Operating Manual

VRZ 965
HEIDENHAIN POSITIP

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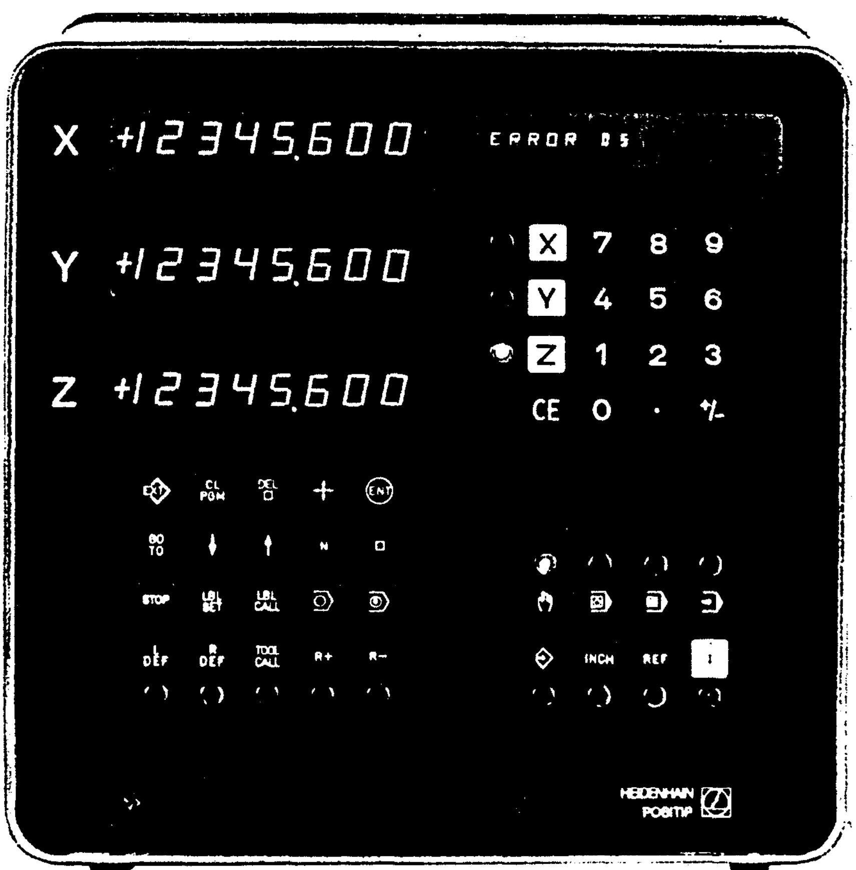


Issue 4/82

OPERATING INSTRUCTIONS

VRZ 965

HEIDENHAIN POSITIP

Keys for value entry and axis selection

Key Symbol	Abbreviation for	Description	SECTION
0 ... 9		Keys for entering numerical values (decimal keyboard); For entering nominal position values, block no's, subroutine no's, tool no's, tool length and radius compensation values.	B3
·		Decimal point key	B3
+/-		Sign change	B3
X Y Z		Axis keys for selection of the axis to be traversed, setting the origin, setting the spindle axis during a tool-call. When an axis is selected, the corresponding lamp is illuminated.	E1, F3 F4.1
I		Chain dimensions (incremental measurement). If incremental entry is selected, the lamp is illuminated. Absolute Mode Input: I Switched off.	F4.1
CE	Clear Entry	For the deletion of entry values and clearing error messages.	B3,C

OPERATING MODE KEYS

Basic Symbols	Description
❩	Single block
□	Program memory
◇	Program mode

Key Symbol	Description	Section
	Actual value display 1. In this operating mode the POSITIP acts as an actual value display. 2. Setting datum values.	E1
 REF	3. Setting datum values with automatic storage of the REF-values (position values relative to the reference marks). 4. Traversing of the reference marks.	E2
	Positioning with display of remainder of traverse Absolute and incremental dimensions may be positioned without storage in memory by "traversing to zero".	I
	Entry and editing of programs The program may consist of the following program blocks: Positioning block	F

Key Symbol	Description	Section
	Tool definition Tool call Setting a label (program mark) Calling a label (program mark) Programmed stop	
	Single block program run In this operating mode, the stored program may be run block by block restarting the program after each individual block has been executed. After each restart, the path still to be traversed is displayed in the actual value display of the corresponding axis, and should be brought to zero by traversing in this axis.	H
	Automatic Program Run In this operating mode, the stored program may be run to its end or to a programmed STOP with a single press of the start-button. The path still to be traversed in each individual block is displayed in the actual value display, and should be brought to zero by traversing along the corresponding axis.	H

Key Symbol	Description	Section
INCH	Inch Entry and display of position values in inches; if inch mode is selected, the lamp is illuminated; with INCH switched off entry is in mm.	D

PROGRAMMING- AND OPERATING KEYS

Key Symbol	Abbreviation for	Description	Section
EXT		External data input or output.	L4, L5
CL PGM	CLEAR PROGRAM	Clear program contents	G5
DEL □	DELETE BLOCK	Delete block/"NO" decision	B2, G3
+		Actual position value Transfer of actual position value into program memory.	F4,4
ENT	ENTER	Enter into memory/"YES" decision.	B2, B3
GO TO	GO TO BLOCK	Go to block (block call)	G1
↓ ↑		Paging of program contents forwards or backwards.	G2
N □		Switching over of universal display between display of block no. and block contents.	F1
STOP	STOP	Programmed stop	F6

Key Symbol	Abbreviation for	Description	Section
LBL SET	LABEL SET	Setting program marks (for subroutines or program part repeats) Enter label no. Press LBL SET - key	F5.1
LBL CALL	LABEL CALL	Call-up of program marks (jump to a program mark) Enter label no. (and no. of repeats where necessary) Press LBL CALL -key	F5.2
		Interrupting program run or a positioning procedure	K
		Starting a program run	H
L DEF	L-DEFINITION	Definition of tool length Enter tool no Press L DEF - key Enter tool length Press ENT - key	F2
R DEF	R-DEFINITION	Definition of tool radius Enter tool no Press R DEF - key Enter tool radius Press ENT - key	F2
TOOL CALL	TOOL CALL	Tool call Enter tool no Select spindle axis Press TOOL CALL - key Press ENT - key	F3
R+	—	Tool radius compensation "PLUS" Traversing distance is extended by the tool radius	F4,2

Key Symbol	Abbreviation for	Description	Section
R-	—	Tool radius compensation "MINUS" Traversing distance is reduced by the tool radius.	F4,2

CONTENTS

A. Initial set-up procedure and maintenance

A.1 List of items supplied

POSITIP VRZ 965 - programmable 3-axis numerical position-display unit
Mains fuse 1,0A slow-acting for 100, 120, 140V
0.8A slow-acting for 200, 220, 240V
Mains connector or - if required - mains cable
Operating instructions

A.2 Technical specifications and dimensions

Counter	Programmable 3 axis bi-directional counter, mm/inch conversion for input values and displays. Input resolution: 0.005mm/0.0002" or: 0.01mm/0.0005" Display step : 0.005mm/0.0002" or: 0.01mm/0.0005"
Displays	Actual value displays for X, Y and Z axes Universal display: 16 symbol alphanumeric display for input values, program blocks and error messages.
Program memory	Buffered semi-conductor memory for 400 program blocks.
Operating modes	: Actual value display: The POSITIP displays actual position values. : Positioning with display of remainder of traverse. Positioning blocks may be executed (without storage in the memory) by "traversing to zero". : Single block program run

The entire program is executed block by block

: Automatic program run
The program run is started and the program is executed until a programmed STOP or the end of the program is reached.

The following may be programmed	Nominal position values - absolute or incremental dimensioning, tool number, tool length and radius, direction of tool radius compensation, programmed STOP, subroutines (may be nested up to 3 times). program - part repeats
Program editing	By inserting and deleting program blocks
Safety checks	The POSITIP checks the functioning of important electronic components as well as the transducers.
Evaluation of reference marks	After a power interruption, automatic reference value transfer by traversing over the transducer reference marks.
Transducers	Incremental HEIDENHAIN linear transducers with grating pitch 0.04mm, or HEIDENHAIN ROD angle encoders with no pulse-shaping stage.
Maximum traversing distance	+- 19999,995mm or 787,4014 inch

Control input	Facility for the connection of an external START button.
Data interface	V.24 interface with programmable Baud-Rate
Mains voltage	Adjustable: 100/120/140/200/220/240V +10%/-15% 48 ..... 62Hz
Power Input	approx 32W
Ambient temperature	Operation: 0°C ..... 45°C Storage: -30°C ..... 70°C
Relative humidity	Annual mean: 75% Short term : 90%
Weight	Approx 7.6 kg

A.3. Installation

A3.1 Directions/Safety Measures

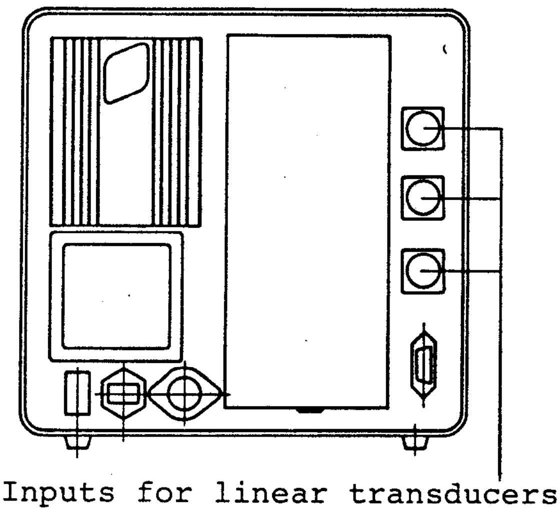
DO NOT REMOVE OR INSERT PLUGS WHILE THE MAINS SUPPLY IS SWITCHED ON!

As illustrated in the dimensioned diagram, the four feet are supplied with M5 tapped holes; the POSITIP may be screwed to tables or consoles from underneath using these holes.
The front panel of the POSITIP is splash-proof.
The equipment conforms to DIN IP54.

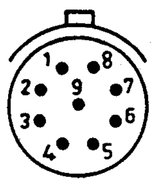
A3.2 Connection of linear transducers

The following transducers may be connected to the POSITIP VRZ 965:
All LS - linear transducers of the HEIDENHAIN 5041 family with a 40µ grating period (20µ grating period for diameter displays)
LIDA linear transducers with a 40µ grating period
HEIDENHAIN ROD angle encoders with no pulse shaping stage.

Connection is via three 9-pin flanged connectors (HEIDENHAIN Id no. 200 719 01) on the rear of the POSITIP. The length of the connecting cable must not exceed 20m.



Connector layout of the HEIDENHAIN transducer plug Id no 212 356 01



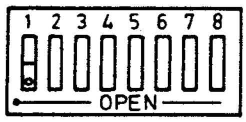
Contact no.	3	4	1	2	5	6	7	8	9*
	+	−	+	−	+	−	+	−	
Signal name	lamp U_L		measuring signal I_{e1} (0°el.)		measuring signal I_{e2} (90°el.)		ref mark signal I_{e0}		screen
Electrical value of signal	5V+/-10% approx. 20mA		15-35µA_{ss}		15-35µA_{ss}		4-15µA effective part		

* Inner screen connected to pin 9
Outer screen connected to plug casing

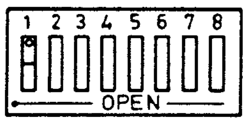
A3.3 Code switch for display step and counting direction .

The code switch with eight two-way selectors may be found in the box on the rear of the POSITIP. To set the switch, the protective cover on the rear of the POSITIP must be removed.

Altering the display step



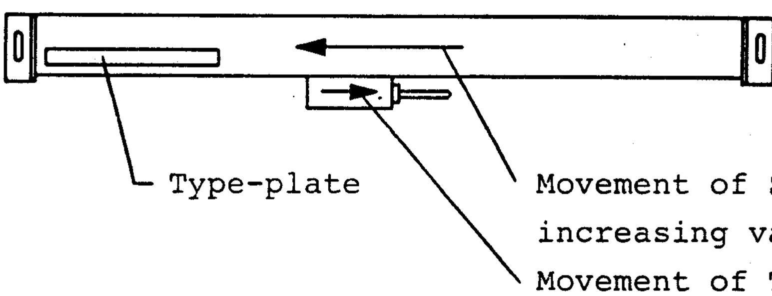
counting step 0.005mm or 0,0002"



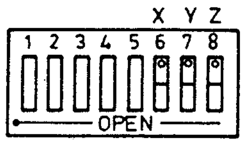
counting step 0.01mm or 0,0005"

Counting direction

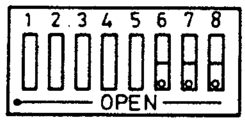
HEIDENHAIN linear transducers count in the following direction



If the direction of measurement in one or more axes is found to be incorrect after mounting, then it may be altered on the POSITIP for each individual axis where required.



Positive counting direction



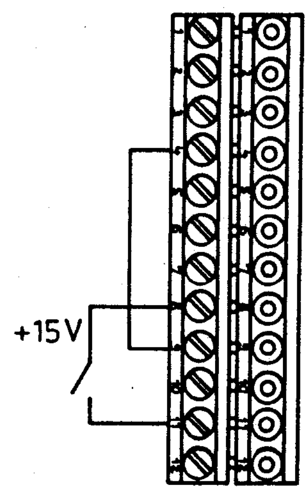
Negative counting direction

Switches 2,3,4 and 5 are inoperative

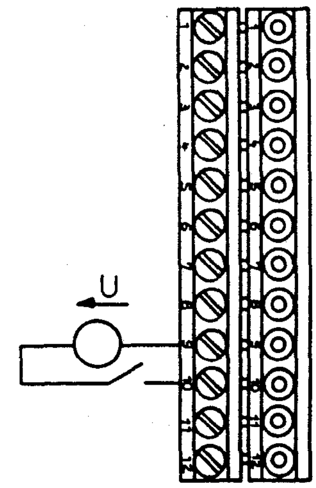
A3.4 Connection of the external start button

The box on the rear of the POSITIP contains cable terminals for the external start-button, which is operative only in the operating mode $\boxed{\Rightarrow}$.

Internal power supply

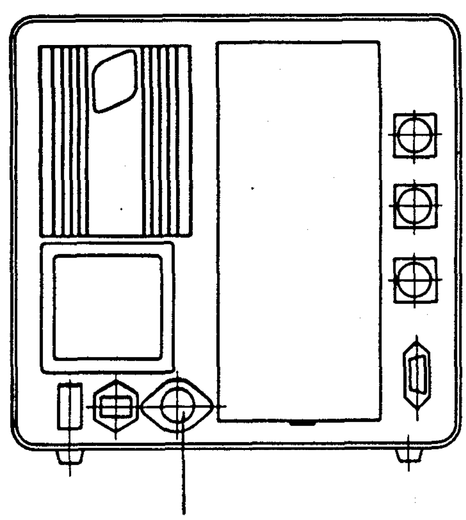


External power supply



U= d.c voltage min.15V, max.30V
I= max. 0,017A

A3.5 Setting the mains voltage



voltage change-over switch with
mains fuse-holder

The POSITIP VRZ 965 is set in the works to 220V; this may be changed to an operating voltage of 100, 120, 140, 200 or 240V.

How to change the mains voltage:

Remove mains fuse holder by rotating

↓

With the edge of a coin, set the selector switch to the required voltage

↓

Replace the mains fuse holder with the correct fuse

Fuse for 200, 220, 240V: TO,8A

Fuse for 100, 120, 140V: T1,0A

A3.6 Connection of mains supply

Wire the mains cable to the accompanying mains connector

↓

Insert the connector into the socket on the counter and secure with the clip

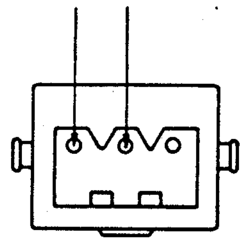
↓

Ensure that the mains voltage supply is correct; the voltage selected on the unit must match the mains supply voltage (see Sec. A3.5)!

Wiring the mains connector

TAKE NOTE!

Connect mains power to contacts 2 & 3



Connect earth to ⏚

If this unit is to be powered by a mains supply with a higher voltage via an Autotransformer, then ensure that the case of the transformer is connected to the neutral mains wire.

☞ The mains plug should only be plugged into a socket which is equipped with an earth contact. The effectiveness of the earth protection must not be nullified by the use of an extension cable without an earth conductor

Warning!
Any break in the earth conductor either inside or outside the unit or any fault in the earth conductor connection can lead to the unit becoming dangerous. Deliberate disconnection of the earth conductor is unsafe.

A3.7 Changing the buffer battery

The buffer battery powers the program memory of the POSITIP whenever the mains supply is interrupted or switched off. Batteries must be changed with the mains supply left on, else the contents of the program memory will be lost. If the error message "ERROR 04" is displayed during operation, then new batteries must be inserted within the next 24 hours. If this error message is displayed immediately the mains supply is switched on, the buffer battery must be changed straight away. The buffer batteries are located in a battery holder behind the front panel. When changing batteries, make sure that the new ones are inserted the correct way round (the polarity symbols are indicated inside the battery holder)!

