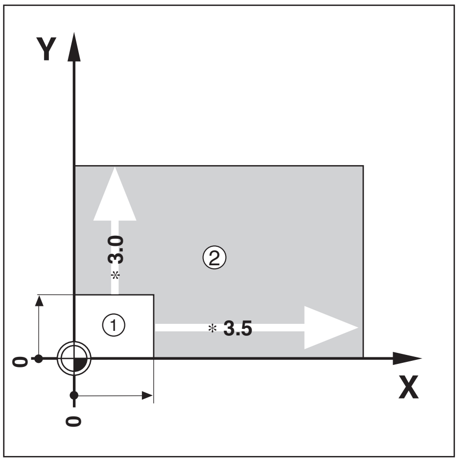


Fig. 31: ① Original workpiece
② After enlargement with scaling factor

Entering user parameters

Choosing settings

Some user parameter settings are chosen directly with the soft keys. You simply switch from one setting to the other.

Example: Angle format

➤ Press MOD.
The MOD main menu now contains either the soft key `Deg. decimal` or `Deg/Min/Sec`

➤ Press the displayed soft key.
The soft key changes to the other setting, for example from `Deg. decimal` to `Deg/Min/Sec`

➤ Press MOD again.
This ends the MOD function.
The new setting for the angle format is now in effect.

Entering values

Some user parameters require that you enter a value or select a setting from a number of possible settings. When you press the soft key, a menu for the parameter is displayed.

Example: Scaling factor for the Z axis

➤ Press MOD.

➤ Press the soft key `Scaling Z`.
POSITIP now displays an input screen for the scaling factor.

➤ Key in the desired scaling factor.

➤ Press ENT.
If you want this scaling factor to apply to all coordinate axes, press the soft key `Set All`.
The MOD main menu is then displayed.

➤ Press MOD again.
This ends the MOD function.
The new setting for the scaling factor is now in effect.

> When you are working with scaling factors, the soft key `Scaling OFF/ON` must be set to `ON`.

Part II: Technical Information

II

Technical Information

II - 1
Installation and Electrical Connection

Items supplied

- POSITIP 855 Display Unit
- Power connector
- User's Manual

Installation

M4 screws are required for securing POSITIP from below or on a tilting base from HEIDENHAIN (Id.-Nr. 281 619 01). See chapter II - 8 for the bore hole dimensions.

Electrical connection

WARNING - Electric Shock Danger
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.

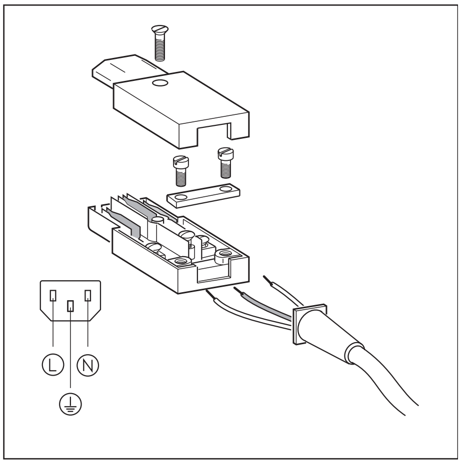


Fig. 32: Wiring the power connector

Power connection

POSITIP requires AC voltage between 100 V and 240 V (48 Hz to 62 Hz). No voltage adjustment is required.

Wiring the power connector

See fig. 32
Hot leads: L and N
Ground: ⏚

Minumum diameter of power connection cable: 0.75 mm^2

Grounding

> Noise immunity can be increased by connecting the ground screw on the rear panel to the star point of machine ground. Minimum cross-section of the connecting wire: 6 mm^2.

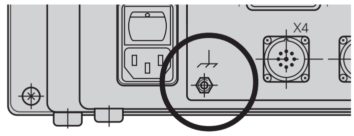


Fig. 33: The ground screw on the rear panel

Connecting the encoders

POSITIP can be used with HEIDENHAIN linear and angle encoders that provide sinusoidal output signals. The encoder inputs on the rear panel are designated X1, X2, X3 and X4. The **connecting cable** may not exceed 30 m (100 ft) in length.

> **Danger to internal components!**
> Do not engage or disengage any connections while the unit is under power.

Pin layout for encoder inputs

Pin	Assignment
1	0°+
2	0°–
3	+5 V (U_P)
4	0 V (U_N)
5	90°+
6	90°–
7	Reference mark signal RI+
8	Reference mark signal RI–
9	Internal shield
Housing	External shield

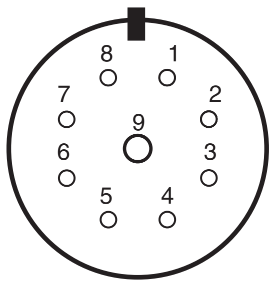


Fig. 34: Flange socket on POSITIP for encoder signal input

The encoder inputs are permanently assigned to 4 axes. Operating parameter P49.∗ determines the designation of the axes, e.g. axis 1 = X axis, axis 2 = Y axis.

Axis	Encoder input
1	X1
2	X2
3	X3
4	X4

> Interfaces X1, X2, X3 and X4 comply with the recommendations in VDE 0160, 5.88 for separation from line power.

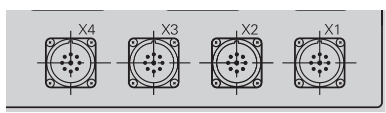


Fig. 35: Encoder inputs on rear panel

Connecting an Edge Finder

Connect the HEIDENHAIN KT Edge Finder to the D-sub input X10 on the rear panel.
Adapt POSITIP for use with the Edge Finder through the following operating parameters:

- P25 (stylus length)
- P26 (stylus diameter)
- P96 (measured value output during probing)

The operating parameters are described in chapter II - 2.

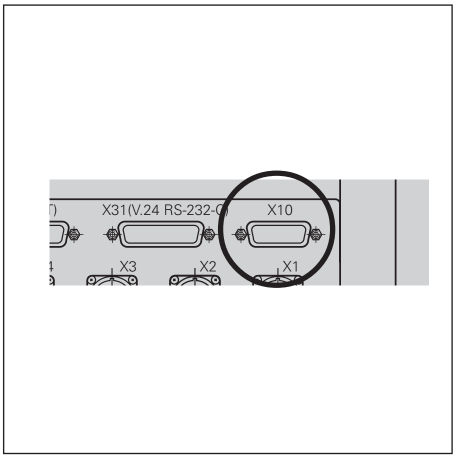


Fig. 36: Input X10 for edge finder

Pin layout for Edge Finder input

Pin	Assignment	Type
1	Internal shield	
2	Stand-by	KT 130
6	UP +5 V	KT 130
8	UP 0 V	KT 130
13	Switch signal	KT 130
14	Contact +2.5 V	KT 120
15	Contact 0 V	KT 120
Housing	External shield	

All other pins: do not assign

Interface X10 complies with the recommendations in VDE 0160, 5.88 for separation from line power

Initial switch-on

When you switch on your POSITIP for the first time, the screen shown in figure 37 appears. You can now select the type of application (milling or turning).

For **milling**:
➤ Press the 0 key

For **turning**:
➤ Press the 1 key

POSITIP automatically provides the functions appropriate to the selected application.

You can change the application later with operating parameter P 99.

Fig. 37: POSITIP screen after initial switch-on

II - 2
Operating Parameters

Operating parameters adapt the POSITIP to the machine.
They are identified with the letter P, a three-digit number and a name.

Axis-specific operating parameters
Some parameters must be entered separately for each axis. Such parameters are identified in the following descriptions with a star (*).
Example: Operating parameter for the counting direction: P30.*
For this parameter you enter the counting direction separately for each axis in parameters P30.1, P30.2, P30.3 and P30.4.

