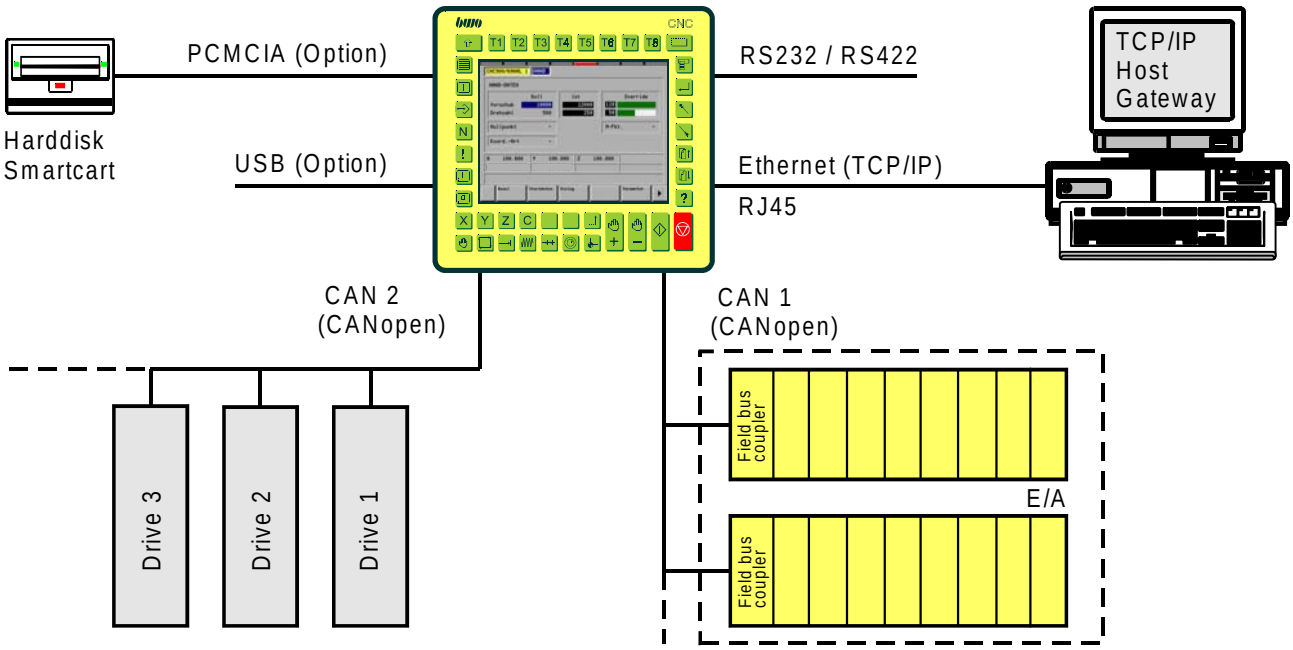
# Hardware

# 1 Compact controls CNC 902 / CNC 903 / CNC 904 / CNC 905

## 1.1 Introduction

The compact controls CNC 902 / CNC 903 / CNC 904 / CNC 905 are conceived for the application with CAN Bus. Communicate to they over the CAN Bus with the drives and the I/O bus.
The CNC Control actual in the operating panel integrates. The operating panels have fully graphicable color LC displays and foil keyses with mechanical pressure point.




Interfaces

| | |
|---|---|
| CAN Bus | 1000kbit for CANopen Drives |
| CAN Bus | 500kbit for I/O box bus system according to CANopen Specification |
| Ethernet | (TCP/CIp) RJ45 |
| Serially | RS232, RS422 |
| PCMCIA | e.g. for external hard disk (CNC 905 option) |
| USB | (CNC 905 option) |

## 1.2 Characteristics and functions

### Functions of the control

- Operating system BWO real-time kernel
- Logs TCP/IP stack, CANopen stack
- Soft PLC
- Construction of a simple CNC controller in connection with soft PLC and soft NC
- BWO file server
- Programming of the control surface also PROMA
- Block-by-block reloading with larger programs
- Graphic cycle programming
- Free DLL for the implementation of own programs

### CPU data

| | |
|---|---|
| Static RAM | 512kB |
| Run-time memory DRAM | 16MB |
| Flash-disk-memory<br>for operating system and control surface | 8MB |
| Flag memory | 60kB |
| NC memory | 193kB |
| Remanent flags | 4096 |
| Parameter | 20000 |

### Programmable box bus coupler

| | | |
|---|---|---|
| I/O knot for input/outputs | | 5 |
| with in each case | digital inputs | 64 |
| | digital outputs | 64 |
| | analog inputs | 2 x16bit |
| | analog outputs | 2 x16bit |

## 1.2 Characteristics and functions

| Versions | CNC 902 | CNC 903 | CNC 904 | CNC 905 |
|---|---|---|---|---|
| NC channel | 1 | 1 | 1 | 1 |
| Axes / Spindles | 4 | 4 | 8 | 8 |
| Spindle in C axes operation | 1 | 1 | 1 | 1 |
| Linear interpolation (Axes) | 3 | 3 | 3 | 3 |
| Cirkular interpolation (Axes) | 2 | 2 | 3 | 3 |
| Screw interpolation (Axes) | 2+1 | 2+1 | 2+1 | 2+1 |
| Spline interpolation | - | - | • | • |
| Polynominal interpolation | - | - | • | • |
| Polar transformation | - | - | • | • |
| Scara transformation | - | - | • | • |