The three batteries required are typical "mini-cells" of the so called "leak-proof" type, with IEC-designation "LR5". We especially recommend the use of Mallory alkaline batteries type "MN1500".

B Preliminary notes on working with the POSITIP VRZ 965

B1 Brief description

The POSITIP is a programmable digital readout that makes use of the advantages of NC-technology for manually operated machines. If a number of identical workpieces are to be manufactured, the POSITIP leads the machine operator step by step through a previously entered program, in which it displays the remaining path to the next position taking into account tool offsets. The machine operator always has to traverse the machine to "zero" during operation. If working tolerances are to be made use of (i.e. the actual value display contains a number offset from zero after a positioning), then the POSITIP will take this difference into consideration during the next positioning in this axis. In this way there is no build-up of cumulative errors - the differences do not accumulate. The stored operating program consists of "program blocks". There are different types of program block, as described in this brief outline and in other sections in this operating manual.

The POSITIP VRZ 965 can store up to 400 program blocks in memory. To each individual block that is stored is automatically assigned a block number.

A buffer battery ensures that the program is retained in the memory even when the POSITIP is switched off (e.g. overnight, at weekends,

or when the mains supply is interrupted).
The POSITIP keys are marked with standard symbols or with common abbreviations of English terms. A stored program may be executed either in operating mode "Automatic Program Run" (key) or in operating mode "Single Step Program Run" (key).

In this operating mode, each individual block is called up from the program memory by the operator: green key . The red key may be used to interrupt or discontinue program execution. Even when <u>only one workpiece</u> is to be manufactured, the machine operator may simplify his job by having the <u>remaining path</u> displayed, allowing for <u>tool length and radius</u> - without the position values being stored (operating mode).
For the POSITIP to be able to allow for tool dimensions during positioning, the length and radius of the tool being used (or the tool to be used) must first be specified in <u>tool definition blocks</u>: keys L DEF and R DEF . For every tool defined, the length definition and the radius definition each occupy one block. Blocks are further required to <u>call up</u> a specific <u>tool</u> for the next operation (TOOL CALL key).

A positioning block will comprise:

- the axis to be traversed (X , Y or Z keys) specifying 'absolute' or 'incremental' dimensioning, I key).

- nominal position values (0 ,... 9 , · , +/- keys).

- instruction as to the direction in which tool radius compensation should be applied in this block:
  R+ key ... due to the tool radius compensation, the traversing distance is <u>greater</u> than the dimension on the drawing.
  R- key ... due to the tool radius compensation, the traversing distance is <u>less</u> than the dimension on the drawing.
  or "no compensation required".

There is also the program block "STOP" (STOP key), which may be used, for example, to call a tool change to the attention of the operator, or to structure the operating program so that it is easier to read. Finally, when subroutines and program-part repeats are used, there is the facility to set and call up program marks (so called labels) (LBL SET and LBL CALL keys).

Pressing the ENT key (ENTER key) effects the transfer of entry values into the program memory.
Writing an operating program is not complicated. It may be carried out in several ways:

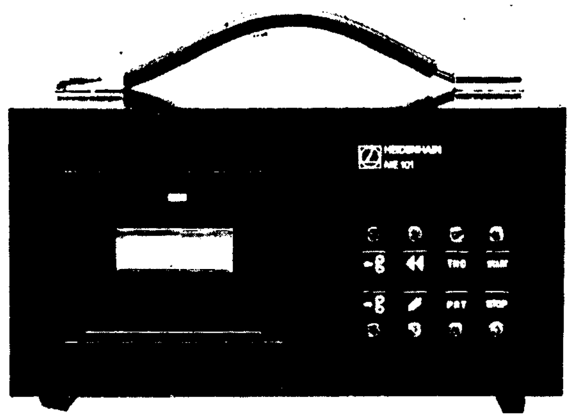
- either with a stationary machine, directly from a workpiece drawing or program sheet (operating mode).

- or with the simultaneous manufacture of the first workpiece - Teach-In - (operating mode).

- or with the manufacture of a workpiece merely using the POSITIP as an actual value display, and transfer of display values = actual position values (+ key) as nominal position values - Playback.

- the program may be entered externally from some data device via the standard data interface (EXT key).

Using this same interface, it is also possible to have the operating program printed out or stored on punched tape or cassette. As an accessory to the POSITIP, HEIDENHAIN produces a special magnetic tape unit ME101 for such program storage.



ME 101

The program in the POSITIP memory may be "edited" (i.e. corrected) by either re-entering a program block, inserting additional program blocks, or by deleting individual blocks ([DEL □] key). The entire program may be deleted using the [CL PGM] key.
Any given program block may be called up using the [GO TO] key, and the [↓] and [↑] keys may be used to page program blocks either forwards or backwards.

Using the [N] and [□] keys, the universal display may be switched to and fro between "Block-number display" and "Display of block contents".
The workpiece datum point may be set in operating mode - [ ] .. It may be reproduced after a power interruption by simply traversing over the transducer reference marks ([REF] key).
The POSITIP permits operation using either metric measurements or measurements in inches ([INCH] key).

B2. DEL/ENT Decisions

Specific keys with important functions (e.g. [CL PGM], [INCH], [REF]) are protected from being pressed unintentionally by the DEL/ENT request. When any of these keys is pressed, proceed as follows:

One of the keys in question has been pressed

Universal Display DEL / ENT

NO

Press the DEL key
Original status is retained.

YES

Press the ENT key
New status is chosen.

B3. Entering numerical values

Numerical values may be entered as follows:

Switch to "inch" or "mm" mode as required
Press INCH key, Press ENT key
(see section D)

Enter the numerical value:
0 ... 9 , · , 0 ... 9
leading zeros and trailing zeros
after the decimal point needn't be entered

If required, press the +/- key
Always enter the number first and then
the minus sign

Values that have been entered incorrectly may be deleted using the [CE] key.

Entering position values

When values are entered in "mm" mode, entry is in steps of either 0,01 mm or 0,005mm. If the least significant digit is other than 0 or 5, then the POSITIP will round the entered value either up or down as appropriate. When values are entered in "inch" mode, entry is in steps of either 0,0002" or 0,0005". If the least significant digit is an odd number, then the entered value will be rounded either up or down as before.

C. Switching on the POSITIP

The POSITIP is switched on either via the power supply switch at the rear, or via the main switch on the machine.
The actual value displays will immediately be set to specific values (the REF values, see section E2); all display lamps are illuminated.

Switch on mains supply

↓

Error message in the universal display
(ERROR 00) i.e. power interruption

↓

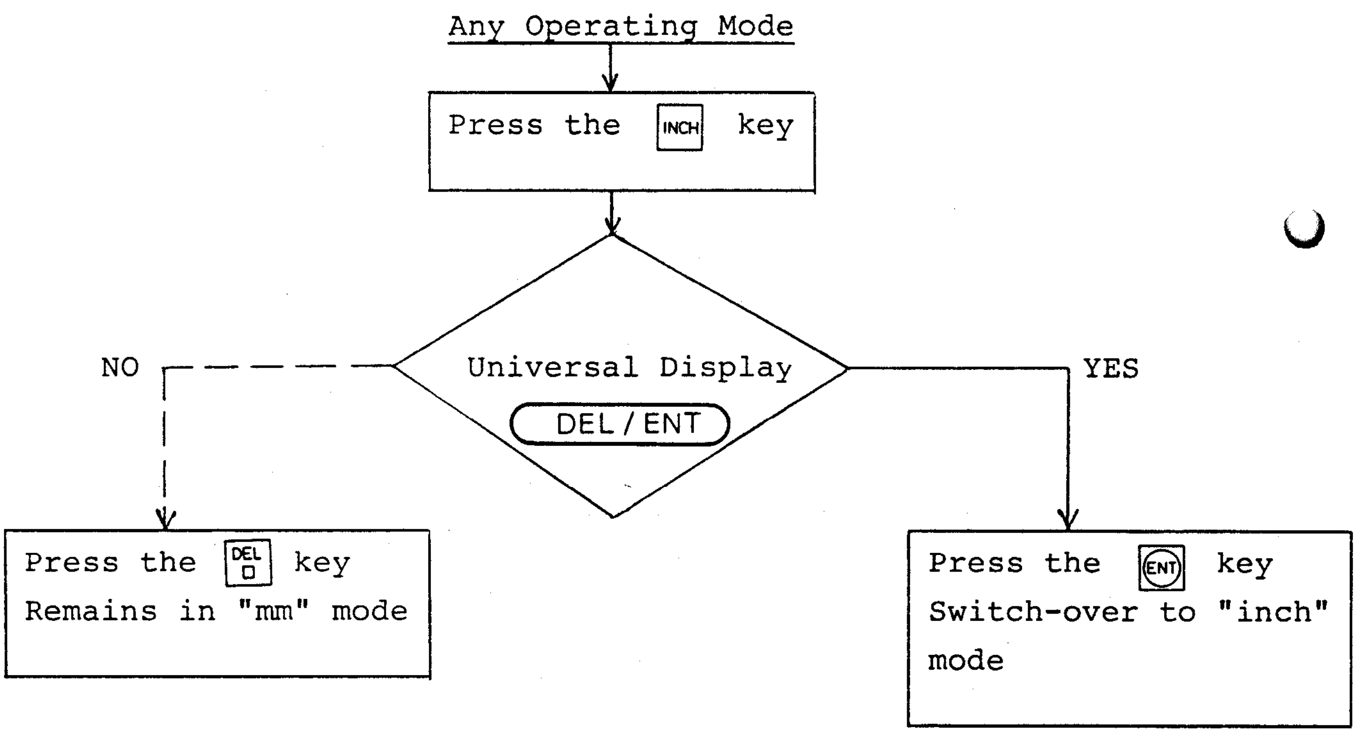
Clear the error message: press the [CE] key

↓

The POSITIP is automatically set to operating mode "actual value display"

D. mm/inch conversion [INCH]

The POSITIP may also be programmed with dimensions in inches ([INCH] key). The switch-over from mm to inch mode must take place before the operating program is entered. The conversion function is protected from unintentional operation by the DEL/ENT request.



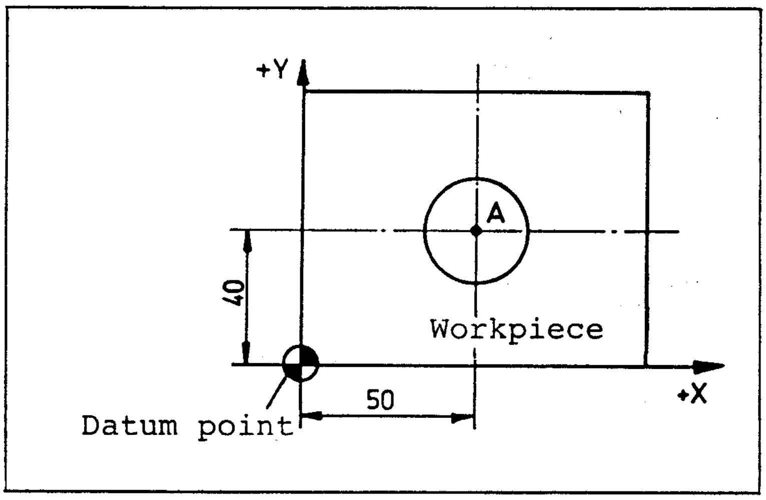
The "inch" operating mode may be converted back to "mm" mode simply by pressing the [INCH] and [ENT] keys again.

E. Operating mode "ACTUAL VALUE DISPLAY" [✋]

In this operating mode, the POSITIP will display the actual position values in each of the three axes relative to the workpiece datum point.

E1. Setting datum points

When a workpiece is machined, the values displayed in the POSITIP must correspond to workpiece positions; in setting datum points, the three actual value displays are preset to given values in relation to the workpiece (specific numbers are set into the displays, giving each machine axis a defined position).
For example, if the dimensions in the following sketch are relative to the lower left hand corner of the workpiece, then that corner becomes the workpiece datum point and is assigned display value 0 in the X and Y axes.

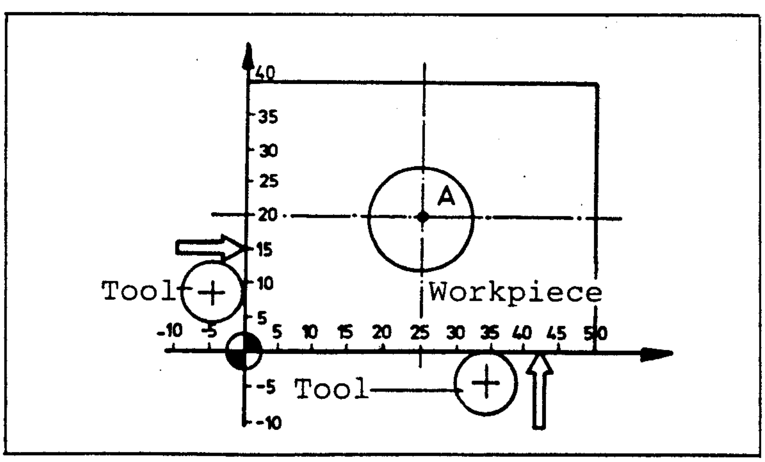


To do this, either

a) locate the workpiece datum point, e.g. with an optical edge finder and then set the X and Y displays to zero.

b) locate known position A, e.g. with a centring device, and then set the X axis to 50 and the Y axis to 40.

or

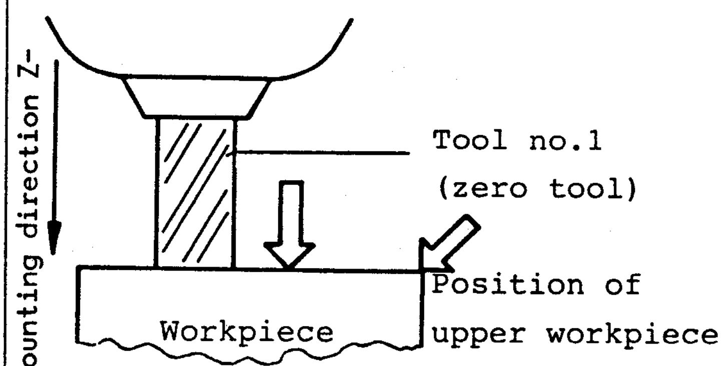


c) the workpiece datum point may be set by scratching the workpiece surface.
Using a tool (or a mechanical edge finder) with a diameter of 10mm, first touch the left hand edge of the workpiece and set the X-display to -5, then touch the bottom edge of the workpiece and set the

Y-display to -5. This method of setting the axes is similar to method b) (except that -5 is entered instead of 50 and 40).

In our example, Z is the spindle axis. The workpiece datum point for the Z axis may be set in various ways, depending on the tool that is used.