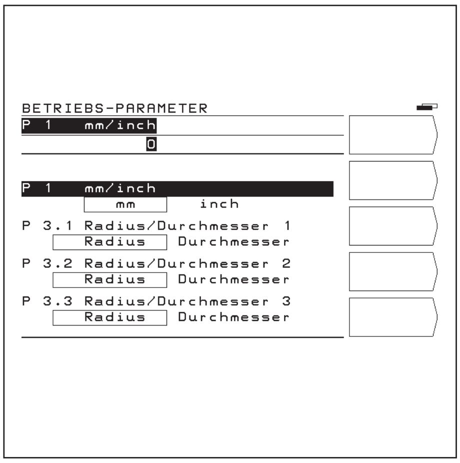


Fig. 38: Example of operating parameters

Factory settings
The factory settings for the operating parameters in the overview on the next pages are set in ***bold italic*** type.

Numerical input, dialog input
The current setting of an operating parameter is shown in plain language under the parameter designation in the on-screen operating parameter list. In addition, each parameter setting has a number in the input line at the top. These numbers are transferred when you read out the operating parameters over the data interface.

To access the operating parameters

- ➤ Press MOD.
- ➤ Go to the soft key row containing `Code Number` (soft key with the key symbol).
- ➤ Press the soft key `Code Number`
- ➤ Enter the code number 95148.
- ➤ Confirm with ENT.
- ➤ Display the operating parameters one after the other with the vertical arrow keys; **or**
- ➤ Go directly to an operating parameter:
  Press GOTO, enter the parameter number and confirm with ENT.

To change parameter settings

Operating parameter settings can be changed by selecting the new setting or entering a numerical value:

- ➤ Select a new setting: Press the horizontal arrow key.
  or
- ➤ Enter a numerical value directly and confirm your entry with ENT.
  The horizontal arrow key has no function with parameters which only allow direct numerical entry.

Transferring operating parameters over the data interface

You can archive the operating parameters on the FE 401 B Floppy Disk Unit or a PC and read them into the POSITIP again whenever required. For further information on the data interface and data transfer, see chapter II - 4.

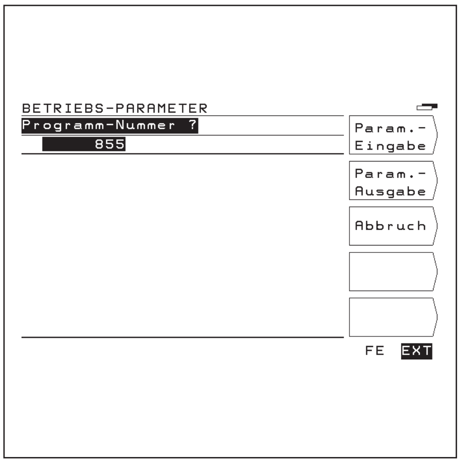


Fig. 39: The POSITIP screen for transfer of operating parameters

Preparation

➤ Access the operating parameters as described above.

➤ Go to the second soft-key level..

To read out parameters

➤ Enter the program number under which you wish to save the operating parameters.

➤ Press the soft key `Param. Output.`
POSITIP reads out all operating parameters.

To download parameters

➤ Enter the program number under which the operating parameters are stored on the diskette.

➤ Press the soft key `Param. Input.`
POSITIP replaces all operating parameter settings in its memory with those on the diskette.

User parameters

The machine manufacturer has defined certain operating parameters as user parameters. You can change the settings of user parameters without having to enter the code number (see Operating Instructions section, chapter I - 7).

Position of user parameters in the menu

In operating parameters P100 to P122, the machine manufacturer defines how the user parameters are arranged in the soft keys.

Field 15 is reserved for the soft key `Code Number`.

If a parameter is assigned field number 0, it will **not** appear in the user parameter menu.

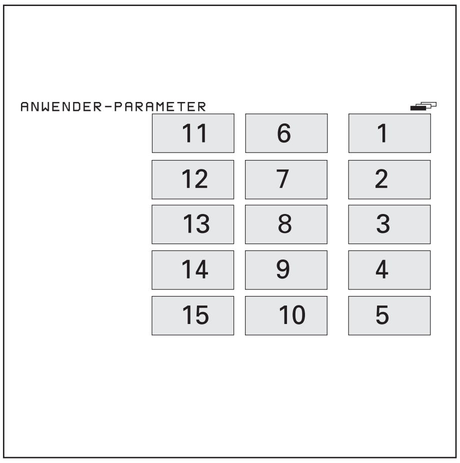


Fig. 40: Fields for user parameters

Operating parameter	User parameter designation*)	Standard field	
P 100	mm / inch (P 1)	***4***	....
P 101.1	Radius / diameter 1 (P 3.1)	***0***	....
P 101.2	Radius / diameter 2 (P 3.2)	***0***	....
P 101.3	Radius / diameter 3 (P 3.3)	***0***	....
P 101.4	Radius / diameter 4 (P 3.4)	***0***	....
P 103	Angle format (P 8)	***5***	....
P 104	Scaling factor ON/OFF (P 11)	***10***	....
P 105.1	Scaling factor 1 (P 12.1)	***6***	....
P 105.2	Scaling factor 2 (P 12.2)	***7***	....
P 105.3	Scaling factor 3 (P 12.3)	***8***	....
P 105.4	Scaling factor 4 (P 12.4)	***9***	....
P 109	Edge finder (P 25, P 26)	***1***	....
P 112	RS-232 baud rate (P 50)	***11***	....
P 113	RS-232 line feeds (P 51)	***12***	....
P 120	Tool table	***2***	....
P 122	Datum table	***3***	....

*) The corresponding operating parameters are indicated in parentheses.

List of operating parameters

Parameter		Page	Function and allowed entries	Numerical entry *)	✍
P1	**mm/inch**	*97*	Dimensions in millimeters: **mm** Dimensions in inches: **inch**	***0*** 1	P1 ....
P3.1 **P3.2** **P3.3** **P3.4**	**Radius/Diameter 1** **Radius/Diameter 2** **Radius/Diameter 3** **Radius/Diameter 4**	*97*	**Radius** display **Diameter** display	***0*** 1	P3.1 .... P3.2 .... P3.3 .... P3.4 ....
P6	**Axis combination**	*97*	No axis combination: **off** **1+4** displayed on 1 **2+4** displayed on 2 **3+4** displayed on 3 **1–4** displayed on 1 **2–4** displayed on 2 **3–4** displayed on 3	***0*** 1 2 3 4 5 6	P6 ....
P8	**Angle format**	*97*	Decimal display: **Degrees** **Deg**rees/**Min**utes/**Sec**onds	***0*** 1	P8 ....
P9.1 **P9.2** **P9.3** **P9.4**	**Angle counting 1** **Angle counting 2** **Angle counting 3** **Angle counting 4**	*97*	**360°** **+/– 180°** **+/– ∞°**	***0*** 1 2	P9.1 .... P9.2 .... P9.3 .... P9.4 ....
P11	**Scaling factor on**	*79*	Scaling factor inactive: **off** Scaling factor active: **on**	***0*** 1	P11 ....
P12.1 **P12.2** **P12.3** **P12.4**	**Scaling factor 1** **Scaling factor 2** **Scaling factor 3** **Scaling factor 4**	*79*	Scaling factor 0.1 bis 9.999 99	 ***1.0***	P12.1 .... P12.2 .... P12.3 .... P12.4 ....
P23	**Display freeze** Influence position display by signal for measured value output	*104*	Ignore signal: **off** Stop display: **concrnt.** Freeze display: **frozen**	***0*** 1 2	P23 ....
P25	**Stylus diameter**	–	0.001 bis 999.999 [mm]	***6.0***	P25 ....
P26	**Stylus length**	–	–999,999 bis 999.999 [mm]	***0.0***	P26 ....
P30.1 **P30.2** **P30.3** **P30.4**	**Counting direction 1** **Counting direction 2** **Counting direction 3** **Counting direction 4**	*93*	**Positive** counting direction with positive traverse direction **Negative** counting direction with positive traverse direction	***0*** 1	P30.1 .... P30.2 .... P30.3 .... P30.4 ....
P31.1 **P31.2** **P31.3** **P31.4**	**Signal period 1** **Signal period 2** **Signal period 3** **Signal period 4**	*94* *95*	Signal period of linear encoder (see Operating Instructions for encoder)	***20***	P31.1 .... P31.2 .... P31.3 .... P31.4 ....
P32.1 **P32.2** **P32.3** **P32.4**	**Linear subdivision 1** **Linear subdivision 2** **Linear subdivision 3** **Linear subdivision 4**	*94* *95*	Linear subdivision of encoder signals	***20***	P32.1 .... P32.2 .... P32.3 .... P32.4 ....