Symboles: • Functions are possible
- Functions are not possible

### CNC Characteristics and functions

- Tangential axis
- Axes couple, reflect and exchange
- Restarting after abort
- Feed, corners, circle and outline dynamics
- Electronic gears and Handwheel
- Polar coordinates system
- Axes simulation
- Coordinates turn, reflect and shift
- Measuring and processing cycles
- Interpolation plane selection
- Tool radius path correction
- Automatic selection of linear and circular interpol.
- Zero points / zero shift
- Outline path short programming
- Parameter calculation
- Diagnostic functions
- Graphic cycle programming
- Graphic simulation

## 1.2 Characteristics and functions

### Operating panel data

LCD display in TFT version.

| | | |
|---|---|---|
| Resolution | 640 x 480, 256 off 4096 colours | |
| display size with | CNC 902 / CNC 904 | 6.4” |
| | CNC 903 / CNC 905 | 10.4” |
| Touch screen with resolution of | 1024 x1024 | |

42 function keys, of it 15 freely shapable,
PLC keys with display on LCD display,
Operating voltage 24V
Battery buffer for the clock

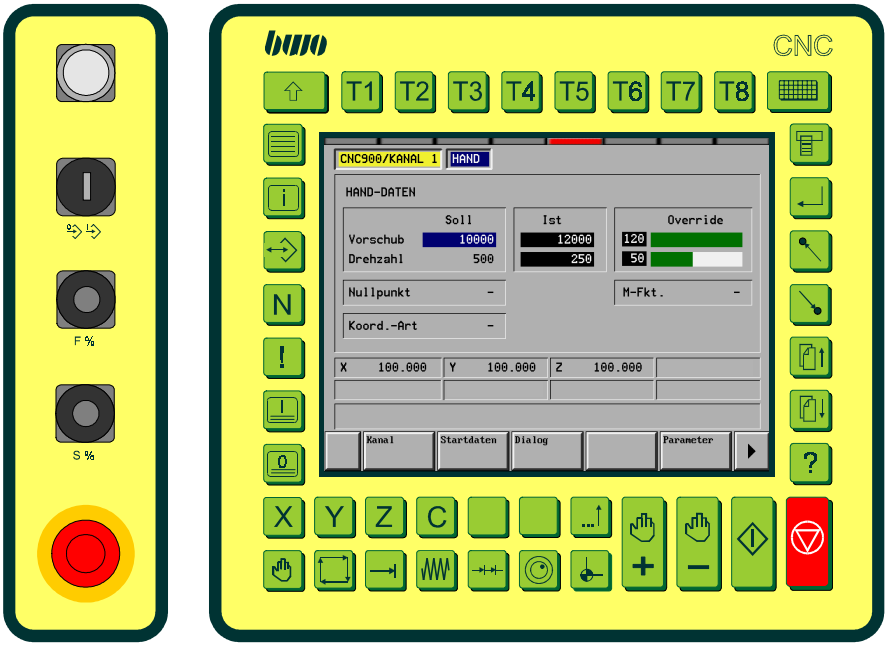
### Connections

(CNC 903 / CNC 905 on separate machine operating panel)
4 Override Potentiometer
1 Handwheel (TTL level cable length 1m, +5V)
1 Key-operated switsch
1 Joystick (in place of 3 override Potentis)

## 1.2 Characteristics and functions


Compact controls CNC 902 / CNC 904

Dimensions (B x H in mm) 277 x 227




Compact controls CNC 903 / CNC 905 with additional machine operating panel

Dimensions (B x H in mm) 328 x 310
Machine operating panel (option) 80 x 310

## 1.3 Software

### Programming software XPLC

XPLC actual a programming software for the compact controls CNC 902 / CNC 903 / CNC 904 / CNC 905. The software actual on PC executably.

With XPLC all functions of the control with stored program (PLC) with the compact controls can be taken in operation.

Details in addition in this manual  paragraph 4. and 5.

### Standard interface for CNC

The standard adaption contains a list of the free, pre-allocated and reserved flag areas.

Details in addition in this manual paragraph 6.

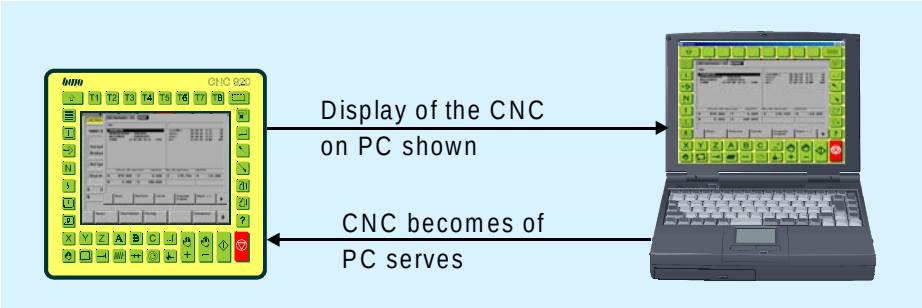
### Programming software NC

With the programming  software can NC programs with the available functions in the compact controls be created.  Details in addition in the NC manual.