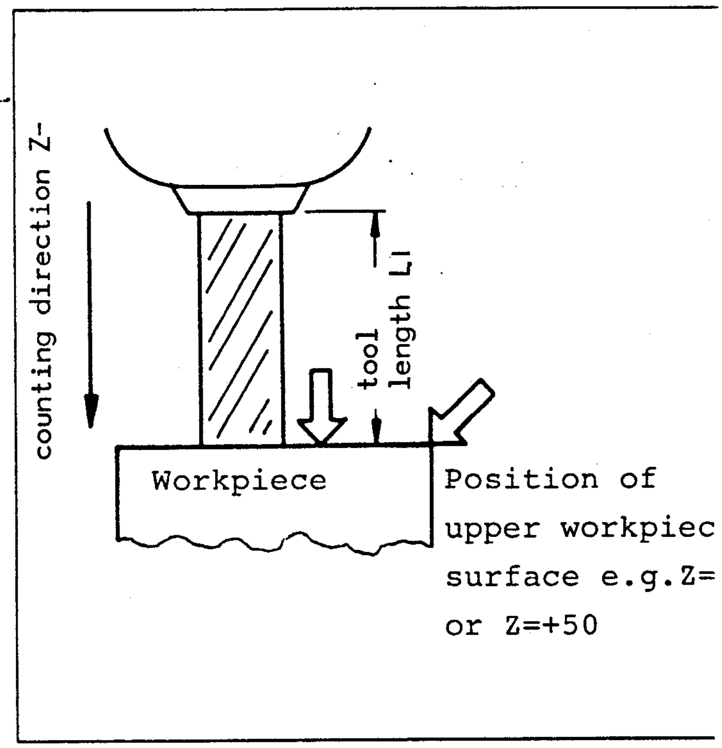
a) Tools in Toolholders (with or without longitudinal stop)



To set the workpiece datum point for the spindle axis, insert the first tool ('zero tool', see section F2, "tool definition"). If, for example, the upper surface of the workpiece is to be assigned datum value 0, then scratch the workpiece surface with the tool and set the Z-axis display to 0 with the tool in this position. (Corresponds to case (a) for axes X and Y). If the upper surface of the workpiece is to be assigned a value other than 0, then the actual value counter for the spindle axis should be set to the position that the upper surface is to assume. e.g. +50

b) Preset tools

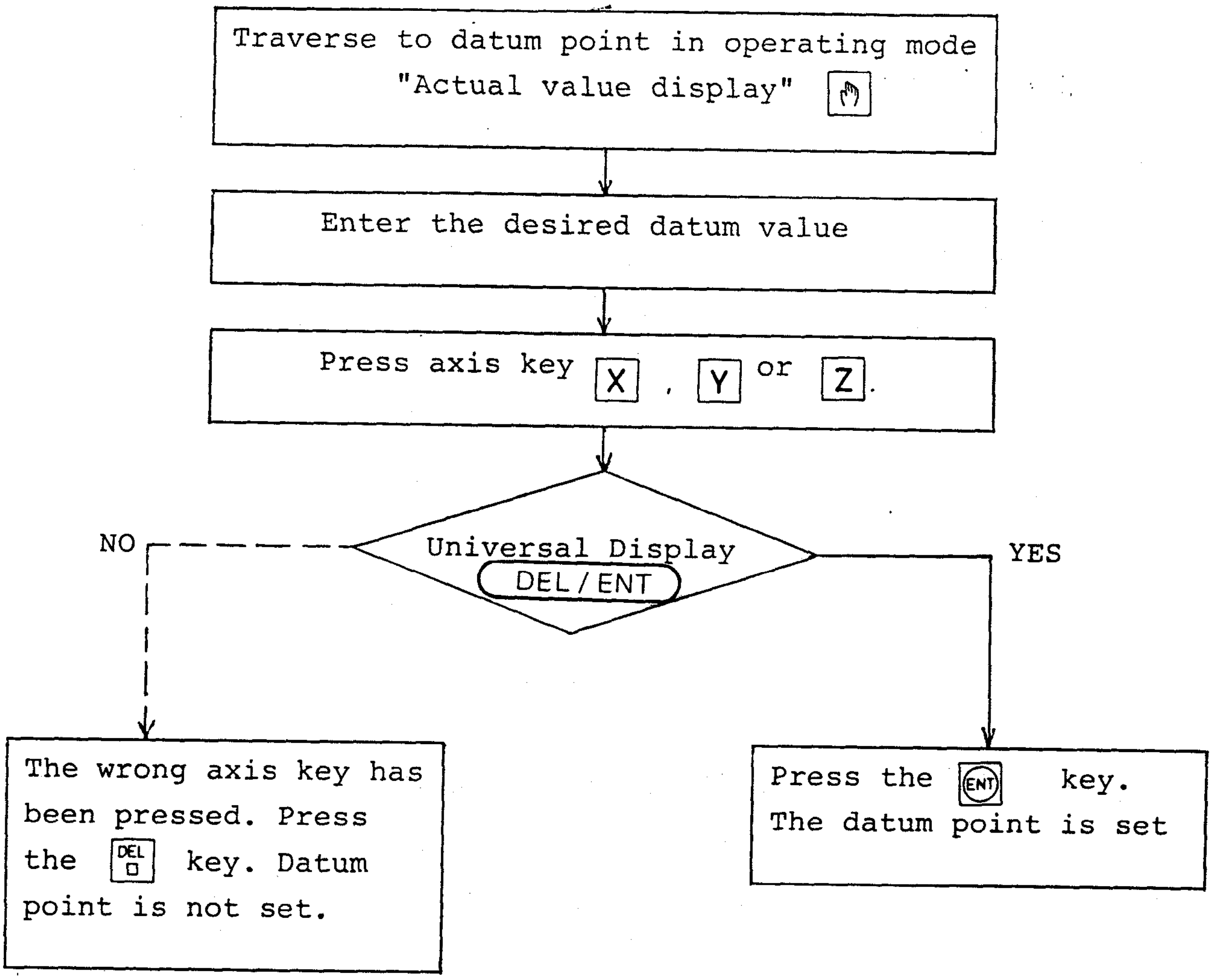
The lengths of preset tools are already known. Scratch the surface of the workpiece with any tool. If the surface of the workpiece is to be assigned the value 0, then the actual value counter for the spindle axis must be set to the length +L1 of the corresponding tool. If the upper surface is to be assigned a value other than zero, then the actual value counter for the spindle axis must be set as follows:



(Actual value Z) = (tool length L1) + (position of upper surface)

Example:
Tool length 100mm, position of workpiece surface to be Z = +50 mm
Actual value Z = 100 mm + 50 mm = 150 mm.

Datum points may be set as follows:



Should the relationship that is established between positions and display values when the datum point is fixed need to be reproduced, then the reference points must be traversed before the datum point is set. (see following section E2.)

E2. Working with REF

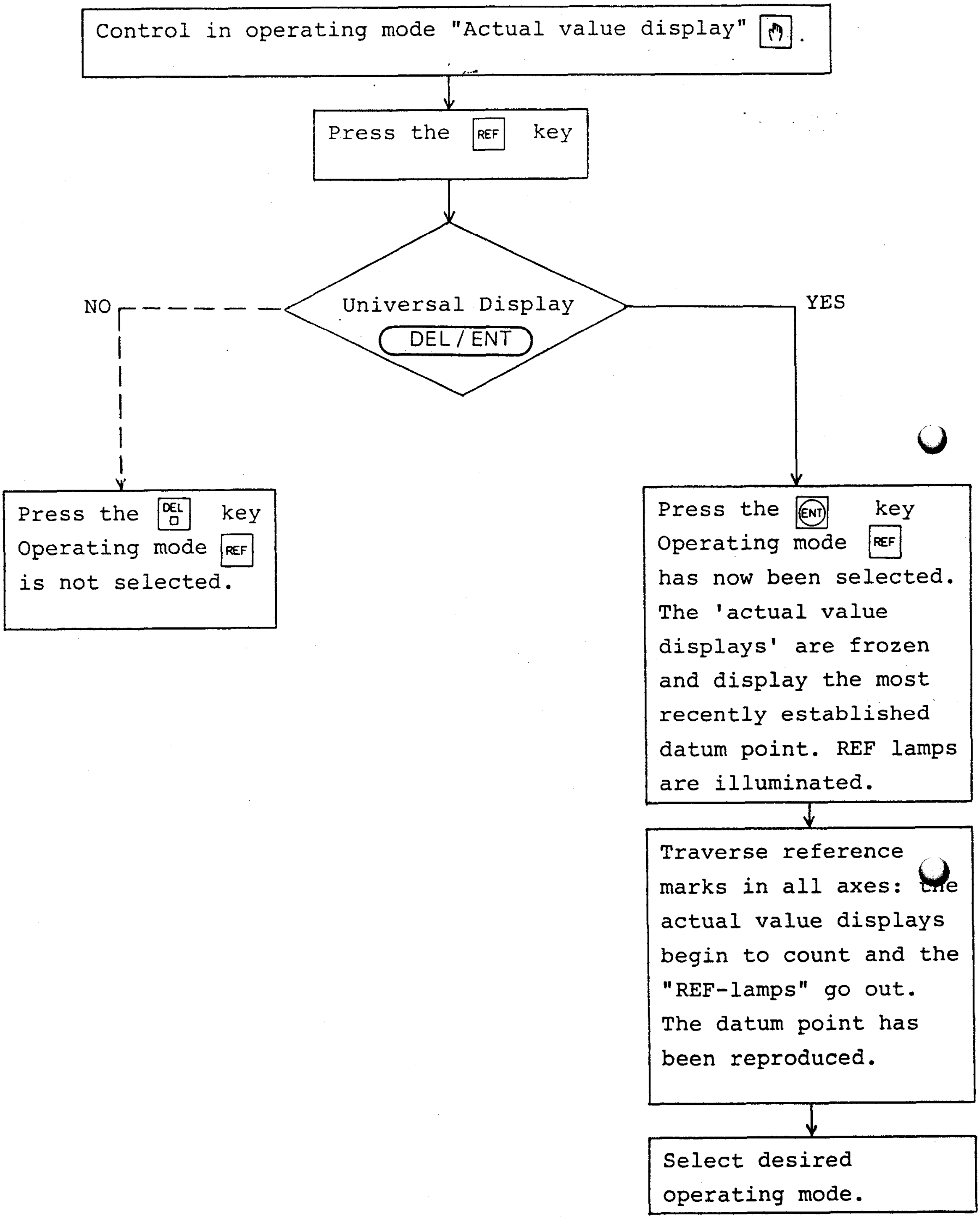
The relationship that is established between positions and display values when a datum point is fixed will be lost when the POSITIP is switched off or if the power supply is interrupted. It may however be easily reproduced. The linear transducers in all machine axes have reference marks (special impulse on the scales) for just this purpose. When traversed, these reference marks output a signal which is evaluated by the POSITIP.

The position of the reference mark in each axis is called the reference point. When the datum point is set, the reference points are also assigned specific position values, which we have named "REF-values".
Whenever datum points are set, the POSITIP will only store these REF-values automatically if the reference marks have been traversed at some point between the time when the POSITIP is switched on and the time when the datum points are set (REF - switched on).

After a power interruption (the POSITIP will have been switched off and then switched back on), these REF-values will be displayed in the "actual value display"; if the REF key is pressed, the individual axes will only start to count when the reference points have been traversed, so that the position values displayed (actual values) will relate to the most recently established datum point.

Next to the figures in the actual value displays are reference-mark-position value display lamps, which we have named "REF lamps" for short. If the REF lamp in one axis is illuminated, then it is indicating that counting was stopped and that the "REF-value" is being displayed.

☞ In general, the reference marks should be traversed straight away whenever the POSITIP is switched on (after the REF and ENT keys have been pressed).
- either to reproduce the previous datum point
- or to store new "REF-values" by establishing a new datum point:


Control in operating mode "Actual value display" .
Press the REF key
Universal Display
DEL / ENT
NO
YES
Press the DEL key
Operating mode REF
is not selected.
Press the ENT key
Operating mode REF
has now been selected.
The 'actual value
displays' are frozen
and display the most
recently established
datum point. REF lamps
are illuminated.
Traverse reference
marks in all axes: the
actual value displays
begin to count and the
"REF-lamps" go out.
The datum point has
been reproduced.
Select desired
operating mode.

The [REF] key should be left switched on: the illumination of the [REF] key control lamp indicates that the reference marks have been traversed and that the "REF-values" have been or are being stored in memory.

If an axis cannot be traversed over a reference mark (due to the danger of collision between the tool and workpiece), the "REF" may be switched off by pressing the [REF] and [ENT] keys again.

F. Writing Programs

F1. Block No./Block Contents Switchover [N] [□]

The universal display can show either the contents of a program block or its number as required.

If the [□] key is pressed: the contents of program blocks are displayed.

If the [N] key is pressed: program block numbers are displayed.

☞ Even when the POSITIP has been switched so that the contents of program blocks are displayed, block numbers are displayed whenever one of the following keys is pressed: [ENT], [DEL □], [GO TO], [↓], [↑], [LBL SET], [LBL CALL]

F2. Tool Definition [L DEF] [R DEF]

The POSITIP allows for tool compensation, so when a program is entered the workpiece contours may be programmed directly from the drawing.

The storage of the values required for this compensation takes place

during the definitions of the tool length and radius.
Length and radius compensation values may be entered for up to 15 tools.
If a tool is reground, or it breaks and has to be replaced, then only the corresponding length and radius definitions need be altered.

A tool is defined by entering values according to the following sequence:

1. Tool number (1...15)
2. Press either the [L DEF] key or the [R DEF] key
3. Enter the compensation value
4. Press the [ENT] key

Operating mode	Press	Universal Display/Remarks
	[□]	Display of block contents
	[0] ... [9]	Enter tool no.
	[L DEF] or [R DEF]	Indicator lamp for [L DEF] or [R DEF] is illuminated
	[0] ... [9] [+/-]	Enter compensation value
	[ENT]	Block is stored in memory e.g. LDEF 12 + 100,000

A tool may not be defined as no. 0: this tool number has been set aside for "no tool" i.e. L = 0 and R = 0.

Tool definition blocks are displayed as follows in the universal display:

Tool No.

Compensation value for tool length

LDEF	1 : 15	± 12345,670

Tool No.

Compensation value for tool radius

RDEF	1 : 15	± 12345,670

If a tool number has been entered incorrectly, and the L and R values have already been entered beneath it, then three asterisks will appea in the universal display in place of the letters "DEF".

L***	1 : 15	± 12345,670

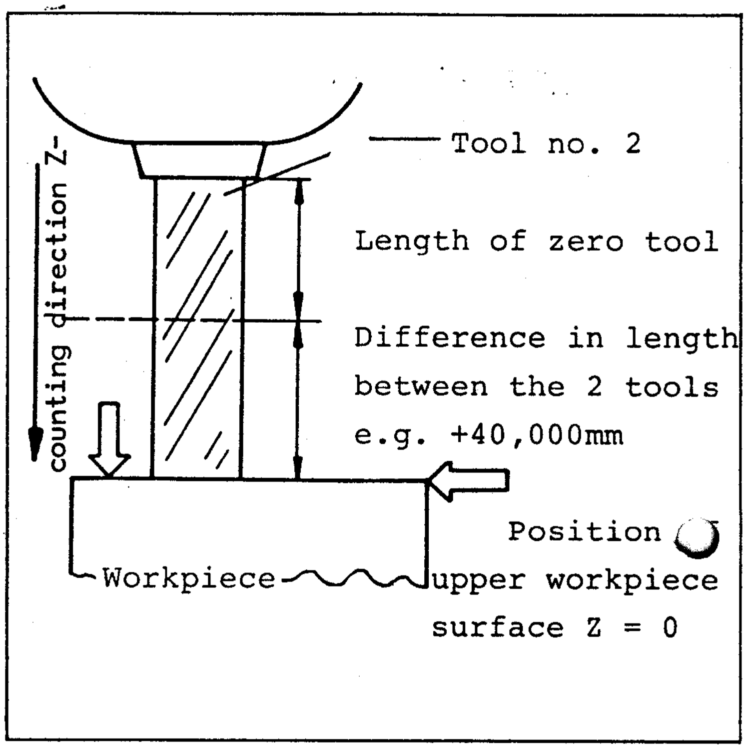
R***	1 : 15	± 12345,670

When this happens:
Press the L DEF key again and enter a new tool number!

Ascertaining the compensation values for tool length L.

a) Clamped tools without longitudinal stop.

The datum point for the spindle axis must first be established (see section E 1) by scratching the upper surface of the workpiece with the first tool and setting the actual value display in the corresponding axis. (e.g. Z-axis). The first tool is defined as the zero-tool, i.e. the following is entered in the tool definition block for the first tool:
e.g. tool length L = 0,000



For all subsequent tools (and also whenever tool no. 1 is reinserted), the difference in length between the new tool and the first tool must be entered. In the case where the upper surface of the workpiece has been assigned the position Z = 0, the length compensation value may be ascertained when a new tool is inserted by scratching the upper surface of the workpiece. The compensation value is displayed in the actual value display for the Z-axis, and may be transferred as the entry value (including the arithmetic sign where necessary) using the $\boxed{+}$ key. This value will be entered in the tool definition block for the corresponding tool. e.g. tool length L = 40,000

If the upper surface of the workpiece has been assigned a value other than zero, then the tool length may be ascertained after the datum point has been set as follows:
Scratch the workpiece surface and note down the value (including arithmetic sign) in the actual value display for the spindle axis. The compensation value L may be calculated from the following equation:

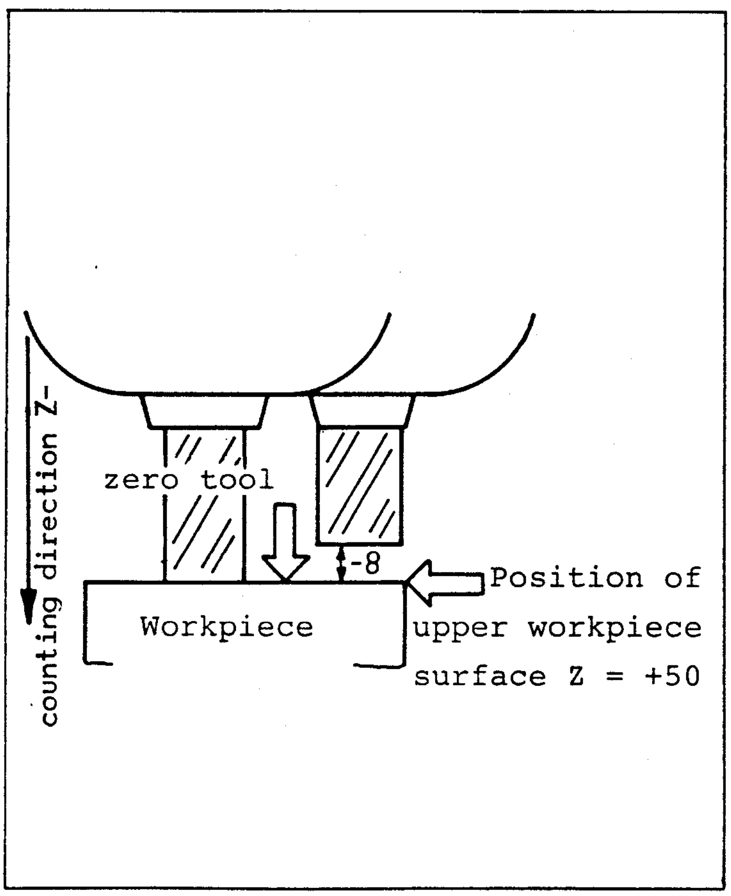
Compensation value L = (actual value Z) - (position of workpiece surface)

Example:
Actual value in Z-axis display = +42
Position of workpiece surface = +50

Compensation value L = (+42) - (+50) = -8

This value is entered in the appropriate tool definition block:

Tool length L = -8



b) Tools in Toolholders with longitudinal stop

The tool length compensation value is determined as described in a). Once a compensation value has been fixed it does not alter even if the tool is removed and then reinserted.

c) Preset tools

The lengths of preset tools have already been determined on a presetting device i.e. all tool lengths are already known and needn't be determined on the machine. Tool lengths entered in tool definition blocks are those determined on the presetting device.