)** Standard factory settings are in ***bold italic type

Parameter	Page	Function and allowed entries	Numerical entry [1]	✍
P35.1 Line count 1 **P35.2 Line count 2** **P35.3 Line count 3** **P35.4 Line count 4**	*96*	Line count of angle encoder (see operating instructions of encoder)	***1 800***	P35.1 .... P35.2 .... P35.3 .... P35.4 ....
P36.1 Angle subdivision 1 **P36.2 Angle subdivision 2** **P36.3 Angle subdivision 3** **P36.4 Angle subdivision 4**	*96*	Angle subdivision of encoder signals	***20***	P36.1 .... P36.2 .... P36.3 .... P36.4 ....
P40.1 Error compensation 1 **P40.2 Error compensation 2** **P40.3 Error compensation 3** **P40.4 Error compensation 4**	*98* *99*	No axis error compensation: **OFF** Linear axis error comp.: **Linear** Non-linear axis error compensation: **Non-linear**	***0*** 1 2	P40.1 .... P40.2 .... P40.3 .... P40.4 ....
P41.1 Linear compensation 1 **P41.2 Linear compensation 2** **P41.3 Linear compensation 3** **P41.4 Linear compensation 4**	*98*	Amount of linear axis error compensation [ppm]	+0.0	P41.1 .... P41.2 .... P41.3 .... P41.4 ....
P43.1 Distance coding 1 **P43.2 Distance coding 2** **P43.3 Distance coding 3** **P43.4 Distance coding 4**	*92*	No distance coding: **None** **500** • GP, **1 000** • GP, **2 000** • GP, **5 000** • GP	0, *500,* ***1 000,*** 2 000, 5 000	P43.1 .... P43.2 .... P43.3 .... P43.4 ....
P44.1 Reference mark 1 **P44.2 Reference mark 2** **P44.3 Reference mark 3** **P44.4 Reference mark 4**	*92* *95*	Evaluate reference marks: **Yes** Do not evaluate: **No**	***0*** 1	P44.1 .... P44.2 .... P44.3 .... P44.4 ....
P45.1 Encoder monitoring 1 **P45.2 Encoder monitoring 2** **P45.3 Encoder monitoring 3** **P45.4 Encoder monitoring 4**	*93*	Monitoring **Off** Monitoring **On**	0 ***1***	P45.1 .... P45.2 .... P45.3 .... P45.4 ....
P48.1 Axis definition 1 **P48.2 Axis definition 2** **P48.3 Axis definition 3** **P48.4 Axis definition 4**	*93*	Axis input inhibited: **Off** Linear axis: **Linear** Rotary axis: **Rotary**	0 ***1*** 2	P48.1 .... P48.2 .... P48.3 .... P48.4 ....
P49.1 Axis designation 1 **P49.2 Axis designation 2** **P49.3 Axis designation 3** **P49.4 Axis designation 4**	*97*	Axis is coordinate axis **A** Axis is coordinate axis **B** Axis is coordinate axis **C** Axis is coordinate axis **U** Axis is coordinate axis **V** Axis is coordinate axis **W** Axis is coordinate axis **X** Axis is coordinate axis **Y** Axis is coordinate axis **Z**	65 [2] 66 [2] 67 [2] 85 [2] 86 [2] 87 [2] 88 [2] 89 [2] 90 [2]	P49.1........... P49.2........... P49.3........... P49.4...........
P50 RS-232 baud rate	*101*	Speed of data transfer 150 [baud] ≤ P 50 ≤ 38 400 [baud]	***9 600***	P50 ....
P51 RS-232 blank lines	*104*	Number of line feeds after output of measured value [0 to 99]	***1***	P51 ....

[1] Standard factory settings are in ***bold italic*** type

[2] Factory setting for P 49.∗:
P49.1 = ***88***; P 49.2 = ***89***; P 49.3 = ***90***; P 49.4 = ***87***

Parameter	Page	Function and allowed entries	Numerical entry *)	✍
P60.0 Switching output 0 **P60.1 Switching output 1** **P60.2 Switching output 2** **P60.3 Switching output 3** **P60.4 Switching output 4** **P60.5 Switching output 5** **P60.6 Switching output 6** **P60.7 Switching output 7**	*108*	**Off** Assigned to axis **1** Assigned to axis **2** Assigned to axis **3** Assigned to axis **4**	***0*** 1 2 3 4	P60.0 .... P60.1 .... P60.2 .... P60.3 .... P60.4 .... P60.5 .... P60.6 .... P60.7 ....
P61.0 Switching range 0 **P61.1 Switching range 1** **P61.2 Switching range 2** **P61.3 Switching range 3** **P61.4 Switching range 4** **P61.5 Switching range 5** **P61.6 Switching range 6** **P61.7 Switching range 7**	*108*	Enter switching range symmetrically about zero in [mm]	***0.0***	P61.0 .... P61.1 .... P61.2 .... P61.3 .... P61.4 .... P61.5 .... P61.6 .... P61.7 ....
P69 Triggering signal	*108*	**Mode 1** (signal delay 80 ms) **Mode 2** (signal delay 5 ms)	***0*** 1	P69 ....
P81.1 16/40µA switchover 1 **P81.2 16/40µA switchover 2** **P81.3 16/40µA switchover 3** **P81.4 16/40µA switchover 4**	*92*	**16 µA** encoder signal **40 µA** encoder signal	***0*** 1	P81.1 .... P81.2 .... P81.3 .... P81.4 ....
P83 Sleep delay Screen saver (periodically reverses the screen image)	–	Screen saver starts after 5 to 98 [min] No screen saver	 ***15*** 99	P83 ....
P88 Rot. direction bolt circle Define direction of rotation for bolt circle graphics	–	Positive counterclockwise: **Normal** Positive clockwise: **Inverse**	 ***0*** 1	P88 ....
P89 Mirroring graphics Mirror coordinate axes in bolt circle graphics	–	No mirroring: **Off** Mirror the vertical axis: **Ver.** Mirror the horizontal axis: **Hor.** Mirror both axes: **Ve+Ho**	***0*** 1 2 3	P89 ....
P91 Distance-To-Go In `DISTANCE-TO-GO` mode, display either graphic positioning aid or actual position of tool	–	Graphic positioning aid: **Graphic** Tool position: **Actual value**	***0*** 1	P91 ....
P92 Feed rate display Display feed rate F in status line at bottom of screen	–	Feed rate not displayed: **Off** Feed rate displayed: **On**	***0*** 1	P92 ....
P96 Data output probing	*104*	No measured value output: **Off** With measured value output: **On**	***0*** 1	P96 ....
P98 Dialog language	–	First language, e.g. **German** Second language, e.g. **English**	***0*** 1	P98 ....
P99 Counter application	–	Milling machine: **Milling** Lathe: **Turning**	***0*** 1	P99 ....

)** Standard factory settings are in ***bold italic type
Operating parameters **P 100 to P 122** are listed on page 88.