## 1.3 Software

### Operating system management program WINBV

Software on a PC to controlling of the CNC.



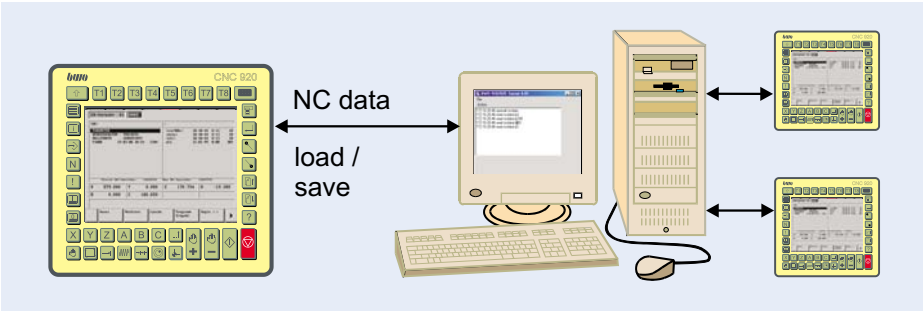

The display of the CNC is illustrated on a PC. The control can be served then from the PC.

Thus can be implemented:
- Diagnosis locally
- On-line remote diagnostics
- Operating system care
- Data adminstration
- Data protection
- NC archiving

Details in addition in this manual paragraph 7.

### Data transfer on one SERVER

Software on a PC for data transfer with the CNC.




By the CNC can be accessed the drive assemblies of a server. Several controls can be connected at a server and load NC data from the server or save on the server.

## 2.1 Compact control CNC 902 / CNC 904

### 2.1.1 Mass and weight

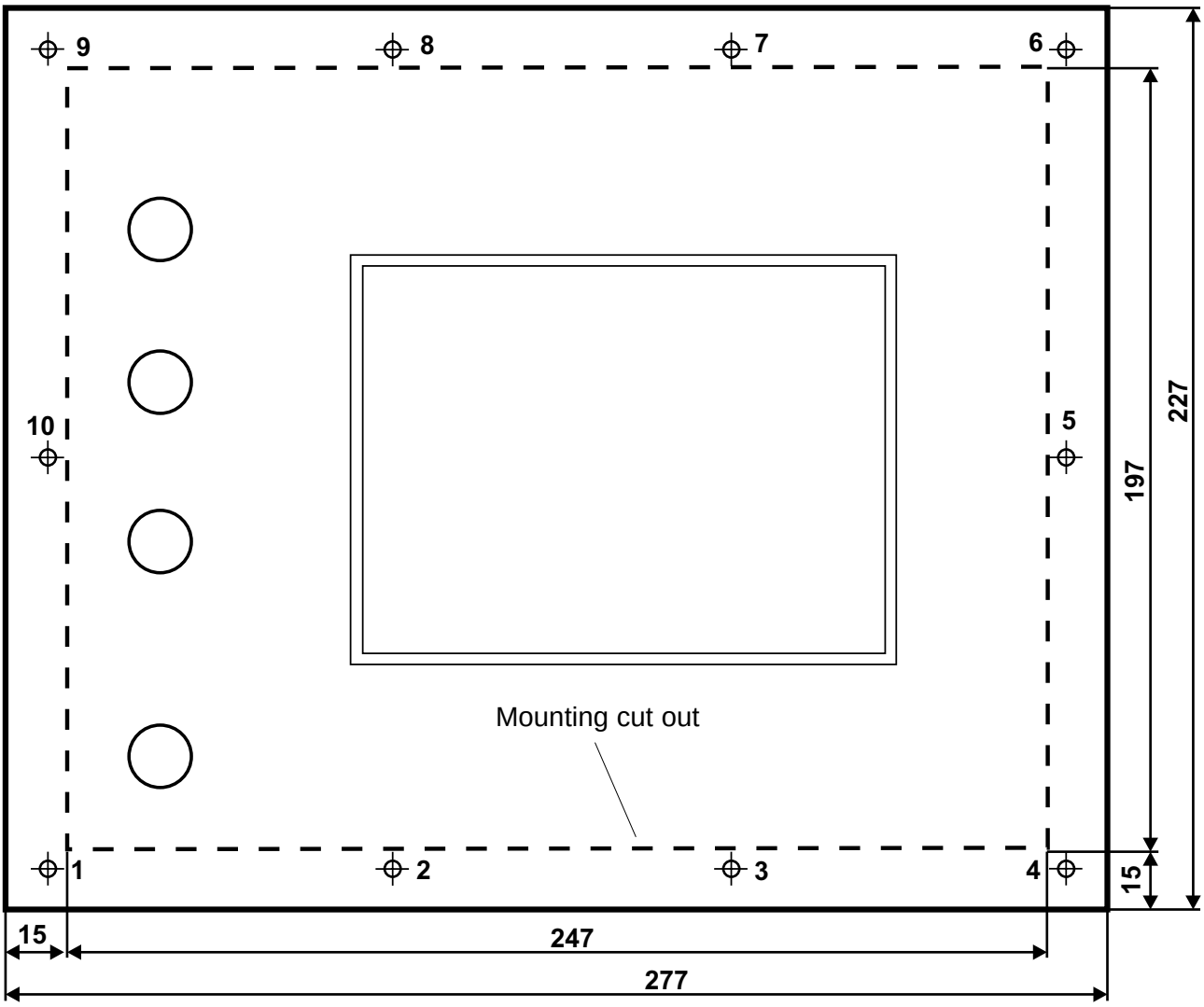
| | | |
|---|---|---|
| Dimensions (width x height) | | 277mm x 227mm |
| max. depth of the rear edge of the front plate to the rear | | 55mm |
| max. depth of the front edge of the front plate forward | | 25mm |
| Strength of the front plate | approx. | 4mm |
| Weight | approx. | 1,6kg |