F3. Tool-call [TOOL CALL]

When a tool is changed, the data (length and radius) for the new tool must be called up using the [TOOL CALL] key.

A "Stop" must be programmed with the [STOP] key before each tool change so that execution of the program is interrupted and the tool may be changed.

Operating mode	Press	Universal Display/Remarks
	[□]	Display of block contents
	[0] ... [9]	Enter tool no. 0...15
	[X] [Y] [Z]	Selection of spindle axis; tool length is parallel to this axis; radius compensation may be programmed in the other two axes as required.
	[TOOL CALL]	Press the tool-call key
	[ENT]	The tool call is stored. The universal display shows e.g. TOOL CALL 8 Z

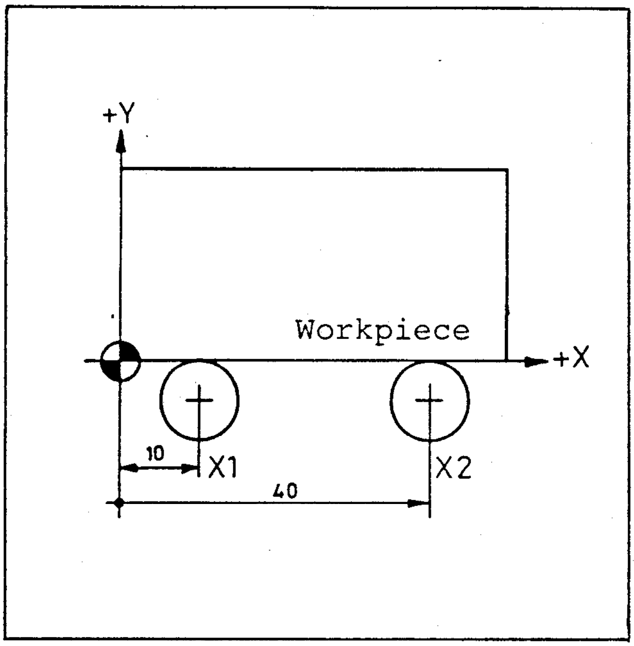
If the machine is to be traversed without compensation after a tool-call, then a tool-call with number 0 must be programmed and executed using the external start button (tool no. 0 has been preprogrammed by the works with length L = 0 and radius R = 0).

F4. The Positioning Block X Y Z

F4.1 Absolute/Incremental Dimensioning I

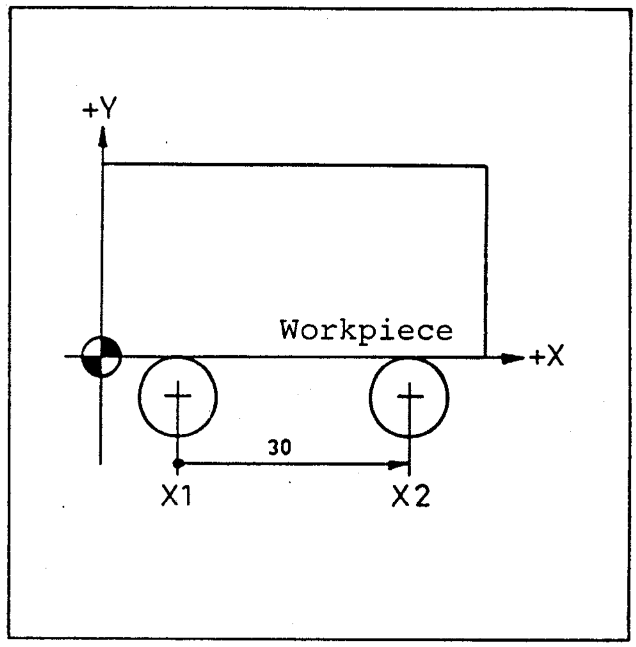
Workpiece dimensions are either absolute or incremental. The difference is explained in the examples below:

Absolute Dimensions



The tool is in position X1=10mm The machine axis is to be traversed to position X2=40mm Both dimensions are relative to the (absolute) workpiece datum point (marked by ⌖).

Incremental Dimensions



The tool is in position X1. The machine axis is to be traversed by 30mm to position X2. With incremental dimensions, the path to be traversed is not relative to the workpiece datum point, but is instead relative to the position that was reached after the last positioning.

Programming in absolute dimensions has the advantage of allowing geometric amendments to individual positions without the remaining positions being affected. Reentry into the interrupted program after a power failure or other defect is simpler with absolute programming (All that is required is that the datum point be reproduced as in section E3.) Furthermore, suitable location of the workpiece datum point can help to dispense with negative values.

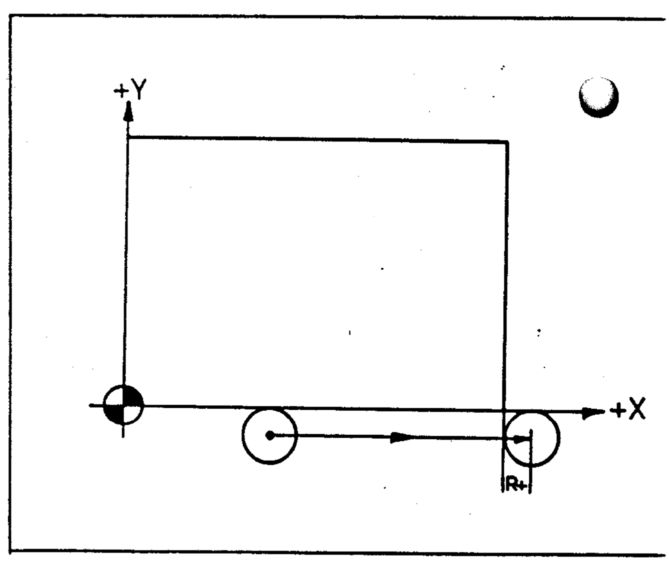
On the other hand, incremental programming eliminates calculation wo in many cases.

To program in incremental mode, press the [I] key. (I = incremental (the corresponding lamp is illuminated). If the key is pressed again absolute mode is reselected (the corresponding lamp goes out). If a block has been programmed in the wrong mode, then it must be deleted using the [DEL □] key and the correct block must be reentered.

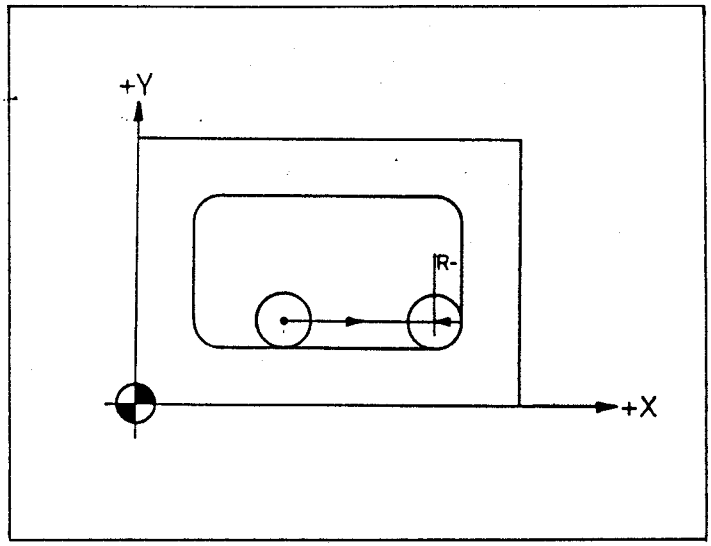
F4.2 Tool radius compensation [R+] [R-]

It is only necessary to determine in the positioning block whether the traversing distance is to be increased or decreased by the radius compensation (the size of the radius compensation is entered in the tool definition block with the [R DEF] key - see section F2). Compensation is selected by pressing either the [R+] or the [R-] key - the corresponding lamp is illuminated.
The [R+] and [R-] keys have the following meanings:

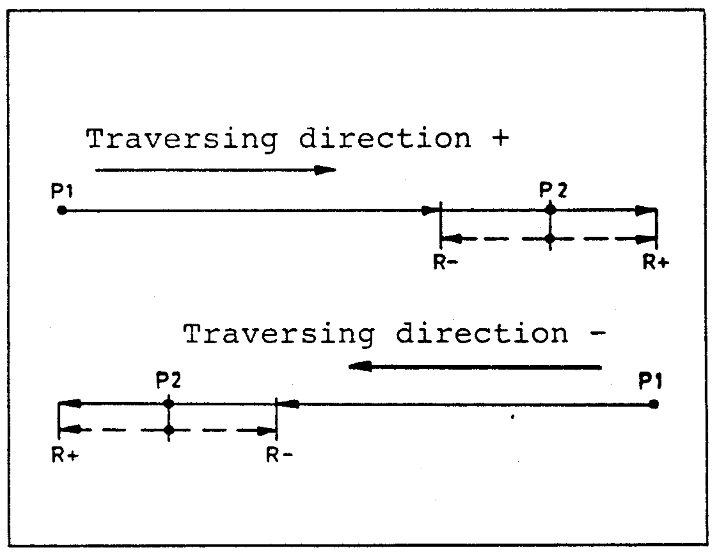
If [R+] is programmed, then the traversing distance is increased by the size of the tool radius
e.g. exterior contour



If $\boxed{\text{R-}}$ is programmed, then the traversing distance is reduced by the size of the tool radius. e.g. interior contour.



Extending and reducing the traversing distance is therefore independent of the traversing direction. (see sketch alongside)



If no radius compensation is entered (R0), then neither of the two lamps is illuminated.

$\boxed{\text{R+}}$ and $\boxed{\text{R-}}$ may be switched off by simply pressing the key whose control lamp is illuminated.

F4.3 Programming a positioning block from a program sheet or drawing

The various entries (block parts or words) to a positioning block may be selected and entered in any order. To display the contents of program blocks: press the [□] key.

Entries	Example
Axis to be traversed: Press [X] , [Y] or [Z]	X-axis : [X]
Absolute or incremental dimensions: Absolute dimensions... [I] off Incremental dimensions... [I] on	Absolute dimensions
Nominal position value: [0]...[9] and [+/-]	22,5 mm
Tool radius compensation: either [R+] on (traversing distance>dimension on drawing) or [R-] on (traversing distance<dimension on drawing) or [R+] and [R-] off (no radius compensation)	[R+]
Store in memory: Press the [ENT] key	Press [ENT]

F4.4 Programming a positioning block using the "Actual value transfer" key (Playback) [+]

If more than one workpiece is to be machined, it can be advantageous to program the POSITIP simultaneously with the machining of the first workpiece. The POSITIP is then used as an actual position value display and the positions to which the machine has been traversed are transferred to the universal display using the "actual value transfer" key.

☞ Programming a positioning block using the 'actual value transfer' key is only meaningful in absolute mode. ([I] key switched off)

Operating mode	Press	Universal Display/Remarks
	[□]	Display of block contents
	–	Position machine axis
	[X] [Y] [Z]	Select the required axis with the axis-selection key.
[⟐]	[+]	Transfer the actual position value to the universal display.
	[R+] [R–]	If radius compensation is required, press key indicating direction of compensation.
	[ENT]	Store block in memory e.g. A x + 231,365 R+

The positioning block selected in the above example would be displayed in the universal display as follows:

Absolute dimension ... A

Axis to be traversed ... X

Nominal position value 22,5 mm

Tool radius compensation "R+"

	A	X	+ 22,500	R+

Examples:

Y-axis
Incremental dimension -82,75 mm
Radius compensation R-

	I	Y	−82,750	R−

Z-axis
Absolute dimension 200 mm
No radius compensation

	A	Z	200.000	R0

When a positioning block is programmed, the nominal position value may also be transferred from the actual value display (instead of entering the value, press the $\boxed{+}$ key, see section F4.4).

The actual position value that is transferred takes into account the length and radius compensation for the tool that is being used.

☞ Values L1=0 and R1=0 must be entered in the tool definition bloc for this tool, and the radius R1 of the tool used should be note down. Positioning blocks that are programmed in "Playback" mode must be entered with the correct radius compensation: R+, R-, R0

If a tool eventually breaks and is replaced by a new tool with a different radius, then proceed as follows:

Radius compensation value = R2 - R1

This radius compensation value may be either positive or negative an must be entered for R1 (including any minus sign) in the tool radius definition.
The length compensation value must also be re-entered.

F4.5 Programming a positioning block with the simultaneous machining of the first workpiece (Teach-In)

When programs are entered in "Teach-In" mode, the program blocks are executed block by block in operating mode "Positioning with display of remainder of traverse" and then transferred immediately to the program memory.

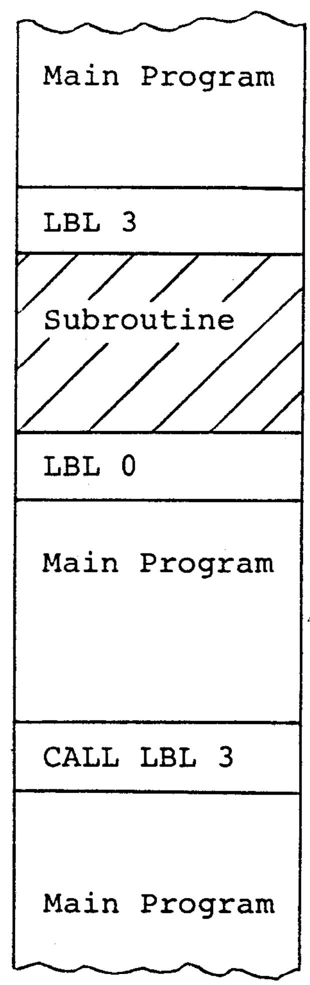
Operating mode	Press	Universal Display/Remarks
		POSITIP in operating mode "Positioning with display of remainder of traverse".
	X Y Z I 0 ... 9 +/- if req. R+ R-	Key-in the positioning block.
		Start the program block and run it by traversing the machine axis to zero.
	ENT	Select operating mode "Program entry" and transfer the block to the program memory.

F5. Subroutines and program part repeats [LBL SET] [LBL CALL]

Program marks (label nos.) for the identification of <u>subroutines or program part repeats</u> may be set at any desired location in the program. These marks serve as jump addresses.

A jump command to a label no. will always reach the correct location in the program even after the program has been edited (insertion and deletion of blocks). Numbers 1 to 99 may be used as label nos. Label no. 0 is always used as a program mark "End of Subroutine". Each program mark and each jump command occupies one program block.

Schematic diagram of a subroutine:



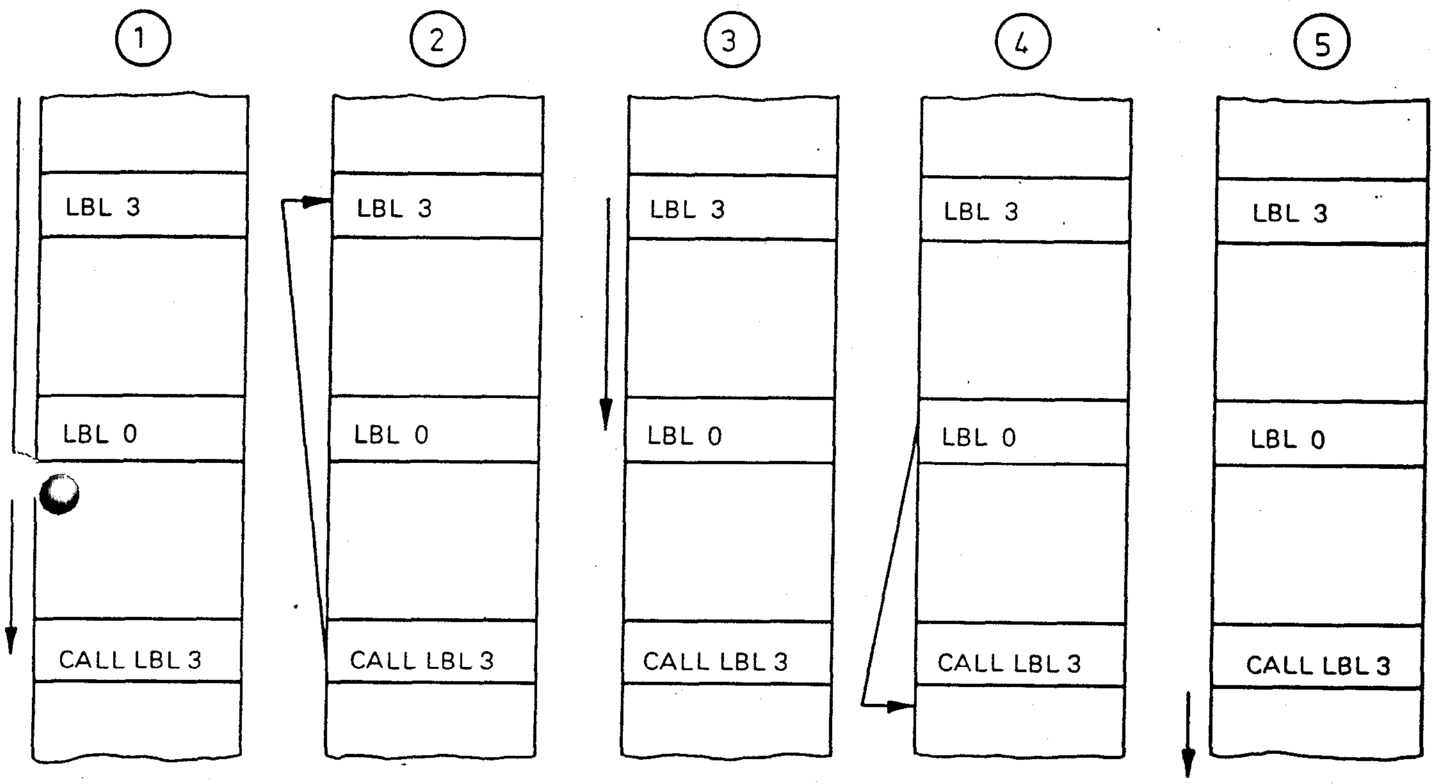
The beginning of the subroutine is marked by a label (e.g. label 3)

The end of the subroutine is marked by label 0.