II - 3
Encoders and Measured Value Display

This chapter describes all operating parameters which you must set for the encoders and measured value display. Most entries can be found in the operating instructions for your encoder.
Chapter II - 2 contains a list of operating parameters in which you can record your entries.

- **Adapting the encoder**
  - Encoder output signals 16 µA or 40 µA
  - Reference marks on the encoder: distance-coded or one reference mark
  - Deactivation of reference mark evaluation
  - Definition of the coordinate axes
  - Counting direction of the encoder signals
  - Encoder monitoring
  - Linear axis error compensation
- **Selection of display step**
- **Setting the measured value display**
  - Designations of the coordinate axes
  - Unit of measurement
  - Display of rotary axes
  - Angle display
  - Axis combination
  - Radius/diameter display

Adapting the encoders

Encoder output signal: P81.∗	
Encoder with **16 µA** output signal:	P81.∗ = 0
Encoder with **40 µA** output signal:	P81.∗ = 1

The position feedback encoders on the machine may have one reference mark or several distance-coded reference marks.

Reference marks on the encoder: P43.∗	
One reference mark (**none**):	P43.∗ = 0
Distance-coded reference marks (**500 •** TP):	P43.∗ = 500
Distance-coded reference marks (**1 000 •** TP):	P43.∗ = 1000
Distance-coded reference marks (**2 000 •** TP):	P43.∗ = 2000
Distance-coded reference marks (**5 000 •** TP):	P43.∗ = 5000

Reference mark evaluation can be deactivated separately for each axis. Note that the datum points for those axes are then no longer stored in non-volatile memory.

Reference mark evaluation: P44.∗	
Evaluate reference marks (**yes**):	P44.∗ = 0
Do not evaluate reference marks (**no**):	P44.∗ = 1

Definition of the coordinate axes: P48.∗	
Axis not displayed; no axis (**Off**):	P48.∗ = 0
Axis is a linear axis (**linear**):	P48.∗ = 1
Axis is a rotary axis (**rotary**):	P48.∗ = 2

You can define separately for each axis whether the encoder signals are counted positive or negative in positive direction of traverse.

Counting direction of the encoder signals: P30.∗	
Positive counting direction:	P30.∗ = 0
Negative counting direction:	P30.∗ = 1

Monitoring of:
- Cables and connectors
- Traversing speeds
- Measuring signal

Encoder monitoring: P45.∗	
Encoder monitoring (**Off**):	P45.∗ = 0
Encoder monitoring (**On**):	P45.∗ = 1

Setting the display step with linear encoders

With linear encoders, the display step depends on the
- signal period of the encoder (**P31**.∗) and the
- linear subdivision (**P32.**∗).

Both parameters are entered separately for each axis. The linear subdivision can range from 0.1 to 128 depending on the signal period of your encoder.

For linear measurement using nut/ballscrew arrangements and rotary encoders, calculate the signal period as follows:

$$\text{Signal period [µm]} = \frac{\text{Drivescrew pitch [mm]} \bullet 1000}{\text{Line count}}$$

Display step, signal period and linear subdivision for linear encoders

Signal period [µm]		2	4	10	20	40	100	200	12 800
Display step [mm]	**[inch]**	**Linear subdivision**							
0.000 02	0.000 001	100	–	–	–	–	–	–	–
0.000 05	0.000 002	40	80	–	–	–	–	–	–
0.000 1	0.000 005	20	40	100	–	–	–	–	–
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	–
0.1	0.005	–	–	0.1	0.2	0.4	1	2	128
0.2	0.01	–	–	–	–	–	–	–	64

Example settings for HEIDENHAIN linear encoders

Encoder	P31.* Signal period	P43.* Ref. marks	Display step mm	Display step inch	P32.* Linear subdiv.
LIP 40x	2	0	0.001 0.000 5 0.000 2 0.000 1 0.000 05 0.000 02	0.000 05 0.000 02 0.000 01 0.000 005 0.000 002 0.000 001	2 4 10 20 40 100
LIP 101A LIP 101R	4	0	0.001 0.000 5 0.000 2 0.000 1 0.000 05	0.000 05 0.000 02 0.000 01 0.000 005 0.000 002	4 8 20 40 80
LIF 101, LF 401	4	0	0.001 0.000 5 0.000 2 0.000 1	0.000 05 0.000 02 0.000 01 0.000 005	4 8 20 40
LID xxx LID xxxC	10	0 2 000	0.001 0.000 5	0.000 05 0.000 02	10 20
LS 103, LS 103C LS 405, LS 405C ULS/10		0 or 1 000	0.000 2 0.000 1	0.000 01 0.000 005	50 100
LS 303, LS 303C **LS 603, LS 603C**	20	0 or 1 000	0.01 0.005	0.000 05 0.000 02	2 4
LS 106, LS 106C LS 406, LS 406C LS 706, LS 706C ULS/20	20	0 or 1 000	0.01 0.005 0.002 0.001 0.000 5	0.000 5 0.000 2 0.000 1 0.000 05 0.000 02	2 4 10 20 40
LIDA 190 LB 101	40	0	0.002 0.001 0.000 5	0.000 1 0.000 05 0.000 02	20 40 80
LIDA 2xx, LIDA 2xxC LB 3xx, LB 3xxC	100	0	0.01 0.005 0.002 0.001	0.000 5 0.000 2 0.000 1 0.000 05	10 20 50 100
LIM 102	12 800	0	0.2 0.1	0.01 0.005	64 128

Setting the display step with angle encoders

With angle encoders, the display step depends on the
- line count of the encoder (**P35.**∗) and the
- angle subdivision (**P36.**∗)

Both parameters are entered separately for each rotary axis.
The angle subdivision can range from 0.2 to 100 depending on the line count of the encoder.

Display step, line count and subdivision for angle encoders

Line count		**72 000**	**36 000**	**18 000**	**9 000**	**3 600**	**1 800**
Display step [Deg.]	**[Deg/Min/Sec]**	**Angle subdivision**					
0.000 1°	0° 00' 01''	50	100	–	–	–	–
0.000 2°	0° 00' 01''	25	50	100	–	–	–
0.000 5°	0° 00' 01''	10	20	40	–	–	–
0.001°	0° 00' 05''	5	10	20	40	–	–
0.002°	0° 00' 05''	2.5	5	10	20	–	–
0.005°	0° 00' 10''	1	2	4	8	20	–
0.01°	0° 00' 30''	–	–	2	4	10	20
0.02°	0° 01'	–	–	–	–	5	10
0.05°	0° 05'	–	–	–	–	2	4
0.1°	0° 05'	–	–	–	–	1	2
0.5°	0° 30'	–	–	–	–	–	0.4
1°	1°	–	–	–	–	–	0.2

Example settings for HEIDENHAIN angle encoders

Encoder	**Line count P35.∗**	**P43.∗ Reference marks**	**P43.∗ Display step**	**P36.∗ Angle subdivision**
ROD 450, ROD 456 ROD 450M, RON 455	1 800	0	0.05° 0.01°	4 20
ROD 450, ROD 456 ROD 450M, RON 455	3 600	0	0.01° 0.005°	10 20
ROD 250, RON 255	9 000	0	0.001°	40
ROD 250C, RON 255C	9 000	500	0.001°	40
ROD 250, ROD 252 RON 255, ROD 700 RON 705, RON 706 ERA 150, ERO 725	18 000	0	0.001° 0.000 5° 0.000 2°	20 40 100
ROD 250C, ROD 255C ROD 700C, RON 705C RON 706C	18 000	1 000	0.001° 0.000 5° 0.000 2°	20 40 100
ROD 700, ROD 800 RON 806, RON 905 ERA 150, ERO 725	36 000	0	0.000 1°	100
ROD 700C, ROD 800C	36 000	1 000	0.000 1°	100