## 2.1.2 Mounting cut out and fixing

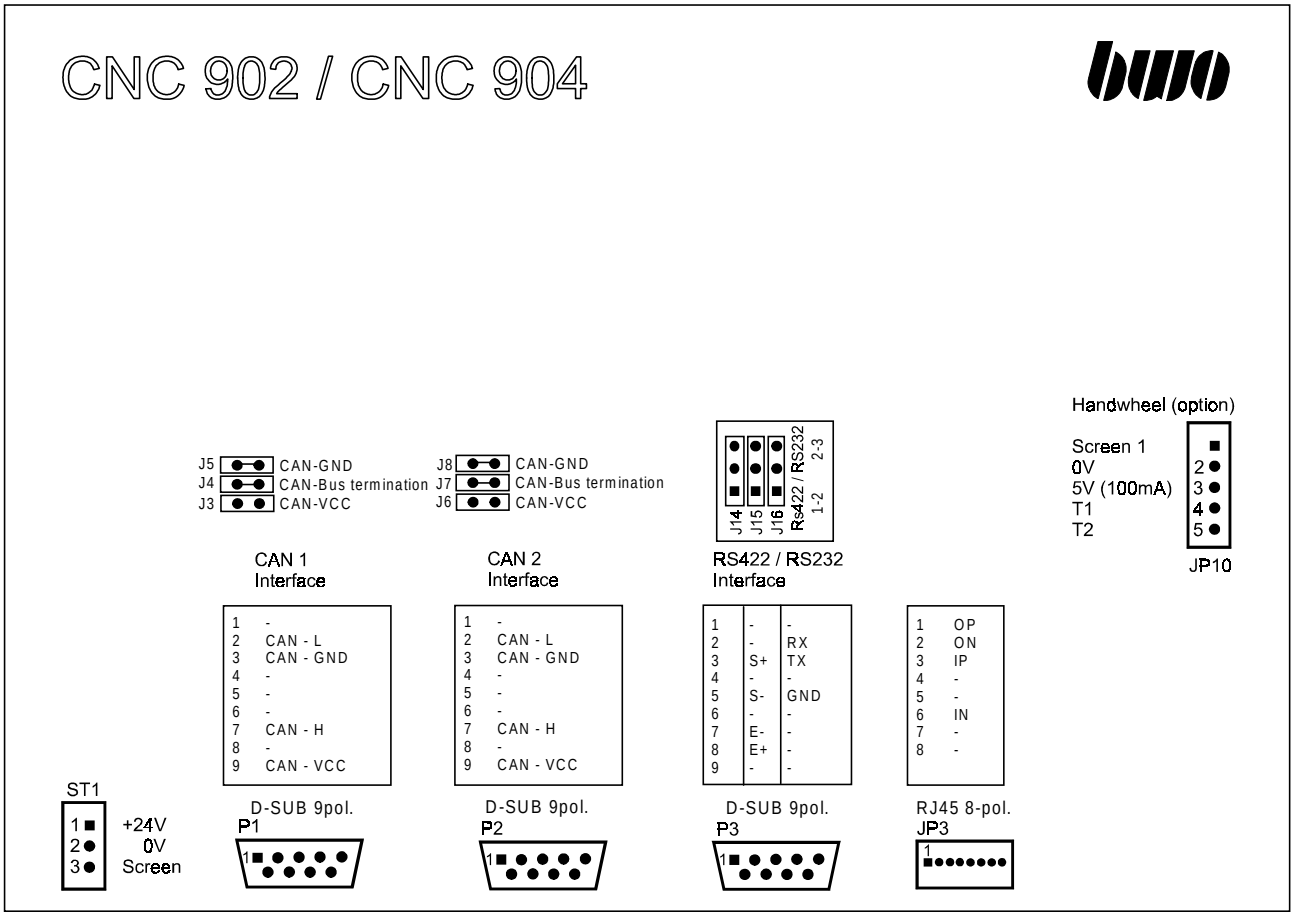
**Mounting cut out** 247mm x 197mm (width x height)