A subroutine may be called at any point in the main program using the subroutine call feature i.e. a jump is made to the appropriate program label.

<u>Note</u>: A subroutine can only be <u>executed once</u> when it is called.

Description of program run:



1. The main program is executed up to the subroutine call.

2. A jump is then made backwards to the label called.

3. The subroutine is executed to its end (label 0).

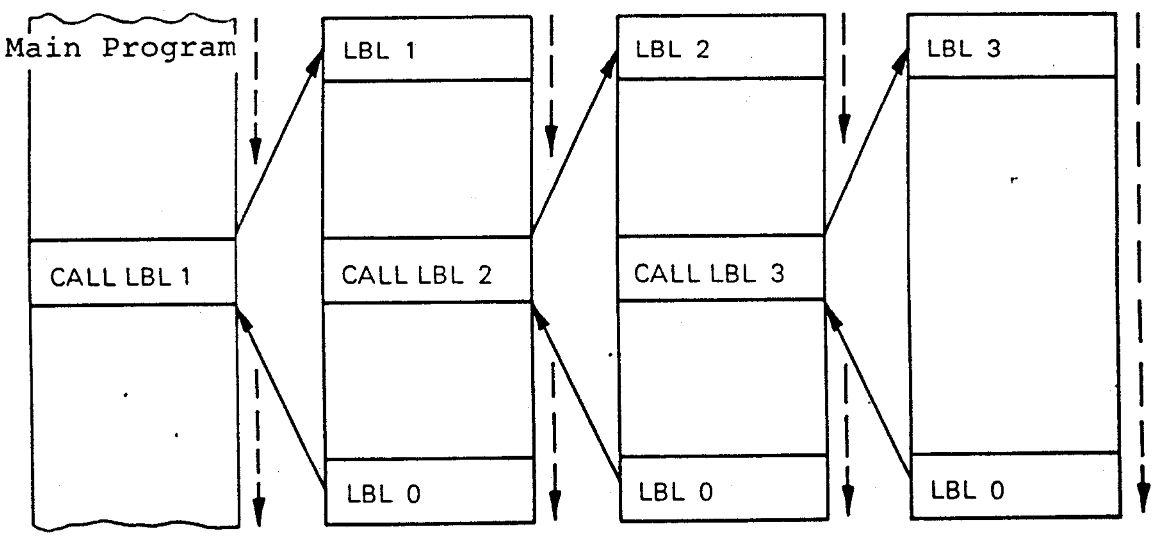
4. Return to the next block after the subroutine call.

5. Normal program execution is continued.

Nesting of subroutines

Subroutines may be nested up to 3 times i.e. up to 3 different subroutines may be interconnected by jump commands within the individual subroutines. Subroutines may also contain program part repeats. If subroutines are nested more than 3 times, then "ERROR 45" will be shown in the display.

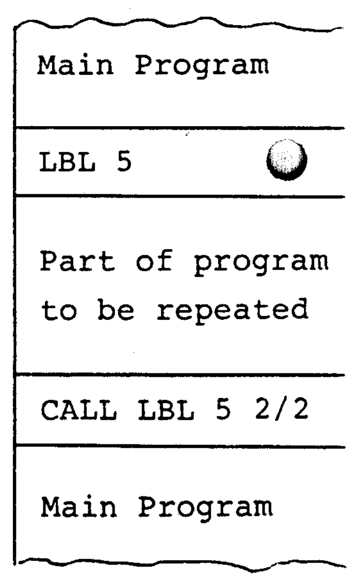
Schematic Diagram of a Subroutine Nesting



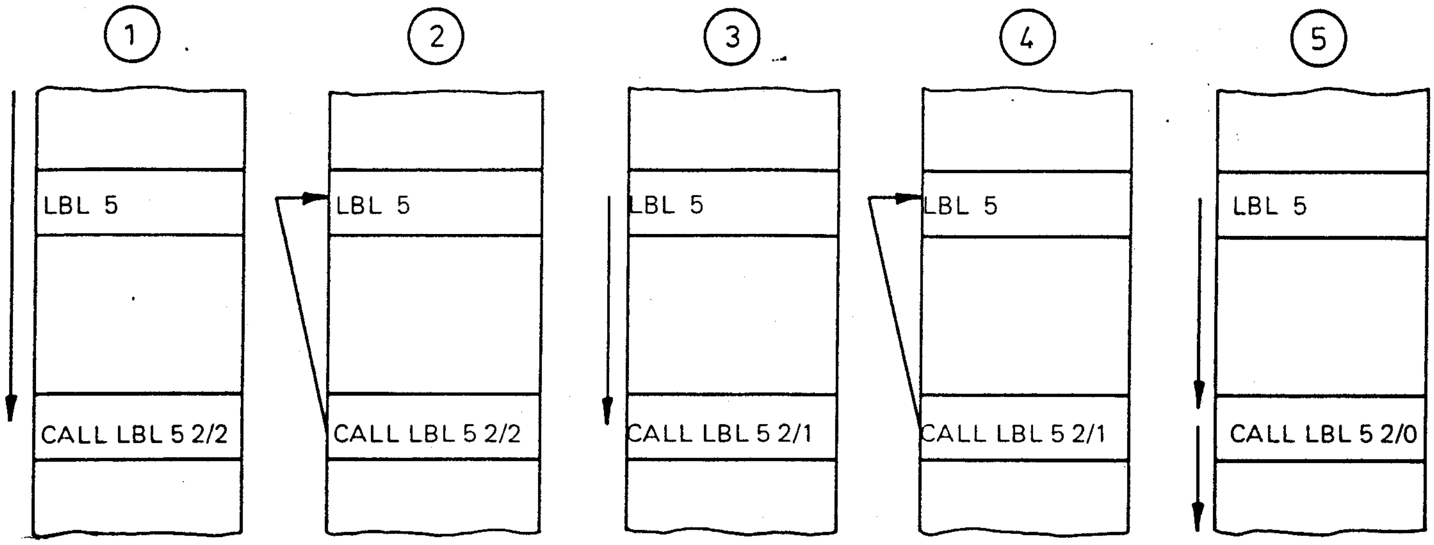
Schematic Diagram of a Program Part Repeat

The beginning of the program part to be repeated is marked by a program label (e.g. LBL 5)

For a program part repeat, the no. of repeats is entered after the program label. The maximum no. of repeats that may be entered is 99.



Description of program run



1. The operating program is executed up to the Program Part Repeat Call. Two repeats are programmed in the "CALL-LBL" block.

2. The jump back to the label that has been called now proceeds.

3. The Program Part is repeated. In the event of a "Label 0" being in the repeated part of the program, it is ignored. CALL LBL 5 2/1 appears in the data display.

4. Repeated jump back to the program mark.

5. After the second repeat, the block CALL LBL 5 2/0 appears in the data display. All programmed repeats have been executed, the normal program run continues.

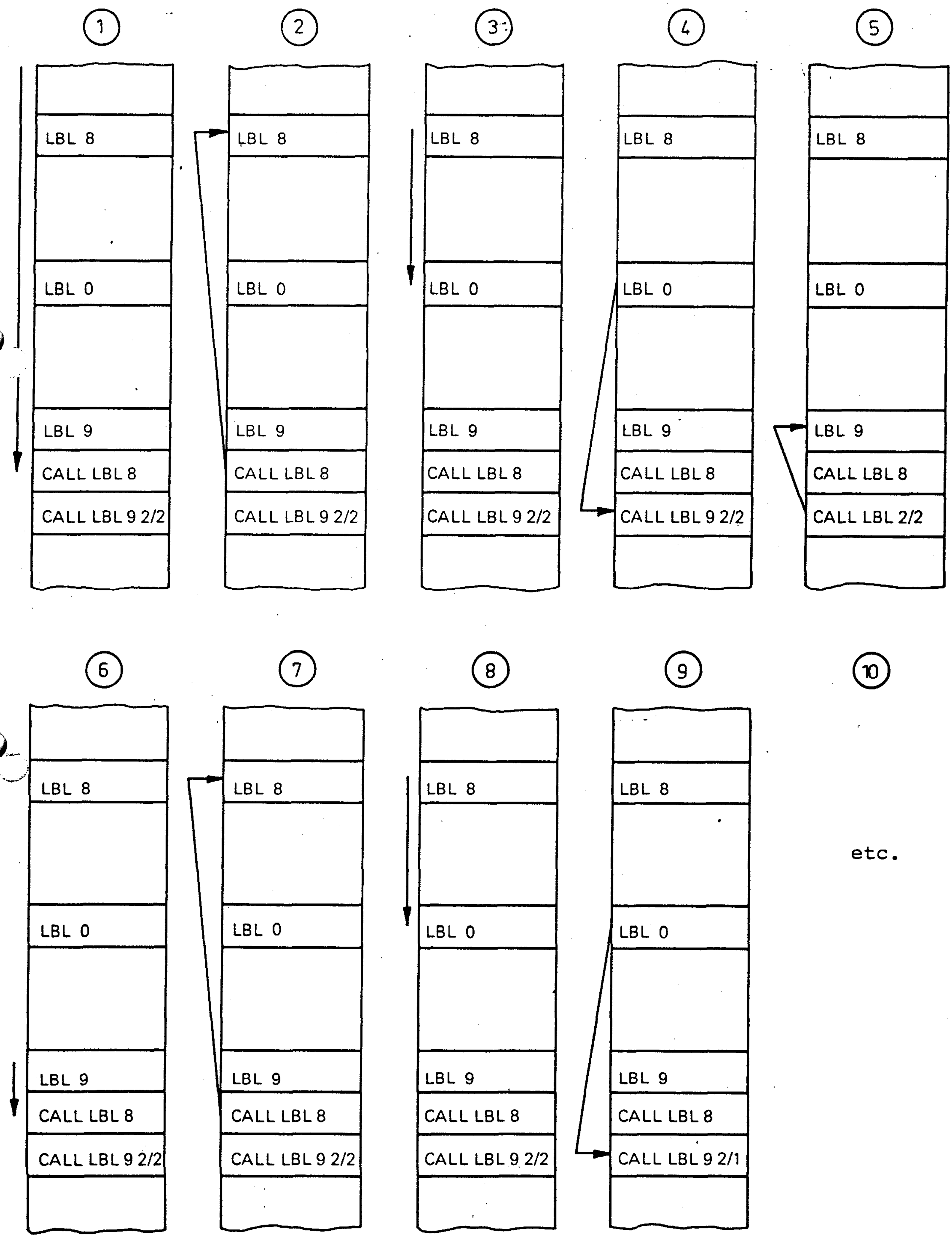
Schematic Diagram of a Multiple Subroutine Repeat

Should repeats of a subroutine be required, then they should be programmed as follows:

	Main Program
Program mark defining the subroutine	LBL 8
	Subroutine
Program mark defining the "End of Subroutine"	LBL 0
	Main Program
Program mark defining the Program Part Repeat	LBL 9
Subroutine-Call	CALL LBL 8
Program Part Repeat for two repeats of the Subroutine-Call	CALL LBL 9 2/2
	Main Program

☞ If two repeats are programmed, the subroutine will be executed three times.

Description of the Program Run



1. The main program is executed up to the Subroutine Call.

2. Jump backwards to the label that has been called.

3. Execution of the subroutine.

4. Jump to the block located after the Subroutine Call.

5. Jump back to the program label for the Program Part Repeat.

6. The Subroutine Call appears in the Program Part Repeat.

7. Jump back to the label that has been called.

8. Execution of the subroutine.

9. Jump to the block located after the Subroutine Call.

10. The cycle is repeated until all Program Part Repeats and consequently all Subroutine Calls have been executed.

F5.1 Setting a label no. (program mark)

Operating mode	Press	Universal Display/Remarks
	[□]	Display of block contents
[⇨]	[0] ... [9]	Enter the label no. in the data display: permissable values 0-99
	[LBL SET]	The program mark is stored in memory e.g. [LBL 3]

F5.2 Jump to a label no. (program mark)

Operating mode	Press	Universal Display/Remarks
	□	Display of block contents
	0 ... 9	a) For subroutines - enter label no. Permissable values: 1-99 b) For program part repeats - enter label no. and no. of repeats XX, XX Label no. | No. of repeats 1-99 | 1-99
	LBL CALL	The block is stored in memory. e.g. CALL LBL 62'33/33

F6. Programmed Stop: STOP key

A programmed 'Stop' will interrupt the program run. It may be programmed as follows:

Operating mode	Press	Universal Display/Remarks
	□	Display of block contents
	STOP	STOP The STOP block has been programmed, the key need not be pressed again.

G. Program Editing

G1. Calling up a specific program block

Select operating mode , or

↓

Enter the desired block no. and press the GO TO key

G2. Step by step checking of program blocks

Select operating mode , or

↓

Select the no. of the block from which the program is to be checked

↓

Page the program either forwards or backwards using the paging keys ↓ and ↑

G3. Deleting a program block

Select operating mode

↓

Select the no. of the block to be deleted, or the no. of the last block in the part of the program to be deleted

↓

Delete block (or blocks) with the DEL key

G4. Inserting a program block into an existing program

With the POSITIP, new program blocks may be inserted into an existing program at any random location. Simply select the block after which the new block is to be inserted: the new block is then simply entered: the block numbers of the subsequent blocks are automatically amended. If the storage capacity of the memory is exceeded, then the error message "ERROR 09" will be shown in the universal display.

Select operating mode

↓

Select the block after which the new block is to be inserted

↓

Key in the new block and store in memory

G5. Deleting a program

Select operating mode

↓

Press the CL PGM key

↓

Universal Display DEL / ENT

NO: Press the DEL key. The program is retained in memory.

YES: Press the ENT key. The program is deleted.

H. Single-block and Automatic program run

Programs may be executed in operating modes "Single block program run and "Automatic program run" . After the start of the program run, the paths to be traversed (remainder of traverse) are shown in the actual value displays. The displayed values will include any tool compensation that might have been programmed.