Setting the measured value display

Designation of the coordinate axes: P49.∗	
Axis is coordinate axis „**A**“:	P49.∗ = 65
Axis is coordinate axis „**B**“:	P49.∗ = 66
Axis is coordinate axis „**C**“:	P49.∗ = 67
Axis is coordinate axis „**U**“:	P49.∗ = 85
Axis is coordinate axis „**V**“:	P49.∗ = 86
Axis is coordinate axis „**W**“:	P49.∗ = 87
Axis is coordinate axis „**X**“:	P49.∗ = 88
Axis is coordinate axis „**Y**“:	P49.∗ = 89
Axis is coordinate axis „**Z**“:	P49.∗ = 90

Unit of measurement: P1 (User Parameter)	
Display dimensions in millimeters (**mm**):	P1 = 0
Display dimensions in inches (**inch**):	P1 = 1

Angle display format: P8 (User Parameter)	
Display in **degrees**, decimal:	P8 = 0
Display in **deg**rees **/ min**utes **/ sec**onds:	P8 = 1

Angle counting mode: P9.∗	
Display angles from 0° to **360°**:	P9 = 0
Display **+/– 180°**:	P9 = 1
Display **+/– ∞°:**	P9 = 2

The fourth axis can be combined with one of the three main axes (X,Y, Z), for example with plungers. POSITIP adds or subtracts the measured position values for the fourth axis and main axis and display the sum or difference as the "position value" for the main axis.

Axis combination: P6	
No axis combination (**off**):	P6 = 0
The position values of axes 1 and 4 are added together and the result displayed on axis 1 (**1 + 4**):	P6 = 1
The position values of axes 2 and 4 are added together and the result displayed on axis 2 (**2 + 4**):	P6 = 2
The position values of axes 3 and 4 are added together and the result displayed on axis 3 (**3 + 4**):	P6 = 3
The position value of axis 4 is subtracted from axis 1 and the result displayed on axis 1 (**1 – 4**):	P6 = 4
The position value of axis 4 is subtracted from axis 2 and the result displayed on axis 2 (**2 – 4**):	P6 = 5
The position value of axis 4 is subtracted from axis 3 and the result displayed on axis 3 (**3 – 4**):	P6 = 6

When diameter display is selected, a symbol (Ø) appears next to the position value display, and the display value doubles. For milling, only the radius display is needed.

Radius/diameter display: P3.∗ (User Parameter)	
Display position values as "**Radius**":	P3.∗ = 0
Display position values as "**Diameter**":	P3.∗ = 1

Axis error compensation

Linear and non-linear errors can occur on the axes of a machine, e.g. errors in drivescrew pitch or errors caused by axis sag and tilt. These errors can be detected with a comparator system such as the VM 101 from HEIDENHAIN. POSITIP can compensate these errors. You can activate error axis compensation using parameter P40.

Axis error compensation: P40.*	
Axis error compensation (**Off**):	P40.* = 0
Linear axis error compensation (**Linear**):	P40.* = 1
Non-linear axis error compensation (**Non-linear**):	P40.* = 2

Linear axis error compensation

A factor that you enter in operating parameter P41.* compensates for this error.

Example calculation of compensation factor k
Displayed distance: L_D = 620 mm
Actual distance as determined
with comparator system: L_A = 619.876 mm
Difference: $\Delta l = L_A - L_D$ = –0.124 mm Δl = –124 µm
Compensation factor **k** = $\Delta l / L_D$ = **–200 µm / m = –200 ppm**

Linear axis error compensation: P41.*	
Compensation factor k – 99 999 [ppm] < P41.* < 99 999 [ppm]	P41.* = 0

Non-linear axis error compensation

Working with non-linear axis error compensation
To activate the non-linear axis error compensation you have to:
➤ Activate the function using working parameter P40 .
➤ Enter the compensation values in the table.
➤ Traverse the reference points every time you turn the machine on .

Selecting the operating mode COMPENSATION VALUE TABLE
In the operating mode COMPENSATION VALUE TABLE enter the compensation values for non-linear axis error compensation as follows:
➤ Press the "MOD" key.
➤ Select "Code Number" soft key.
➤ Enter code number 105 296 and confirm with ENT.

The POSITIP 855 automatically switches the position display to REF when the compensation value table is selected (the datum for the display is the scale reference point).

The functions are in two soft-key rows and can be selected using the "paging" keys.
Row 1: Enter the compensation value using the keyboard.
Row 2: Read in or output the compensation value table using data interface.
You can enter compensation values at 64 compensation points for each axis — as a function of the positions in the axis causing the error.

Input data
Select the individual input fields with the arrow keys and enter:
➤ The axis which is to be corrected under "faulty axis?".
Press axis soft key.
➤ The axis which is causing the error under "axis causing error?"
Press axis soft key.
➤ The datum for the axis causing the error under "datum."
➤ The distance between the compensation points for the axis causing the error under "compensation point distance?" as an exponent to the base 2 :
e.g. $14 = 2^{14} = 16\,384$ µm.
➤ Compensation values: compensation point 0 is preassigned the value 0.000 and cannot be changed.

Delete the table
You can delete the table values as follows:
➤ Select the table to be deleted under "faulty axis?" and press the axis soft key.
➤ Press "delete table."

II - 4
Data Interface

The POSITIP's data interface allows you to save programs and operating parameters on diskette, or print out or save coordinates. Chapter I - 4 describes how to **transfer programs**, and chapter II - 2 describes how to **transfer operating parameters**.

This chapter covers what you need to know about **setting up** the data interface:

- Pin layout of data interface
- Signal levels
- Wiring of the connecting cable and connectors
- Baud rate (data transfer speed)
- Data format

Connections

The RS-232-C/V.24 serial port is located on the rear panel. The following devices can be connected to this port:

- HEIDENHAIN FE 401 Floppy Disk Unit
- Printer with serial data interface
- Personal computer with serial data interface

> The HEIDENHAIN FE 401 floppy disk unit is ready to run as soon as it is connected to POSITIP's data interface.

> Interface X31 complies with the recommendations in VDE 0160,5.88 for separation from line power.

Pin layout on the POSITIP data interface

Pin	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	SIGNAL GND	– Signal ground
20	DTR	– Data terminal ready
8 to 19	do not assign	
21 to 25	do not assign	

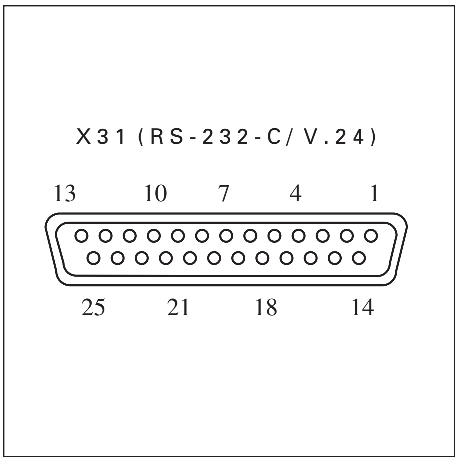


Fig. 41: Pin layout of RS-232-C/V.24 data interface

Signal-Pegel

Signal	Signal level „1“ = „active“	Signal level „0“ = „inactive“
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

Wiring the connecting cable

The wiring of the connecting cable depends on the device being connected (see technical documentation for external device).