**Fixing** with 10 threaded bolts M4 x 8, grounding rear side M4

| No. | X | Y | Nr. | X | Y |
|---|---|---|---|---|---|
| 1 | 10,0 | 10,0 | 6 | 267,0 | 217,0 |
| 2 | 95,7 | 10,0 | 7 | 181,3 | 217,0 |
| 3 | 181,3 | 10,0 | 8 | 95,7 | 217,0 |
| 4 | 267,0 | 10,0 | 9 | 10,0 | 217,0 |
| 5 | 267,0 | 113,5 | 10 | 10,0 | 113,5 |



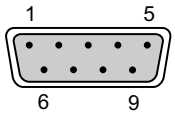
### 2.1.3 Plug contacts

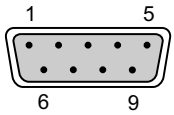


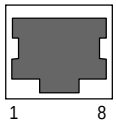

| | | |
|---|---|---|
| St1 | 3-polige plug | Power supply |
| P1, P2 | 9 pin D-SUB pin-type plug | CAN1, CAN 2 - interface |
| P3 | 9 pin D-SUB pin-type plug | RS422 or RS232 interface |
| J14, J15, J16 | Selection of the interface P3 | 1 with 2 bridged = RS422 (preset)<br>2 with 3 bridged = RS232 |
| Jp3 | 8 pin socket | Connection with host over RJ45 |
| Jp10 | 5 pin plug | Connection handwheel (CNC 904 option) |

### 2.1.3 Plug contacts

| Power supply | | CAN Interface CAN 1 / CAN 2 | | RS422 / RS232 interface | | | TCP/IP Host | |
|---|---|---|---|---|---|---|---|---|
| 3 pin plug ST1 | | 9 pin D-SUB pin-type plug P1 / P2 | | 9 pin D-SUB pin-type plug P3 RS422 | | RS232 | 8 pin RJ45 JP3 EtherNet (socket) | |
| 1 | +24V | 1 | - | 1 | - | - | 1 | OP |
| 2 | 0V | 2 | CAN - L | 2 | - | RX | 2 | ON |
| 3 | Screen | 3 | CAN - GND | 3 | S+ | TX | 3 | IP |
| | | 4 | - | 4 | - | - | 4 | - |
| | | 5 | - | 5 | S- | GND | 5 | - |
| | | 6 | - | 6 | - | - | 6 | IN |
| | | 7 | CAN - H | 7 | E- | - | 7 | - |
| | | 8 | - | 8 | E+ | - | 8 | - |
| | | 9 | CAN - VCC | 9 | - | - | | |