Example:
The following has been programmed in the tool definition:

LDEF 1 + 100,000	RDEF 1 + 20,000

A tool call must be programmed so that the compensation values can be taken into consideration:

```
TOOL CALL 1   Z
```

The first positioning block programmed reads:

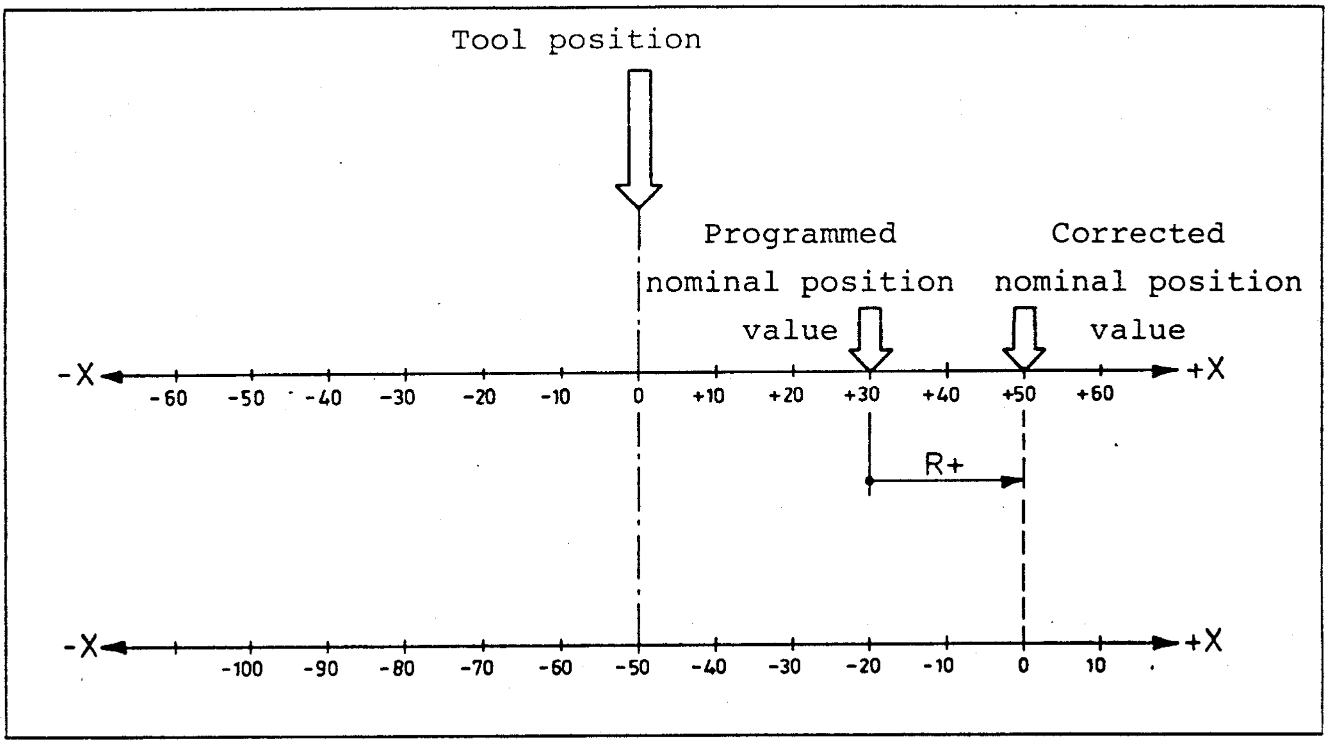
```
A  X  +  30,000  R +
```

Assumption:
At the start of the operating program the tool is at the datum point, i.e. X = 0, Y = 0, Z = 0

The program is started in operating mode or : the remainde of the traverse is shown in the actual value display for the X-axis:

X =-50,000

The displayed value for the remainder of the traverse is obtained as follows:



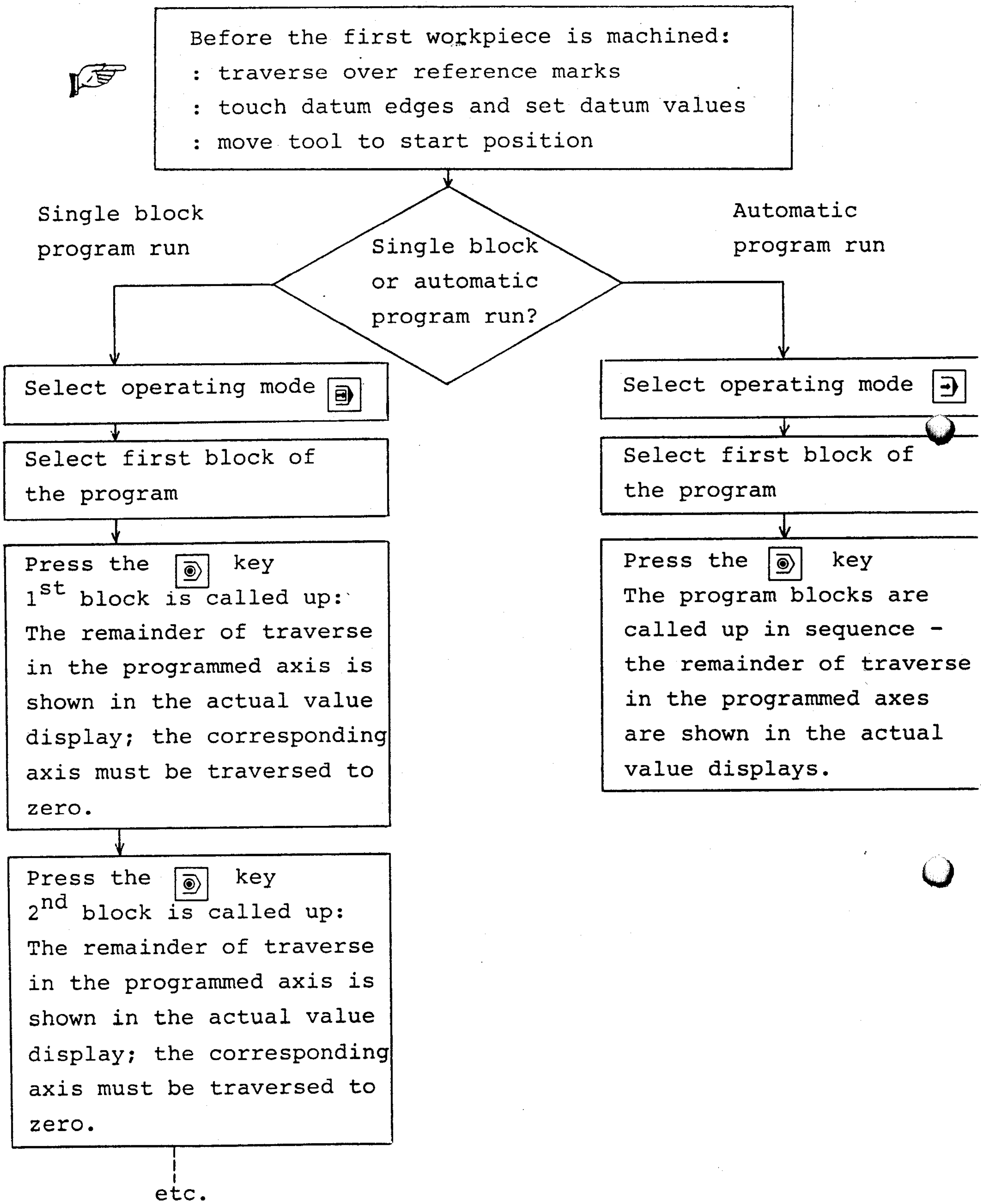
The tool must be traversed to the corrected nominal position value. The corrected nominal position value is obtained by combining the programmed nominal value with the radius compensation value.

In our example:

programmed nominal value 30 mm + radius compensation 20 mm = corrected nominal position value 50 mm.

The POSITIP sets the "remainder of traverse" display to -50 so that the actual value of the position to which the machine is to be traversed is 0: the positioning block is executed by traversing the tool to zero.

Flow diagram for Single block- and Automatic- program run



If your machine is equipped with an external start button, then program run in operating mode "Single block program run" may also be started using this button.

I. Operating mode "Positioning with display of remainder of traverse"

In this operating mode, positioning blocks may be executed without being stored in memory by "traversing to zero".

Select operating mode "Positioning with display of remainder of traverse"
↓
Enter the positioning block (see sec. F4) Do not press the ENT key
↓
Press the key; The residual path is shown in the actual value display for the selected axis: the control lamp in the universal display is illuminated.
↓
The machine axis selected must be traversed until the corresponding actual value display shows 0.
↓
The control lamp in the universal display goes out. The next nominal position value may be entered.

If tool radius compensation is to be taken into account in operating mode "Positioning with display of remainder of traverse" then the following should be noted:

- program the tool definition and tool-call in operating mode "Program entry".
- start the tool-call in operating mode "Single block program run" using the key.
- enter the positioning block in operating mode "Positioning with display of remainder of traverse" . The tool radius and tool length are automatically taken into account when the remainder of the traverse is determined.

K. Interrupting a positioning process

If necessary, a positioning process may be interrupted by pressing the key.

The POSITIP has been started in one of the operating modes , or :
The control lamp in the universal display is illuminated.

↓

The positioning process is to be interrupted.
Press the key - the control lamp in the universal display goes out and the positioning process is interrupted.

↓

Any desired operating mode may now be selected or a new block may be entered.

L. External data-input and -output

L1. Interface

The POSITIP VRZ 965 has a CCITT-type V.24 interface (EIA standard RS-232-C).
This data-input/output facilitates the connection of the HEIDENHAIN ME 101 magnetic tape unit (portable unit).

Other programming or peripheral devices (e.g. tape punch, tape reader, teletype printer) may also be connected to the POSITIP if they have a V.24 compatible connection. (Peripheral devices with a 20mA interface may not be connected).

L2. The HEIDENHAIN magnetic tape unit ME 101

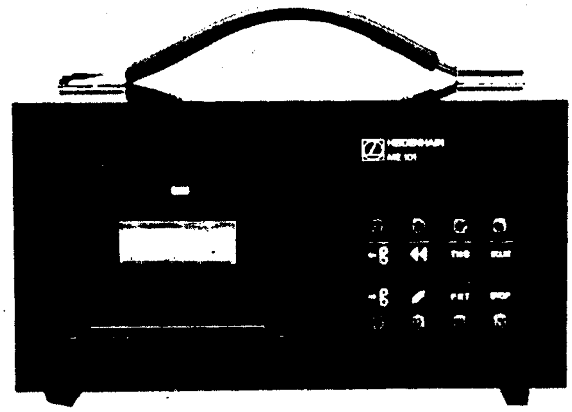
HEIDENHAIN produce a special magnetic tape unit for the external storage of data:

The ME 101, a portable device for alternate use on several machines.

The ME 101 magnetic tape unit is equipped with two data-input/output connections.

A typical peripheral device may also be connected to the V.24 (RS-232-C) output of the ME (connection PRT) as well as to the POSITIP.

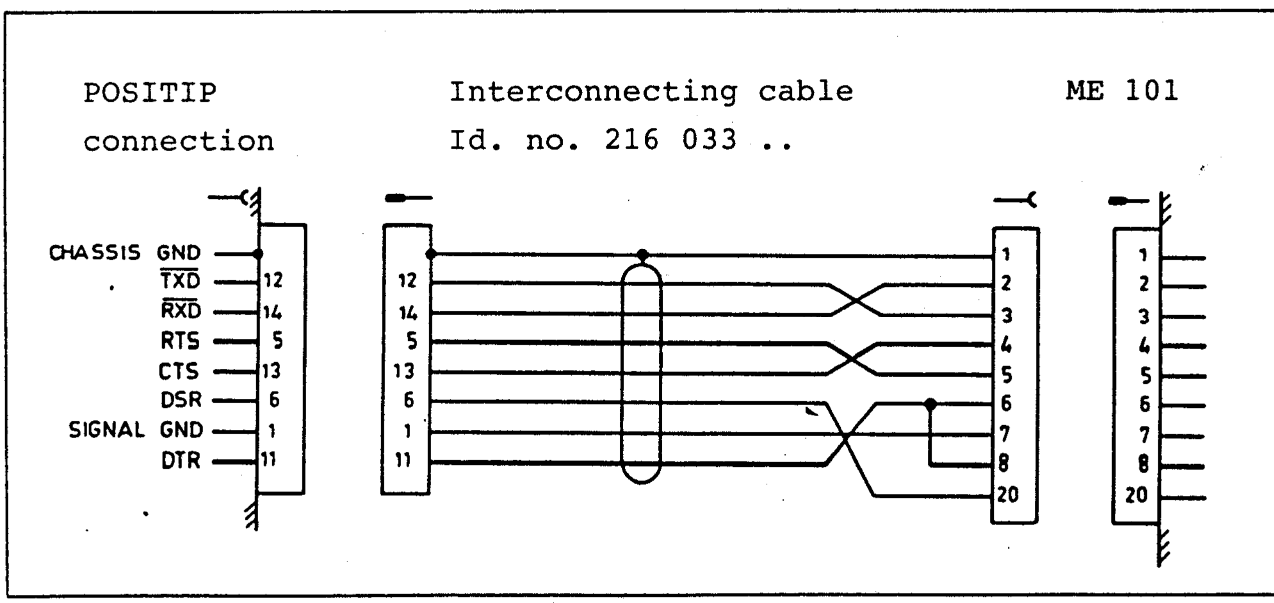
The data transfer rate between the POSITIP and the ME has been set to 2400 Baud. The transfer rate between the ME and the peripheral device may be adjusted as required using a selector switch (110, 150, 300, 600, 1200, 2400 Baud).
More detailed information on using the magnetic tape unit may be found in the ME 101 operating instructions.



ME 101

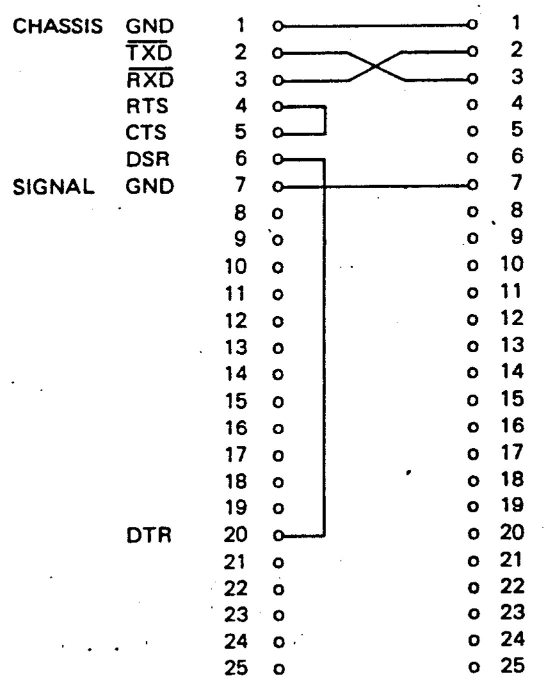
L3. Interconnecting cable

HEIDENHAIN supply the following cable for connecting the ME 101 directly to the POSITIP:



The following connector layout is suitable for the connection of a typical peripheral device (e.g. printer with tape reader/punch) to the ME 101.

PRT connection | Peripheral device



Key to signal abbreviations:

$\overline{TXD}$	Transmit data
$\overline{RXD}$	Receive data
RTS	Request to send
CTS	Clear to send
DSR	Data set ready
DTR	Data Terminal ready

Note:
The peripheral device must be set to even parity

L4. Entering the Baud Rate

The transfer rate for the POSITIP V.24 interface has been set to 2400 Baud, suitable for the HEIDENHAIN magnetic tape unit ME 101.

If a peripheral device with a different Baud Rate is to be connected to the POSITIP (not via the ME), then the Baud Rate may be altered as follows:

POSITIP in operating mode
"Actual Value Display"

↓

Press the EXT key

↓

The stored Baud Rate is displayed.
If required, enter new Baud Rate
(110, 150, 300, 600, 1200, 2400)

↓

Press the ENT key
New Baud Rate is stored

If the Baud Rate is merely to be displayed, then the display should be cleared using the DEL key after the EXT key has been pressed.

☞ If the POSITIP is switched off without buffer batteries, or if the buffer batteries are discharged when the POSITIP is switched off, then the programmed transfer rate is deleted and will automatically be set to 2400 Baud when the POSITIP is switched back on.

5. The data-transfer process

Output of data to printer, tape punch, or magnetic tape unit ME 101. The POSITIP will issue the following commands automatically (for line by line printout):

CR - carriage return
LF - line feed
SP - space
ETX - end of text

When programs are stored using a tape punch, the punched tape will contain these symbols; when programs are stored in the ME 101, they are present on the magnetic tape.

Starting the data output

Select operating mode [⇥] or [→].
↓
Select the start of the program or the block from which data transfer should commence
↓
Start data output with the [EXT] key

External input of an operating program

Before entering the program into the POSITIP, clear the program memory; during external input, the program blocks are overwritten by the new information, and if the memory has not been cleared it is possible that small parts of the "old" program will remain in the memory.

Select operating mode [⇦]
↓
Clear the program memory with the [CL PGM] key
↓
Start data input with the [EXT] key

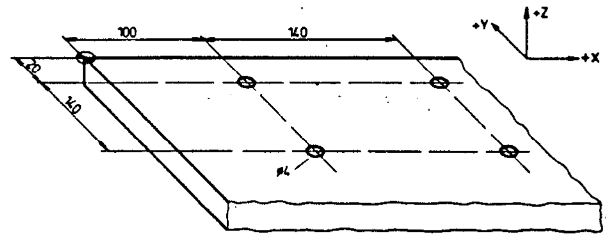
M. Example programs

Programming example 1

Workpiece with holes
Tool: drill diameter 4mm

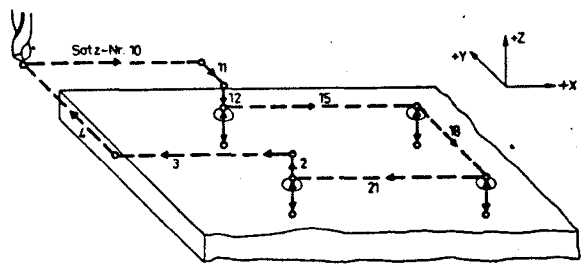
Material: Steel St 37
Thickness of workpiece: 20mm

Dimensions in (mm)



Datum point: X = 0, Y = 0, Z = 0

Operating program		
Block no.	Block contents	Remarks
001 002 003 004 005	LBL 1 AZ + 100,000 R0 AX – 20,000 R0 AY + 20,000 R0 LBL 0	Definition of tool change position as a subroutine
006 007	LDEF 1 ... RDEF 1 + 2,000	Tool definition *
008	STOP	
009	TOOL CALL 1 Z	Tool call

Operating program					Remarks
Block no.	Block contents				
010	AX	+	100,000	R0	Positioning commands and return to tool-change position
011	AY	–	20,000	R0	
012	AX	+	2,000	R0	
013	AZ	–	25,000	R0	
014	AZ	+	2,000	R0	
015	IX	+	140,000	R0	
016	AZ	–	25,000	R0	
017	AZ	+	2,000	R0	
018	IY	–	140,000	R0	
019	AZ	–	25,000	R0	
020	AZ	+	2,000	R0	
021	IX	–	140,000	R0	
022	AZ	–	25,000	R0	
023	AZ	+	2,000	R0	
024	CALL LBL 1' 0/0				

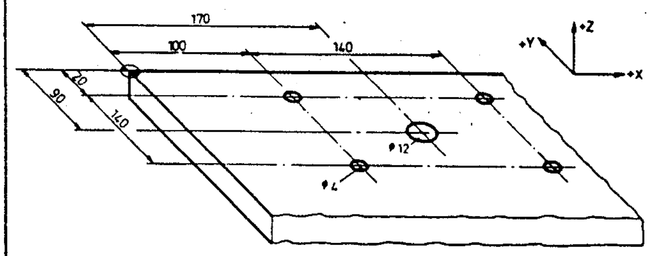
* For calculation of the compensation value for tool length L: see section F2 "tool definition".