Full wiring

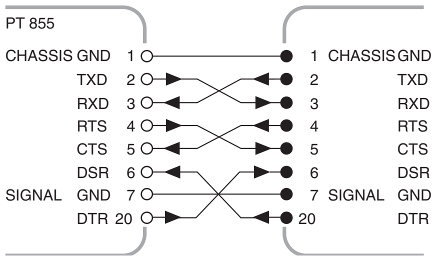


Fig. 42: Diagram for full wiring

Simplified wiring

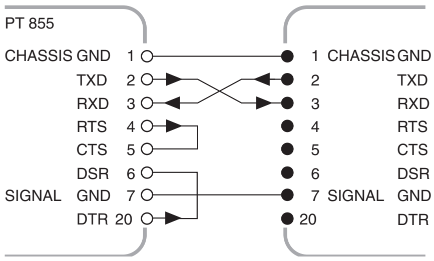


Fig. 43: Diagram for simplified wiring

Setting the baud rate: P 50

The data interfaces on the POSITIP and on the external device must be set to the same baud rate. The external device must be capable of processing the selected baud rate.
The baud rate for the data interface on the POSITIP is set with an operating parameter.
The machine manufacturer can also make this parameter available as a user parameter (see I - 7).

Settings for the baud rate
P 50 = 110, 150, 300, 600, 1 200, 2 400
4 800, 9 600, 19 200, 38 400 [baud]

> The baud rate for data transfer between POSITIP and the FE 401 Floppy Disk Unit is always 9600.

Data format

Data are transferred in the following sequence:
1. Start bit
2. Seven data bits
3. Parity bit (even parity)
4. Two stop bits

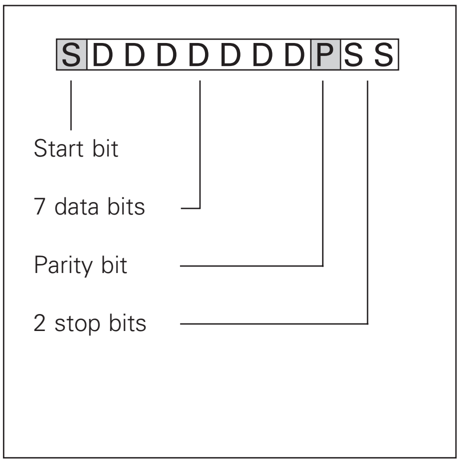


Fig. 44: Data transfer format

Interrupting data transfer

There are two ways to interrupt data transfer from the external device and restart it:

➤ Start/Stop over input RXD
DC3 = XOFF = CTRL S: interrupt data transfer
DC1 = XON = CTRL Q: resume data transfer

➤ Start/Stop over control line CTS

> When the stop signal CTS or DC3 has been received, POSITIP sends up to two further characters.

II - 5
Measured Value Output

POSITIP can output measured values over the data interface.

Starting measured value output

There are three ways to start measured value output:
- Transmit control character to the data interface
- Send signal to switching input
- Signal from edge finder

The delay between the latch signal and measured value output depends on the selected signal.

Transit time of encoder signals

After approximately 4 µs the encoder signals are present in a buffer which is interrogated by the internal latch signal. The measured value that is output is therefore the value that existed approximately 4 µs prior to the internal latch.

Starting measured value output with Ctrl B

t_1: Delay between Ctrl B command and internal latch
$t_1 \leq 0.5$ ms
t_2: Delay between internal latch and measured value output
$t_2 \leq 30$ ms + (5 ms • N)
N = number of rotary axes with Deg/Min/Sec display
t_3: Time between end of data output and next latch with Ctrl B
$t_3 \geq 0$ ms
t_D: Duration of measured value output

The duration of measured value output (t_D) depends on:
- The selected baud rate (BR)
- The number of axes (M)
- The number of blank lines (L)

$$t_D = \frac{176 \bullet M + L \bullet 11}{BR} \quad [s]$$

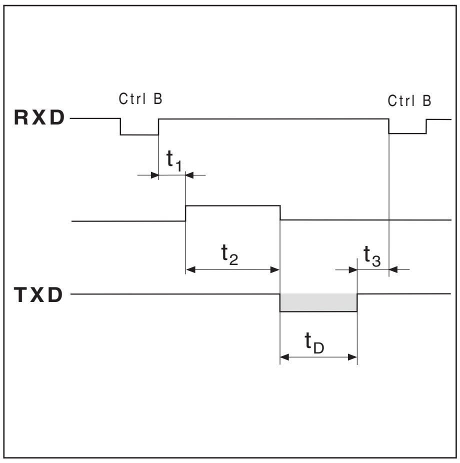


Fig. 45: Time diagram for measured value output with Ctrl B

Starting measured value output over external switching input

You can start start measured value output over the switching input at the D-sub connection EXT by sending a pulse or by make contact.

Contact at pin 9: make contact against 0 V
Pulse at pin 8: pulse duration $t_e \geq 1.2$ µs

The contact or pulse can also be sent over a TTL logic device (such as SN 74 LS XX):
$U_H \geq 3.9$ V ($U_{MAX} = 15$ V)
$U_L \leq 0.9$ V with $I_L \leq 6$ mA

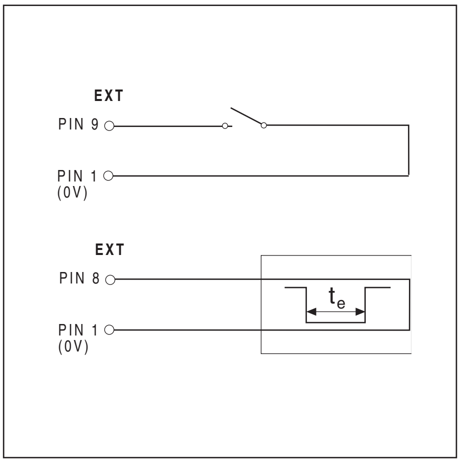


Fig.46: Signal by make contact against 0 V or by pulse

t_e: Minimum duration, **pulse**
$t_e \geq 1.2$ ms
t_e: Minimum duration, **contact**
$t_e \geq 7$ ms
t_1: Delay between **pulse** and internal latch
$t_1 \leq 0.8$ µs
t_1: Delay between **contact** and internal latch
$t_1 \leq 4.5$ ms
t_2: Delay between internal latch and measured value ouput
$t_2 \leq 30$ ms + (5 ms • N)
N = number of rotary axes with Deg/Min/Sec display
t_3: Delay between end of data output and next latch over external switching input
$t_3 \geq 0$ ms
t_D: Duration of measured value output

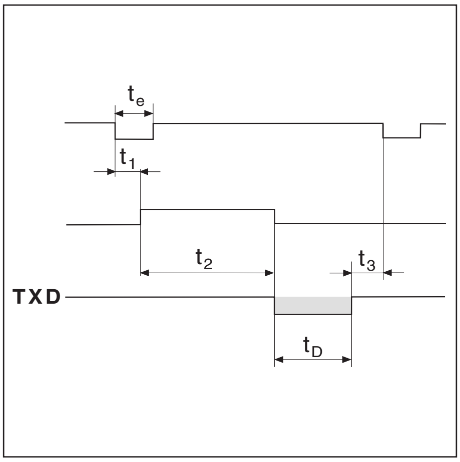


Fig.47: Time diagram for measured value output over external switching input

The duration of measured value output (t_D) depends on:

- The selected baud rate (BR)
- The number of axes (M)
- The number of blank lines (L)

$$t_D = \frac{176 \bullet M + L \bullet 11}{BR} \quad [s]$$

Starting measured value output with an edge finder

During the probing functions Edge, Centerline and Circle Center it is possible to output measured values over the data interface when the edge finder sends a signal.

The following data are output:
- The coordinates of the edge, centerline or circle center
- The distance between the two edges (with Centerline)
- or the circle diameter (with Circle Center).

Measured value output with the edge finder: P 96	
No measured value output during probing:	P96 = 0
Measured values are output during probing:	P96 = 1

Operating parameters for measured value output

The following operating parameters will influence measured value output – regardless of how measured value output is started.