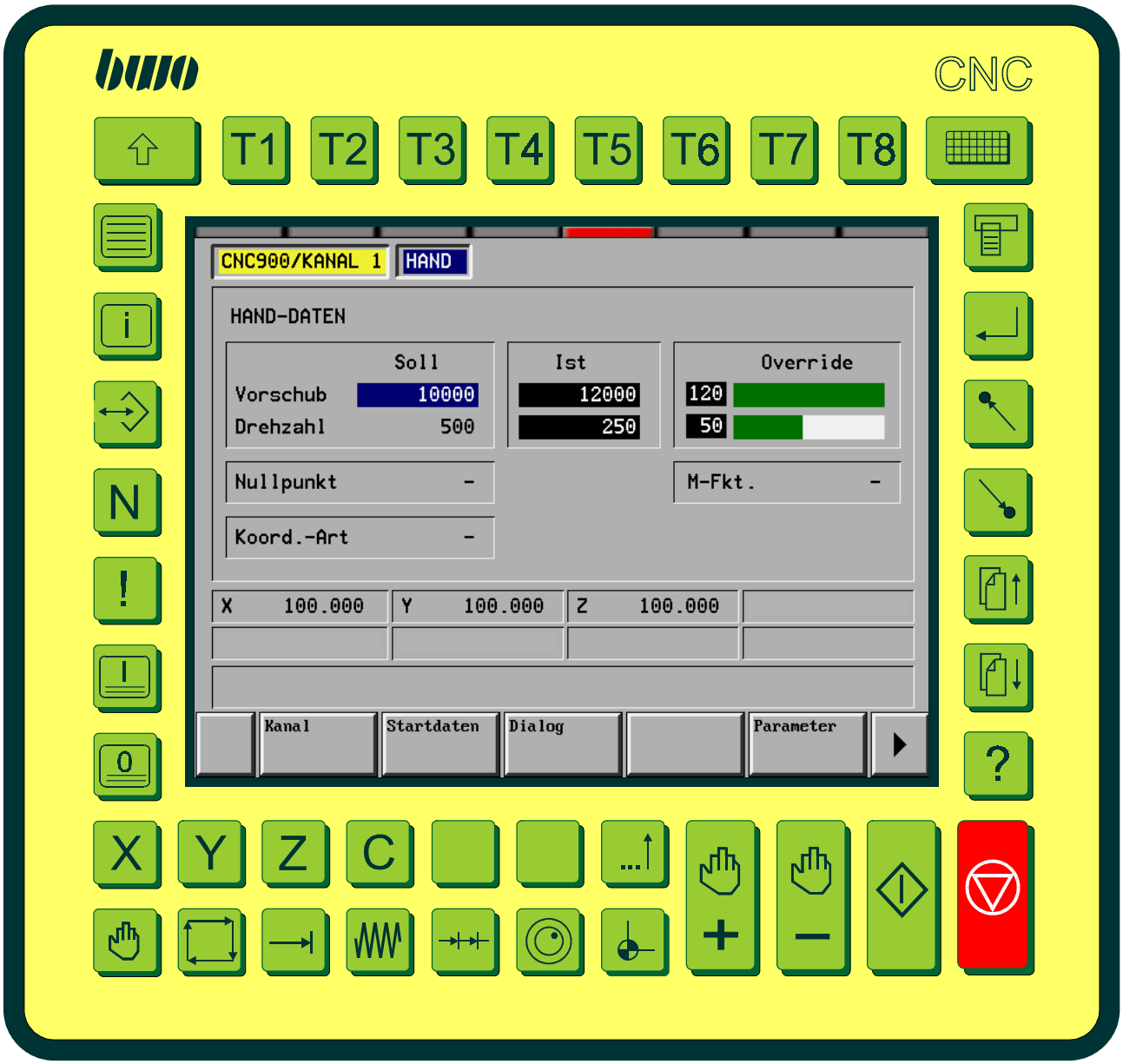



## 2.2 Compact control CNC 903 / CNC 905

### 2.2.1 Mass and weight

| | | |
|---|---|---|
| **Dimensions** (width x height) | | 328mm x 310mm |
| max. depth of the rear edge of the front plate to the rear | | 55mm |
| Strength of the front plate | approx. | 4mm |
| Weight | approx. | 2kg |