Programming example 2

Workpiece with holes
Tool 1: drill diameter 4mm
Tool 2: drill diameter 12mm

Material: Steel St 37
Thickness of workpiece: 20mm

Dimensions in (mm)

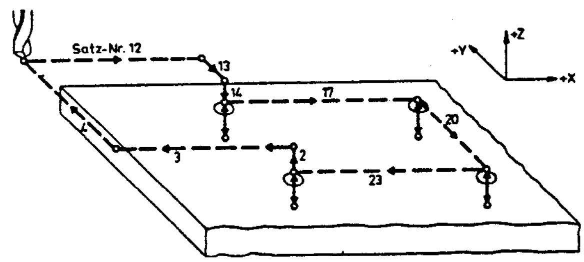
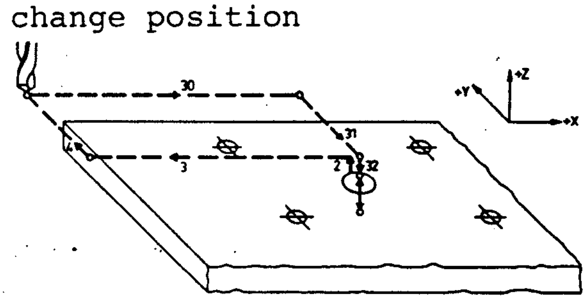


Datum point: X = 0, Y = 0, Z = 0

perating program

Block no.	Block contents	Remarks
001 002 003 004 005	LBL 0 AZ + 100,000 R0 AX – 20,000 R0 AY + 20,000 R0 LBL 0	Definition of tool change position as subroutine 1
006 007 008 009	LDEF 1 ... RDEF 1 + 2,000 LDEF 2 ... RDEF 2 + 6,000	Tool definitions
010	STOP	
011	TOOL CALL 1Z	Tool call 1

Operating program

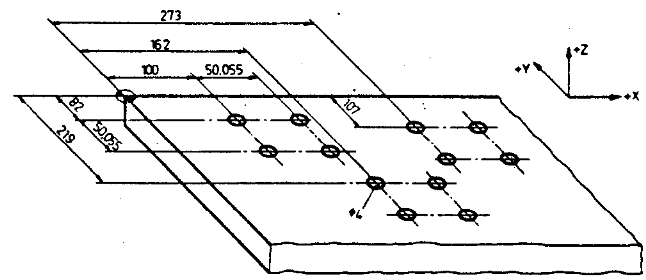
Block no.	Block contents				Remarks
012	AX	+	100,000	R0	Positioning commands for 4 holes diameter 4mm. Return to tool change position 
013	AY	–	20,000	R0	
014	AZ	+	2,000	R0	
015	AZ	–	25,000	R0	
016	AZ	+	2,000	R0	
017	IX	+	140,000	R0	
018	AZ	–	25,000	R0	
019	AZ	+	2,000	R0	
020	IY	–	140,000	R0	
021	AZ	–	25,000	R0	
022	AZ	+	2,000	R0	
023	IX	–	140,000	R0	
024	AZ	–	25,000	R0	
025	AZ	+	2,000	R0	
026	CALL LBL 1' 0/0				
027	STOP				
028	TOOL CALL 2Z				Tool call 2
029					Spindle speed for tool 2
030	AX	+	170,000	R0	Positioning commands for 1 hole diameter 12mm. Return to tool change position 
031	AY	–	90,000	R0	
032	AZ	+	2,000	R0	
033	AZ	–	25,000	R0	
034	AZ	+	2,000	R0	
035	CALL LBL 1' 0/0				

Programming example 3

Workpiece with hole matrices
Repetition of positioning commands
using a subroutine
Tool: drill diameter 4mm

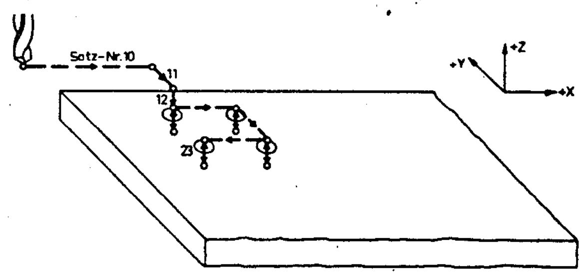
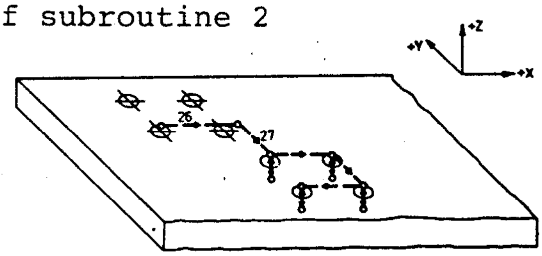
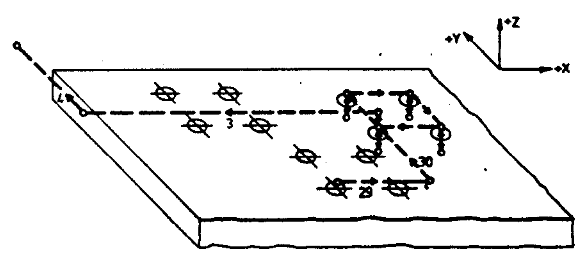
Material: Steel St 37
Thickness of workpiece: 20mm

Dimensions in (mm)



Datum point: X = 0, Y = 0, Z = 0

Operating program		Remarks
Block no.	Block contents	
001	LBL 1	Definition of tool change position as subroutine 1
002	AZ + 100,000 R0	
003	AX – 20,000 R0	
004	AY + 20,000 R0	
005	LBL 0	
006	LDEF 1 ...	Tool definition
007	RDEF 1 + 2,000	
008	STOP	
009	TOOL CALL 1Z	Tool call
010	AX + 100,000 R0	
011	AY – 82,000 R0	
012	AZ + 2,000 R0	

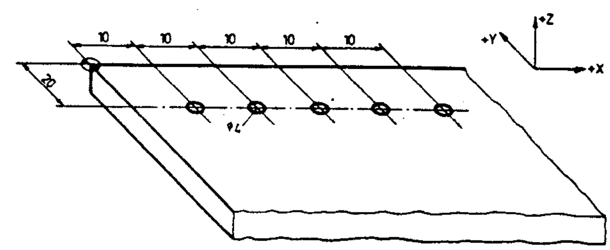
Operating program		Remarks
Block no.	**Block contents**	
013 014 015 016 017 018 019 020 021 022 023 24 025	LBL 2 AZ − 25,000 R0 AZ + 2,000 R0 IX + 50,000 R0 AZ − 25,000 R0 AZ + 2,000 R0 IY − 50,000 R0 AZ − 25,000 R0 AZ + 2,000 R0 IX − 50,000 R0 AZ − 25,000 R0 AZ + 2,000 R0 LBL 0	Positioning commands and definition of subroutine 2 
026 027 028	AX + 162,000 R0 AY − 219,000 R0 CALL LBL 2' 0/0	Positioning commands and call-up of subroutine 2 
029 030	AX + 273,000 R0 AY − 107,000 R0	
031 032	CALL LBL 2' 0/0 CALL LBL 1' 0/0	Positioning commands and call-up of subroutine 2. Return to tool change position 

Programming example 4

Workpiece with holes.
Repetition of a positioning
command using program-part repeats
Tool: drill diameter 4mm

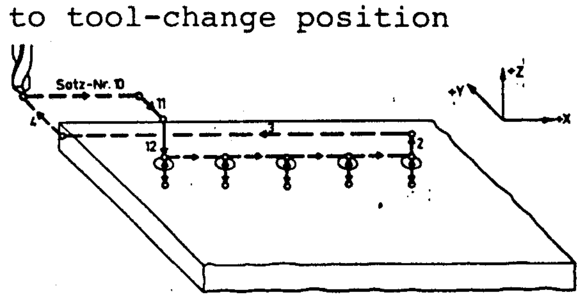
Material: Steel St 37
Thickness of workpiece: 20mm

Dimensions in (mm)



Datum point: X = 0, Y = 0, Z = 0

Operating program

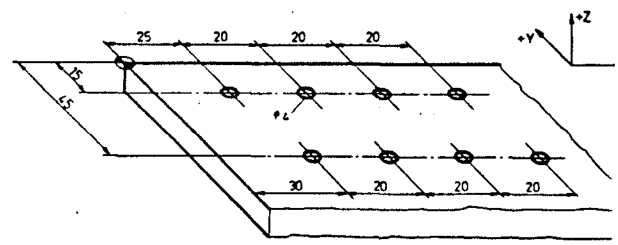
Block no.	Block contents	Remarks
001 002 003 004 005	LBL 1 AZ + 100,000 R0 AX – 20,000 R0 AY + 20,000 R0 LBL 0	Definition of tool change position as a subroutine
006 007	LDEF 1 ... RDEF 1 + 2,000	
008	STOP	
009	TOOL CALL 1Z	Tool call
010 011 012 013 014 015 016 017 018 019 020	AX + 10,000 R0 AY – 20,000 R0 AZ + 2,000 R0 LBL 2 AZ – 25,000 R0 AZ + 2,000 R0 IX + 10,000 R0 CALL LBL 2' 3/3 AZ – 25,000 R0 AZ + 2,000 R0 CALL LBL 1' 0/0	Positioning commands and call-ups of program-part repeats. Return to tool-change position 

Programming example 5

Workpiece with holes
Repetition of positioning commands using program-part repeats within a subroutine.
Tool: drill diameter 4mm

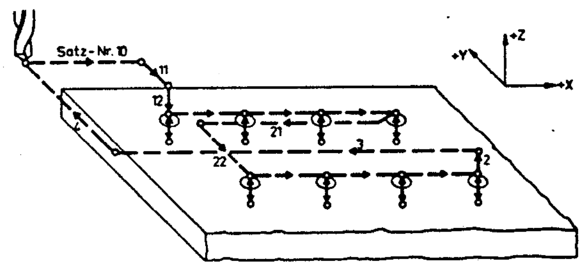
Material: Steel St 37
Thickness of workpiece: 20mm

Dimensions in (mm)



Datum point: X = 0, Y = 0, Z = 0

Operating program		
Block no.	Block contents	Remarks
001 002 003 004 005	LBL 1 AZ + 100,000 R0 AX – 20,000 R0 AY + 20,000 R0 LBL 0	Definition of tool-change position as subroutine 1
006 007	LDEF 1 ... RDEF 1 + 2,000	Tool definition
008	STOP	
009	TOOL CALL 1Z	Tool call

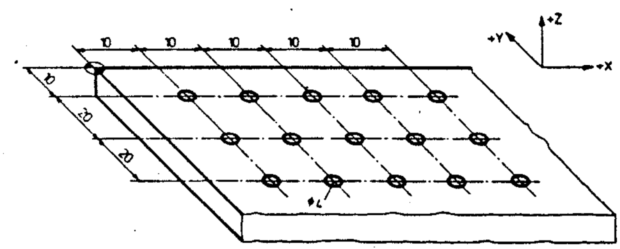
Operating program		
Block no.	Block contents	Remarks
010	AX + 25,000 R0	Positioning commands and repetition of a series of holes using a program-part repeat within subroutine 2. Return to tool-change position
011	AY – 15,000 R0	
012	AZ + 2,000 R0	
013	LBL 2	
014	AZ – 25,000 R0	
015	AZ + 2,000 R0	
016	IX + 20,000 R0	
017	CALL LBL 2' 2/2	
018	AZ – 25,000 R0	
019	AZ + 2,000 R0	
020	LBL 0	
021	AX + 30,000 R0	
022	AY – 45,000 R0	
023	CALL LBL 2' 0/0	
024	CALL LBL 1' 0/0	

Programming example 6

Workpiece with hole matrix
Positioning of matrix holes using program-part repeats within a subroutine.
Tool: drill diameter 4mm

Material: Steel St 37
Thickness of workpiece: 20mm

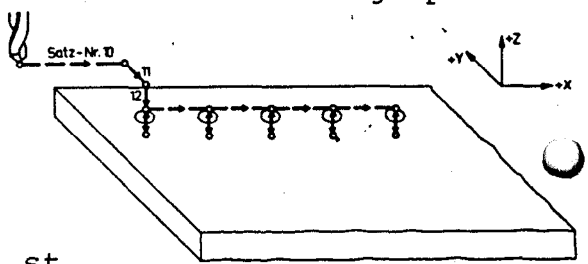
Dimensions in (mm)



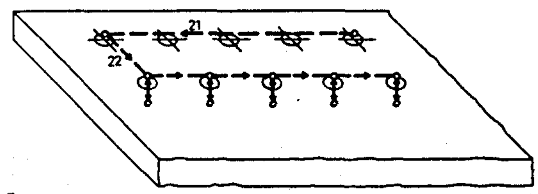
Datum point: X = 0, Y = 0, Z = 0

Operating program		Remarks
Block no.	Block contents.	
001 002 003 004 005	LBL 1 AZ + 100,000 R0 AX – 20,000 R0 AY + 20,000 R0 LBL 0	Definition of tool-change position as subroutine 1
006 007	LDEF 1 ... RDEF 1 + 2,000	Tool definition
008	STOP	
009	TOOL CALL 1Z	Tool call

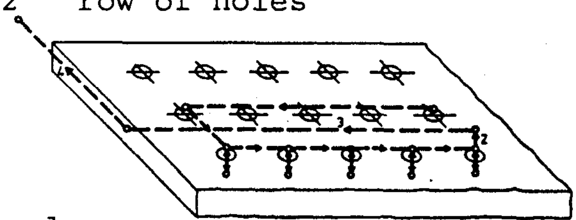
Operating program		Remarks
Block no.	Block contents	
010	AX + 10,000 R0	Positioning commands and locatio of the individual matrix holes using program-part repeats withi a subroutine.
011	AY – 10,000 R0	
012	AZ + 2,000 R0	
013	LBL 2	
014	AZ – 25,000 R0	Return to tool-change position.
015	AZ + 2,000 R0	
016	IX + 10,000 R0	
017	CALL LBL 2' 3/3	
018	AZ – 25,000 R0	
019	AZ + 2,000 R0	
020	LBL 0	
021	AX + 10,000 R0	
022	IY – 20,000 R0	
023	CALL LBL 2' 0/0	
024	AX + 10,000 R0	
025	IY – 20,000 R0	
026	CALL LBL 2' 0/0	
027	CALL LBL 1' 0/0	



1st row of holes



2nd row of holes



3rd row of holes

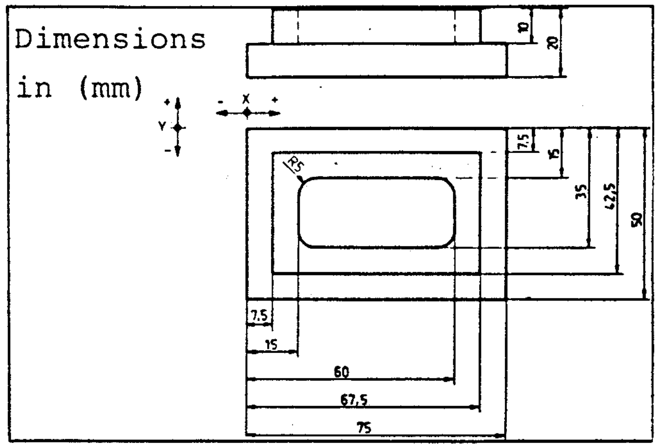
Programming example 7

Milling operation

Tool 1: Milling cutter diameter 20mm

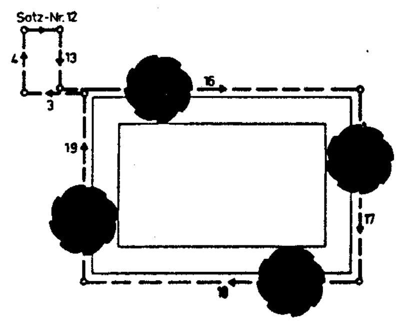
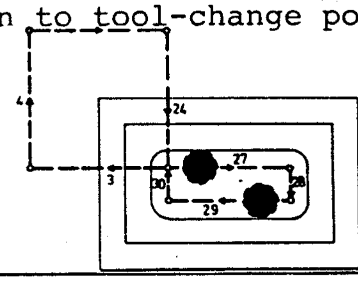
Tool 2: Milling cutter diameter 10mm