Number of blank lines after each measured value: P51	
Number of blank lines (line feeds) after each measured value:	P51 = 0 to 99

The signal for measured value output can also influence the postion display on the screen:

Screen display during measured value output: P23	
The display is not stopped during measured value output (**Off**):	P23 = 0
The display is stopped during measured value output and remains stopped while the switching input "output measured value" is active (**Concrnt**):	P23 = 1
The display is stopped but is updated by every measured value output (**Frozen**):	P23 = 2

Examples of character output at the data interface

In all three examples on this page, measured value output is started with **Ctrl B** or a **switching signal at the EXT input**.
The numbers stand for:

① Coordinate axis
② Equal sign
③ +/– sign
④ Carriage return
⑤ Blank line (Line Feed)

Example 1: Linear axis with radius display X = + 5841.2907 mm

X	=	+	5	8	4	1	.	2	9	0	7		R	<CR>	<LF>
①	②	③												④	⑤

2 to 7 places
Decimal point
1 to 6 places
Unit: blank space for mm, " for inches
Actual value display:
R for radius, D for diameter
Distance-to-go display:
r for radius, d for diameter

Example 2: Rotary axis with degrees decimal display C = + 1260.0000°

C	=	+	1	2	6	0	.	0	0	0	0		W	<CR>	<LF>
①	②	③												④	⑤

4 to 8 places
Decimal point
0 to 4 places
Blank space
W for angle (in distance-to-go display: w)

Example 3: Rotary axis with degrees/minutes/seconds display

C = + 360° 23' 45''

C	=	+	3	6	0	:	2	3	:	4	5		W	<CR>	<LF>
①	②	③												④	⑤

3 to 8 places degrees
Colon
0 to 2 places minutes
Colon
0 to 2 places seconds
Blank space
W for angle (in distance-to-go display: w)

Examples of character output at the data interface

In all three examples on this page, measured value output is started with a **switching signal from the edge finder**.
The numbers stand for:

① Colon
② +/– sign or blank space
③ 2 to 7 places before the decimal point
④ Decimal point
⑤ 1 to 6 places after the decimal point
⑥ Unit: blank space for mm, " for inches
⑦ R for radius display, D for diameter display
⑧ Carriage return
⑨ Blank line (Line Feed)

Example 4: Probing function Edge Y = –3674.4498 mm

Y		:	–	3 6 7 4	.	4 4 9 8		R	<CR>	<LF>
		①	②	③	④	⑤	⑥	⑦	⑧	⑨

Coordinate axis
2 blank spaces

Example 5: Probing function Centerline

Coordinate of centerline on X axis CLX = + 3476.9963 mm
(**C**enter **L**ine **X** axis)
Distance between the probed edges DST = 2853.0012 mm
(**Dist**ance)

CLX	:	+	3 4 7 6	.	9 9 6 3		R	<CR>	<LF>
DST	:		2 8 5 3	.	0 0 1 2		R	<CR>	<LF>
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

Example 6: Probing function Circle Center

First centerpoint coordinate, e.g. CCX = –1616.3429 mm
Second centerpoint coordinate, e.g. CCY = +4362.9876 mm
(**C**ircle **C**enter **X** axis, **C**ircle **C**enter **Y** axis; coordinates depend on working plane)
Circle diameter DIA = 1250.0500 mm

CCX	:	–	1 6 1 6	.	3 4 2 9		R	<CR>	<LF>
CCY	:	+	4 3 6 2	.	9 8 7 6		R	<CR>	<LF>
DIA	:		1 2 5 0	.	0 5 0 0		R	<CR>	<LF>
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

II - 6
Switching Inputs and Outputs

Switching signals at the D-sub connection EXT allow you to
- reset the actual value display of a coordinate axis to zero
- control motor cutoff
- start measured value output (see chapter II - 5)

Interface X41 (EXT) complies with the recommendations in VDE 0160, 5.88 for separation from line power.

The outputs for the switching ranges are metallically isolated from the device electronics by means of optocouplers.

Danger to internal components!
Voltage from external circuitry must conform to the recommendations in VDE 0100, Part 410 for low-voltage electrical separation.

Connect inductive loads such as relays only with a quenching diode. Shield against electromagnetic fields. Connect with a shielded cable with the shield extended to the connector housing.

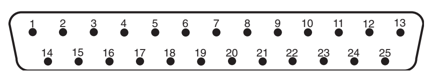


Fig. 48: The D-sub connection EXT

Pin layout of D-sub connection EXT (X41)

	Pin	Assignment
Outputs	10	0 V for switching range
	23, 24, 25	24 V DC for switching range
	11	POSITIP ready for operation
	14	Display value outside of switching range 0
	15	Display value outside of switching range 1
	16	Display value outside of switching range 2
	17	Display value outside of switching range 3
	18	Display value outside of switching range 4
	19	Display value outside of switching range 5
	20	Display value outside of switching range 6
	21	Display value outside of switching range 7
Inputs	1	0 V (internal)
	2	Reset axis 1 to zero
	3	Reset axis 2 to zero
	4	Reset axis 3 to zero
	5	Reset axis 4 to zero
	8	Pulse: output measured value
	9	Contact: output measured value
	6, 7, 12, 13, 22	Do not use

Reset actual value display to zero

You can reset the actual value display of each axis to zero.

Minimum pulse duration for zero reset: $t_{min} \geq 100$ ms

Zero reset signal: make contact against 0 V **or**
input pulse over TTL logic device (such as SN 74 LS XX):
$U_H \geq 3.9$ V ($U_{MAX} = 15$ V)
$U_L \leq 0.9$ V with $I_L \leq 6$ mA

Using the switching signals

If you wish to use the switching signals, you must supply POSITIP with 24 V d.c. at the D-sub connection EXT (pins 23 to 25; 0 V to pin 10). Pins 14 to 21 will then be supplied with 24 V as long as the display value is **not** within a switching range.

These pins are then assigned to the axes with operating parameter P60.x. As soon as a display value is within the switching range, the voltage to the corresponding pin will be cut off.
Define the switching range in operating parameter P61.x symmetrically about zero.

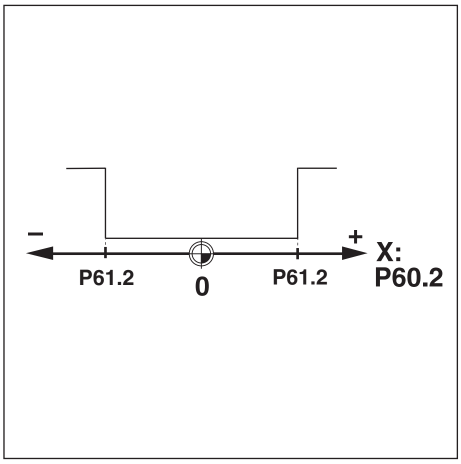


Fig. 50: The switching ranges are symmetrical about zero

If the location of the datum point changes, move the switching ranges correspondingly.

Axis assignment: P60.x	
No axis assigned (**Off**):	P60.x = 0
Assigned to axis **1**:	P60.x = 1
Assigned to axis **2**:	P60.x = 2
Assigned to axis **3**:	P60.x = 3
Assigned to axis **4**:	P60.x = 4

Define switching range: P 61.x	
0 bis 99 999,999 [mm] symmetrically about zero	P61.x

Permissible load at switching outputs

$I_{MAX} = 100$ mA
Ohmic resistance

Danger to internal components!
Connect inductive loads only with a quenching diode parallel to the inductance.

Accuracy of switching ranges and switching delay: P 69

You can select the switching delay and the accuracy with which the switching outputs are switched.

You can choose between

- Accuracy = display step; switching delay = 80 ms
  -> Mode 1:P 69 = 0

- Accuracy = $\dfrac{\text{Grating period GP of encoder}}{128}$

  Switching delay = 5 ms -> Mode 2:P 69 = 1

Output "POSITIP ready for operation"

In order to work with the signal "POSITIP is ready for operation" you must supply 24 V= to pins 23, 24 and 25 (0 V to pin 10).

During **normal operation**, **pin 11** of D-sub connection EXT has **24 V**.