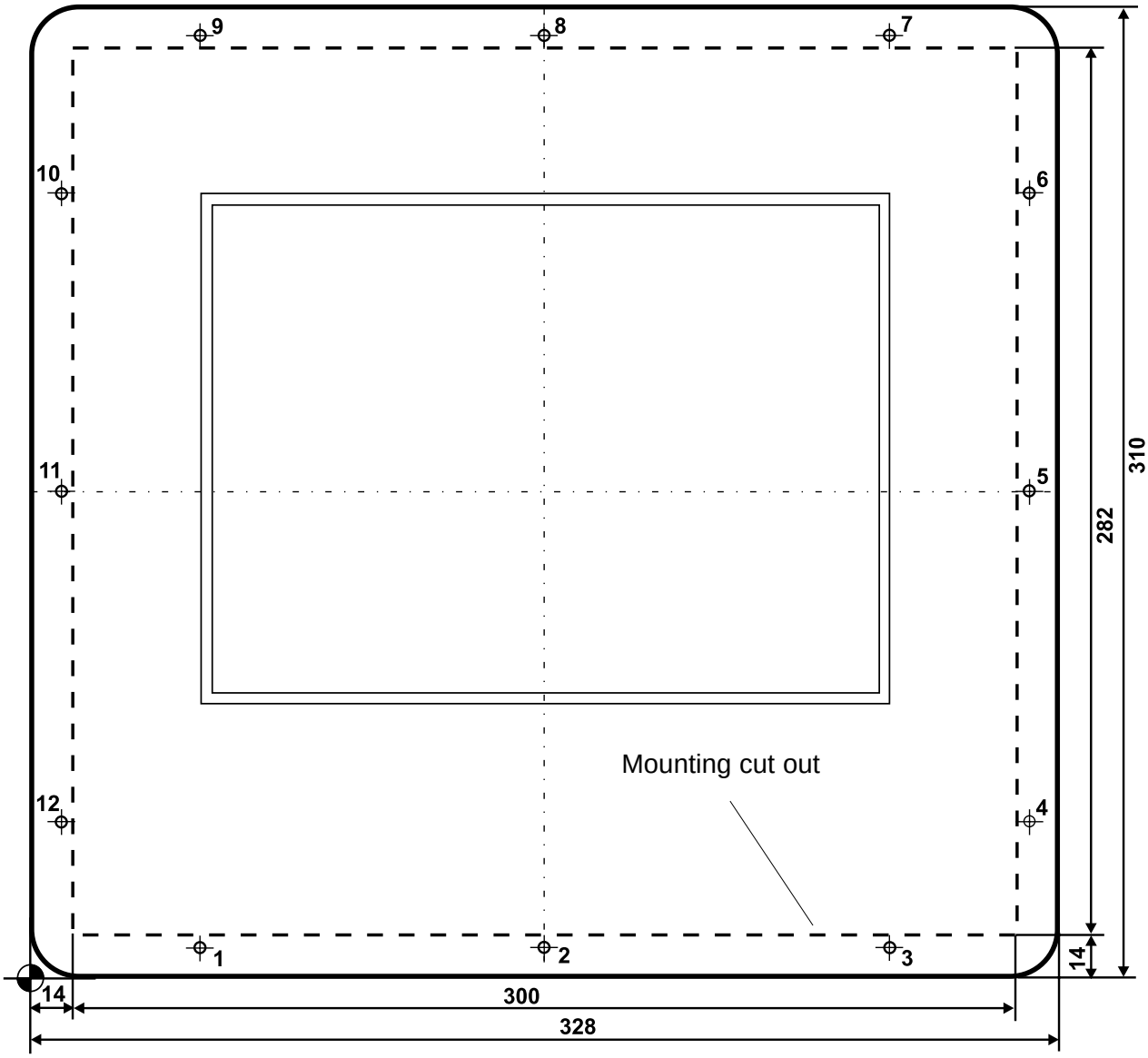


## 2.2.2 Mounting cut out and fixing

**Mounting cut out** 300mm x 282mm (width x height).

**Fixing** with 12 threaded bolts M4 x 8, grounding rear side M4

| No. | X | Y | Nr. | X | Y |
|---|---|---|---|---|---|
| 1 | 54,0 | 10,0 | 7 | 274,0 | 300,0 |
| 2 | 164,0 | 10,0 | 8 | 164,0 | 300,0 |
| 3 | 274,0 | 10,0 | 9 | 54,0 | 300,0 |
| 4 | 318,0 | 50,0 | 10 | 10,0 | 250,0 |
| 5 | 318,0 | 155,0 | 11 | 10,0 | 155,0 |
| 6 | 318,0 | 250,0 | 12 | 10,0 | 50,0 |

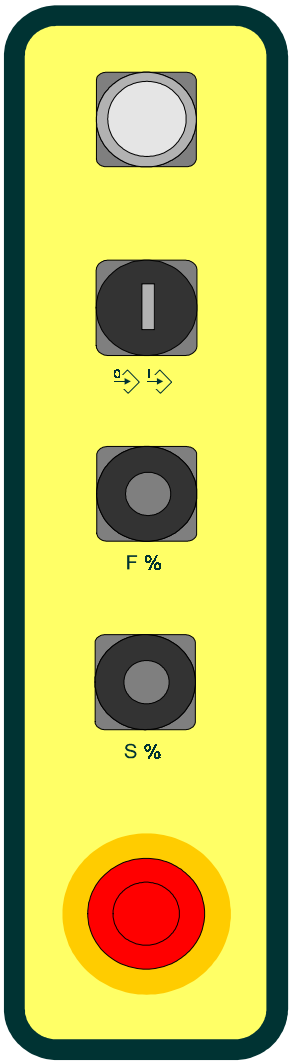


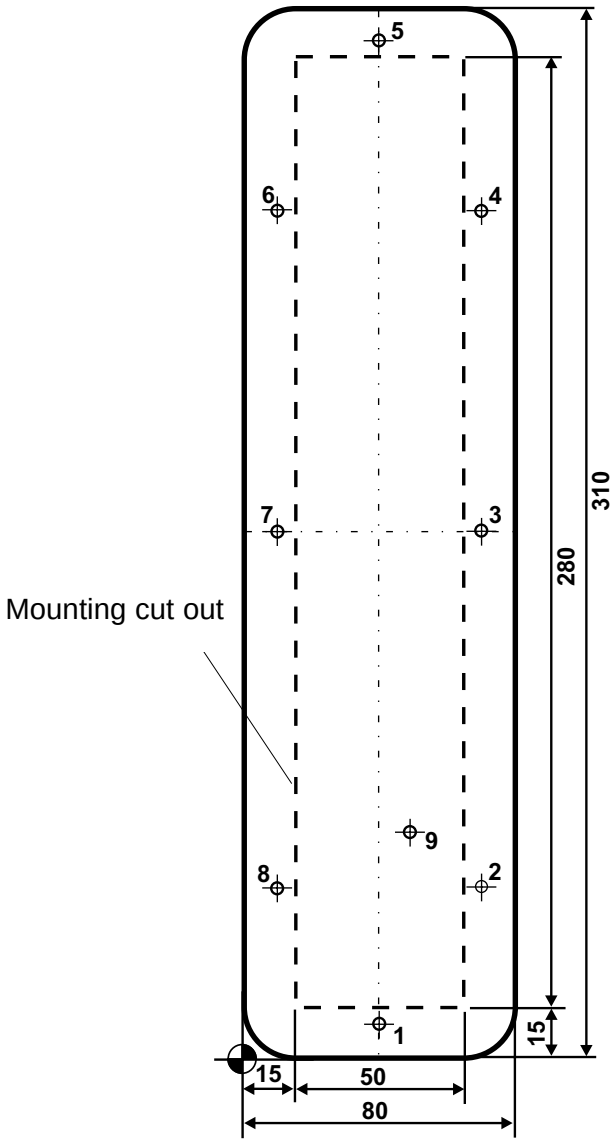
### 2.2.2 Mounting cut out and fixing machine operating panel