Material: Steel St 37



Operating program

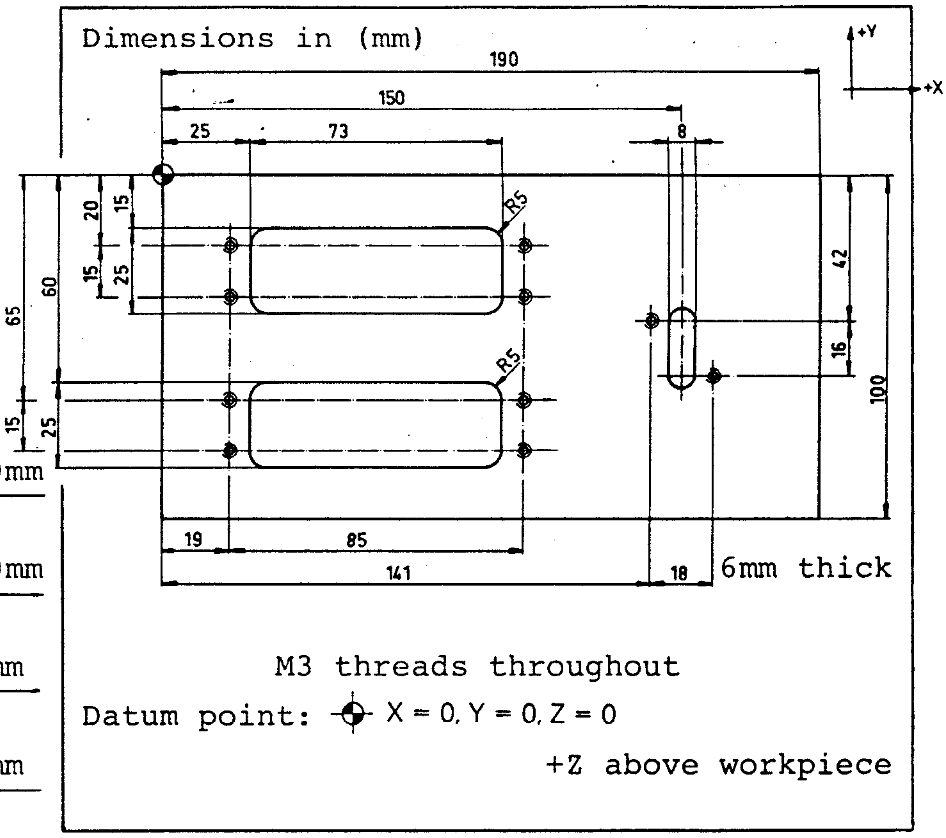
Block no.	Block contents	Remarks
001 002 003 004 005	LBL 1 AZ + 100,000 R0 AX – 20,000 R0 AY + 20,000 R0 LBL 0	Definition of tool-change position as a subroutine
006 007 008 009	LDEF ... RDEF 1 + 10,000 LEEF 2 ... RDEF + 5,000	Tool definition
010	STOP	
011	TOOL CALL 1Z	Tool call

Operating program		Remarks
Block no.	**Block contents**	
012 013 014 015 016 017 018 019 020	AX – 5,000 R– AY – 7,500 R– AZ + 2,000 R0 AZ – 10,000 R0 AX + 67,500 R+ AY – 42,500 R+ AX + 7,500 R+ AY – 7,500 R+ CALL LBL 1' 0/0	Positioning commands for milling of outer frame. Return to tool-change position 
021	STOP	Stop for tool-change
022 023 024 025 026 027 028 029 030 031	TOOL CALL 2Z AX + 15,000 R+ AY – 15,000 R+ AZ + 2,000 R0 AZ – 10,000 R0 AX + 60,000 R– AY – 35,000 -R– AY + 15,000 R– AY – 15,000 R– CALL LBL 1 0/0	Tool call 2 Positioning commands for milling of pocket. Return to tool-change position. 

Programming example 8

Milled workpiece with large open slots, elongated hole and threaded hole.

Tool no.	Tool
1	Three-lip milling cutter diameter 10mm
2	Rough/Finishing cutter diameter 10mm
3	Three-lip milling cutter diameter 8mm
4	Rough/Finishing cutter diameter 8mm
5	NC-centering tool diameter 10mm
6	Drill diameter 2.4mm



Material: Cast aluminium

Thickness of workpiece: 6mm

Operating program

Block no.	Block contents			Remarks
001	LBL 1			Definition of tool-change position as subroutine 1
002	AZ	+ 100,000	R0	
003	AX	– 20,000	R0	
004	AY	– 20,000	R0	
005	LBL 0			

Operating program		Remarks
Block no.	Block contents	
006 007 008 009 010 011 012 013 014 015 016 017	LDEF 1 RDEF 1 + 5,000 LDEF 2 RDEF 2 + 5,000 LDEF 3 RDEF 3 + 4,000 LDEF 4 RDEF 4 + 4,000 LDEF 5 RDEF 5 + LDEF 6 RDEF 6 + 1,200	Tool definition
018	STOP	
019	TOOL CALL 1Z	Tool call 1
020 021 022 023 024 025 026 027	AX + 25,000 R+ AY – 15,000 R+ AZ + 2,000 R0 AZ – 6,500 R0 AZ + 2,000 R0 AY – 60,000 R+ AZ – 6,500 R0 CALL LBL 1' 0/0	Positioning commands for double plunge cut of three-lip milling cutter (open slot). Return to tool-change position.
028	STOP	
029	TOOL CALL 2 Z	Tool call 2 Spindle speed for tool 2

Operating program		Remarks
Block no.	**Block contents**	
030 031 032 033 034 035 036 037 038 039 040 041 042 043	AX + 25,000 R+ AY – 15,000 R+ AZ + 2,000 R+ LBL 2 AZ – 6,500 R0 IX + 73,000 R– IY – 25,000 R– IX – 73,000 R– IY + 25,000 R– AZ + 2,000 R0 LBL 0 AY – 60,000 R+ CALL LBL 2' 0/0 CALL LBL 1' 0/0	Positioning commands for milling of both open slots are programmed as subroutine 2. Return to tool-change position.
044	STOP	
045	TOOL CALL 3Z	Tool call 3 Spindle speed for tool 3
046 047 048 049 050 051 052	LBL 3 AX + 150,000 R0 AY – 42,000 R0 AZ + 2,000 R0 AZ – 6,500 R0 LBL 0 CALL LBL 1' 0/0	Positioning commands for plunge cut of three-lip milling cutter (elongated hole) are programmed as subroutine 3. Return to tool-change position.
053	STOP	
054	TOOL CALL 4Z	Tool call 4 Spindle speed for tool 4
055 056 057	CALL LBL 3' 0/0 IY – 16,000 R0 CALL LBL 1' 0/0	Positioning commands for milling of elongated hole. Return to tool-change position.

Operating program		
Block no.	**Block contents**	**Remarks**
058	STOP	
059	TOOL CALL 5Z	Tool call 5 Spindle speed for tool 5
060 061 062 063 064	LBL 4 AX + 19,000 R0 AY – 20,000 R0 AZ + 2,000 R0 LBL 0	Positioning commands for traversing to the first threaded hole are programmed as subroutine 4.
065 066 067 068 069 070 071 072	LBL 5 AZ – 2,250 R0 AZ + 2,000 R0 IY – 15,000 R0 AZ – 2,250 R0 AZ + 2,000 R0 LBL 0 CALL LBL 1' 0/0	Positioning commands for centering the threaded holes are programmed as subroutine 5. Return to tool-change position.
073	STOP	
074	TOOL CALL 6Z	Tool call 6 Spindle speed for tool 6
075	CALL LBL 5' 0/0	Positioning for the first threaded hole.
076 077 078 079 080 081 082 083	LBL 6 AZ – 7,000 R0 AZ + 2,000 R0 IY – 15,000 R0 AZ – 7,000 R0 AZ + 2,000 R0 LBL 0 CALL LBL 1' 0/0	Positioning commands for tap drilling the threaded holes are programmed as subroutine 6. Return to tool change position.

VRZ 965 Programming Sheet

Block no.	Block contents						Remarks
	Absolute/ Incremental	Axis X, Y,Z	L - DEF R - DEF Tool Call LBL Set Call LBL	Nominal position value Tool length Tool radius	Tool radius compensation	Spindle axis	
1			LBL 1				
2	A	Z		+ 100,000	R0		
3	A	X		- 20,000	R0		
4	A	Y		+ 20,000	R0		
5			LBL 0				
6			LDEF 1	0,000			
7			RDEF 1	2,000			
8			STOP				
9			TOOL CALL 1			Z	
10	A	X		+ 100,000	R0		
11	A	Y		- 20,000	R0		
12	A	Z		+ 2,000	R0		
13	A	Z		- 25,000	R0		
14	A	Z		+ 2,000	R0		
15	I	X		+ 140,000	R0		
16	A	Z		- 25,000	R0		
17	A	Z		+ 2,000	R0		
18	I	Y		- 140,000	R0		
19	A	Z		- 25,000	R0		
20	A	Z		+ 2,000	R0		
21	I	Z		- 140,000	R0		
22	A	Z		- 25,000	R0		
23	A	Z		+ 2,000	R0		
24			CALL LBL1 0/0				
25							
26							
27							
28							

VRZ 965 Programming Sheet

Block no.	Block contents						Remarks
	Absolute/ Incremental	Axis X, Y, Z	L - DEF R - DEF Tool Call LBL Set Call LBL	Nominal position value Tool length Tool radius	Tool radius compensation	Spindle axis	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

Automatic Error Diagnostics

The POSITIP is equipped with its own error diagnostics for operating errors and hardware faults. Errors are indicated in the universal display by "ERROR ..." using a two-digit error code. While an error message is being displayed the POSITIP is inhibited, i.e. further operations may only be carried out after the error message has been cleared. Error messages with a code no. less than 70 may be cleared using the CE key. Error messages with a code no. of 70 or more represent more serious faults in the electronics of the POSITIP or on the transducers. These messages may be cleared by switching off the POSITIP (and repairing the fault). The code no.'s representing the various errors are given in the following table:

Error	Meaning	Remedy	To delete error message
00	Power interruption		CE - key
03	A check of the contents of the program memory has produced an error: the program memory has been deleted.	Re-enter the program. If the Baud-Rate is not 2400, then it must be re-entered. Reset the zero-point.	CE - key
04	Change batteries! Operation is possible with discharged batteries, but the program memory will be lost when the POSITIP is switched off.	1. If this error is indicated during operation with the POSITIP: batteries must be changed within 24 hours. 2. If this error is indicated when the POSITIP is switched on: change the batteries at once with mains left on.	CE - key

05	This key is inoperative in the present operating mode.		CE - key
06	GO TO with illegal input value has been programmed.	Enter the correct value: 0...400 integers only.	CE - key
07	TOOL CALL has been programmed with an illegal tool no.	Enter the correct value: 1...15 integers only.	CE - key
08	L DEF R DEF have been entered with an illegal tool no.	Enter the correct value: 1...15 integers only.	CE - key
09	Capacity of program memory has been exceeded.		CE - key
10	DEL □ key: blocks may only be deleted after they have been displayed (no./ contents)	Select block with the GO TO key	CE - key
11	L DEF block for the specified tool is missing	Define tool length or enter TOOL CALL with the correct tool no.	CE - key
12	R DEF block for the specified tool is missing	Define tool radius or enter TOOL CALL with the correct tool no.	CE - key
13	Programmed path to be traversed = 0: radius compensation undefined.	Enter path to be traversed	CE - key

14	Programmed traversing direction has been reversed by the radius compensation.	Alter the program: the path to be traversed must be greater than the radius compensation	CE - key
15	Attempt to execute an illegal program block	Delete block and re-enter	CE - key
16	Illegal Baud Rate entered	Enter the correct value: 110, 150, 300, 600, 1200, 2400	CE - key
17	External program entry: faulty data transfer (Error resulted from checks of EVEN-parity, non-matching Baud-Rates, too high a speed of symbol transfer)	Devices with a Baud Rate >110 must be equipped with an automatic punched-tape-reader start/stop control.	CE - key
18	External program entry: Symbol transfer too fast	Devices with a Baud Rate >110 must be equipped with an automatic punched-tape-reader start/stop control.	CE - key
19	External unit not ready	Check external unit and connection	CE - key

26	Unknown error message from ME.	Repeat data transfer from the beginning. If error is still present after repeated attempts, use data carrier (punched tape, magnetic tape) with correct program contents.	CE - key
27	External data transfer interrupted with the DEL key		
28	External program entry: erroneous program-data received		
9	Attempt to change batteries with at least one axis "frozen" in the "REF" mode.	Traverse the "frozen" axis over the reference mark or switch off REF-mode.	CE - key
31	External start with empty program memory	Enter program into memory	CE - key
33	Display or entry of Baud Rate in operating mode INCH .	Switch off INCH mode.	CE - key
39	Key inoperative after L DEF R DEF TOOL CALL	Press the correct key	CE - key
40	Illegal LBL SET value Illegal LBL CALL value	Enter correct value: 0...99 1...99	CE - key
41	Incorrect position of comma in entry data LBL CALL	Either two figures or none at all permitted	CE - key

42	LBL CALL entry value 0.	Enter correct value: 1...99	CE - key
43	LBL SET entry value not an integer.	Enter an integer value	CE - key
44	Execution of a LBL CALL block: label no. does not appear in the program	Correct label no. or insert label	CE - key
45	Subroutine execution: LBL 0 is missing or subroutines nested too deep.	Insert LBL 0 or change structure of program.	CE - key
47	LBL SET : label no. entered has already been allocated	Select new label no.	CE - key
60	Erroneous data received by ME.	Repeat data transfer	CE - key
61	No cassette in ME.	Insert cassette	CE - key
62	ME-cassette is write-protected (protected against erasure)	Insert write-enable pin	CE - key
63	ME in incorrect operating mode	Select correct operating mode	CE - key
64	Error in test-value detected during play-back of ME-tape	Re-enter program. If error is still present, then either the tape or the winding mechanism is defective.	CE - key

65	ME-cassette is empty.	Insert cassette with program contents	CE - key
66	ME data transfer process interrupted by STOP key (on ME)	Repeat data transfer	CE - key
67	ME: end of tape reached.	Repeat entire process with ME (normally the end of the tape will not be reached with the POSITIP)	CE - key
	Serious faults:		
70	Operating software: memory 1 defective	Switch off power and then switch back on. If error message reappears, send POSITIP for repair.	Switch off power
71	Operating software: memory 2 defective		
72	Operating software: memory 3 defective		
73	Program memory for workpiece programs is defective		
74	Baud Rate memory defective		
77	Microprocessor faulty	Switch off power and then switch back on. If error message reappears, send POSITIP for repair.	Switch off power

79	Transducer X defective	Check transducer and its connections.	Switch off power
80	Transducer Y defective		
81	Transducer Z defective		
82	Error in operating software	See error no. 75	See error no. 75
83	Error in operating software		

☞ When the POSITIP is switched on, the system RAM memory is tested. In the event of a defect, the normal start-up condition occurs: all display lamps will flash. The POSITIP must be sent to HEIDENHAIN for repairs.

Functions of keys in the various operating modes

Key	Actual value display	Positioning with display of remainder of traverse	Program entry and editing	Single-block and automatic program run	See section
X Y Z	Setting datum point	Positioning without storage in memory	Programming a positioning block		E1, F3, F4.1
EXT	Setting the Baud Rate		Reading in a program from a peripheral device	Transferring a program to a peripheral device	L4, L5
CL PGM			Delete program		G5
DEL			Delete program block		B2, G3
+			Transfer of actual position value as an input value		F4.4
ENT	Entering datum point Entering Baud Rate		Entering a program block		B2, B3

Key	Actual value display	Positioning with display of remainder of traverse	Program entry and editing	Single-block and automatic program run	See sectio[n]
GO TO			Block call-up	Block call-up	G1
↓ ↑			Index blocks forwards or backwards	Index blocks forwards or backwards	G2
N □			Block no./ contents switch-over	Block no./ contents switch-over	F1
STOP			Programmed Stop		F6
LBL SET			Set program mark		F5.1
LBL CALL			Call program mark		F5.2
		Interruption of positioning process		Interruption of program run	K
		Starting a positioning process		Starting a program run	H

Key	Actual value display	Positioning with display of remainder of traverse	Program entry and editing	Single-block and automatic program run	See section
L DEF			Tool-length definition		F2
R DEF			Tool-radius definition		F2
[illegible]			Tool call		F3
R+ R−		Setting direction of radius compensation	Setting direction of radius compensation		F4.2
I		Absolute/ incremental input	Absolute/ incremental input		F4.1