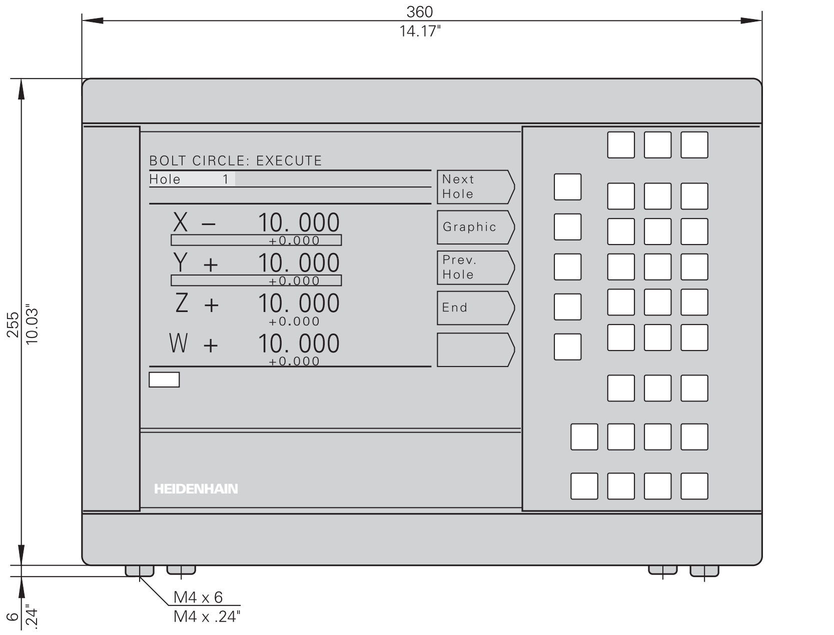
If an **error** occurs which impairs the functioning of POSITIP (such as a hardware or checksum error), POSITIP switches the output at **pin 11** to **high impedance**.

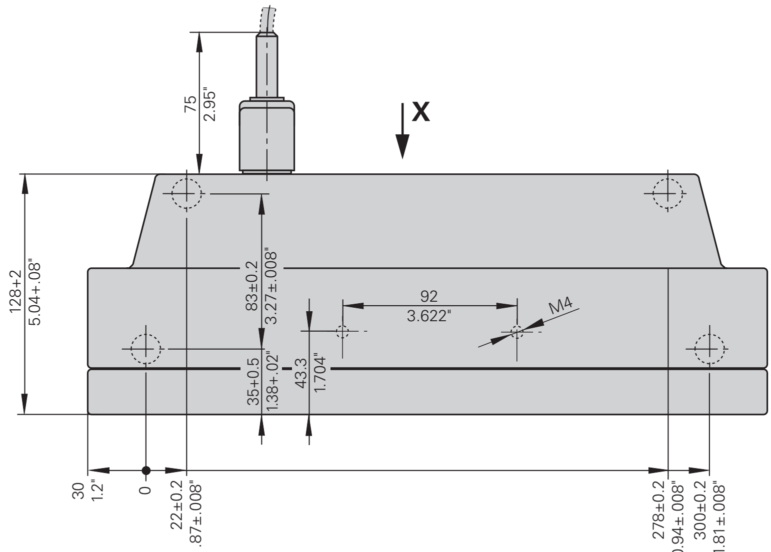
II - 7 Specifications

TNC-Data	
Axes	Up to 4 axes from X, Y, Z, A, B, C, U, V, W
Display	Flat luminescent screen: Position values with tool radius compensation R0, R+, R–, dialogs, entries, graphics
Status display	Operating mode, REF, inches, scaling factor, graphic positioning aid with distance-to-go display Datum number, tool number and tool axis, feed rate
Position encoders	HEIDENHAIN incremental linear, angle and rotary encoders with sinusoidal output signals
Display step	Linear axes: 5 µm, 1 µm or finer (to 0.02 µm) Rotary axes: 0.05° (5'), 0.01° (30'') or finer (to 0.000 1° [1''])
Functions	• REF reference mark evaluation • Distance-to-go mode, nominal position input absolute or incremental • Scaling factor • Axis combination • Tool radius compensation • Fast zero reset • Linear machine error compensation • **HELP:** on-screen operating instructions • **INFO:** on-screen pocket calculator, stopwatch, cutting data calculator
	• Tables for up to 99 datum points and 99 tools • Probing functions for datum acquisition, preferably with the KT edge finder • Tool radius compensation • Calculation of hole patterns (bolt hole circles and linear hole patterns) • Rectangular pocket milling
Programming	Program memory for up to 20 programs with a total of 2000 program blocks, up to 1000 program blocks in each program; subprogramming capability; teach-in programming
	Hole pattern cycles: bolt hole circles and linear hole patterns
	Rectangular pocket milling
	Datum call
Data interface	RS-232-C/V.24; For output of programs, measured values and parameters Baud rate: 110/150/300/600/1 200/2 400/4 800/9 600/19 200/38 400 Baud
Accessories	• KT Edge Finder • Diskette unit for external storage of programs • Tilting base
Switching outputs	• 8 switching outputs (24 V), assigned to the axes with parameters • 1 switching output "POSITIP is ready for operation"
Switching inputs	• 1 input for each axis for zero reset • 2 inputs for measured value output (pulse or contact)
Power source	Switch-mode power supply 100 V to 240 V (–15% to +10%), 48 to 62 Hz
Power consumption	24 W
Operating temperature	0° to 45° C (32° to 113° F)
Storage temperature	–30° to 70° C (–22° to 158°F)
Weight	4.8 kg (10.6 lb)

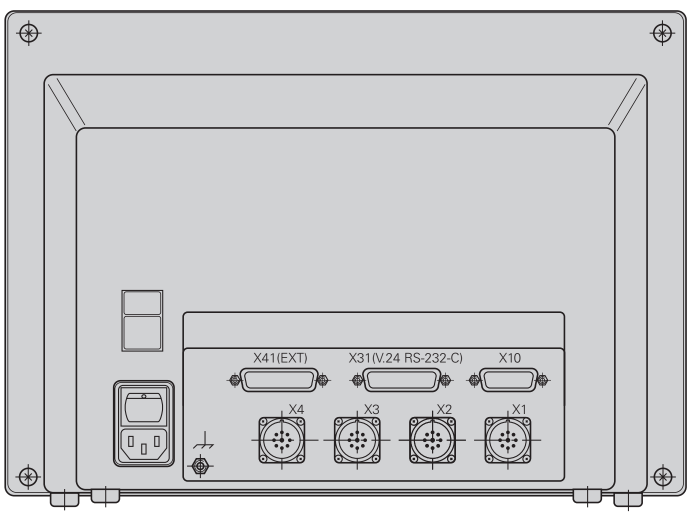
II - 8

Dimensions

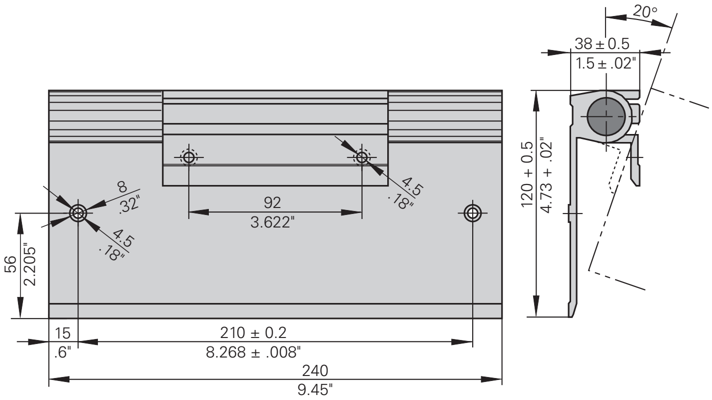




X



Tilting base



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