**Mounting cut out** 50mm x 280mm (width x height).

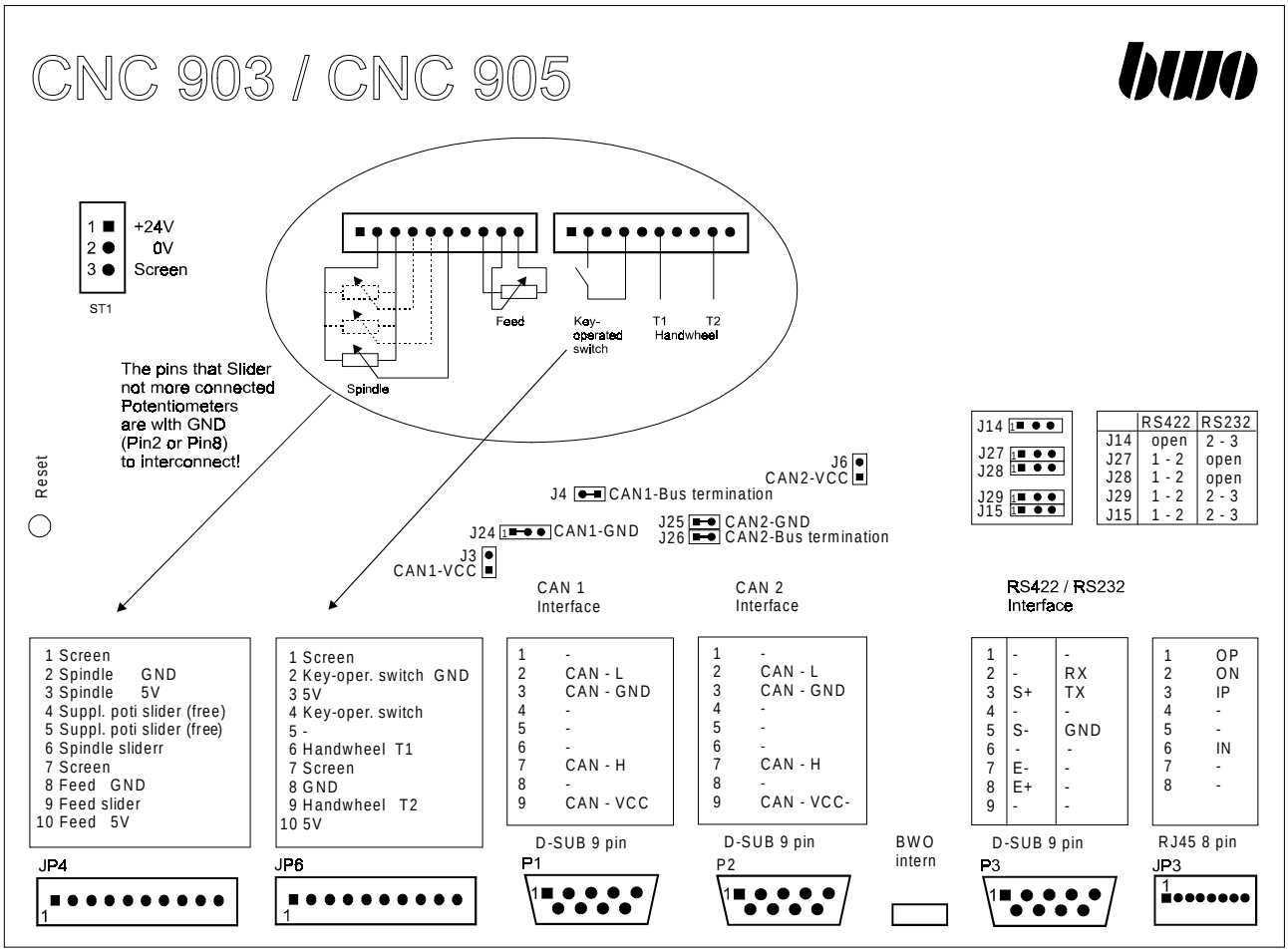
**Fixing** with 12 threaded bolts M4 x 8, grounding threaded bolt 9

| Nr. | X | Y | Nr. | X | Y |
|---|---|---|---|---|---|
| 1 | 40,0 | 10,0 | 5 | 40,0 | 300,0 |
| 2 | 70,0 | 50,0 | 6 | 10,0 | 250,0 |
| 3 | 70,0 | 155,0 | 7 | 10,0 | 155,0 |
| 4 | 70,0 | 250,0 | 8 | 10,0 | 50,0 |



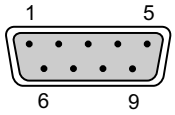
## 2.2.3 Plug contacts

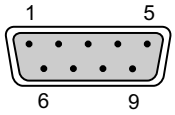


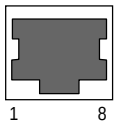

| | | | | |
|---|---|---|---|---|
| JP4 / JP6 | 10 pin terminal strip | externel potentiometers and key-operated switches | | |
| P1 / P2 | 9 pin D-SUB pin-type plug | CAN 1 / CAN 2 interface | | |
| P3 | 9 pin D-SUB pin-type plug | RS422 or RS232 interface | | |
| J14, J15 and J27, J28, J29 | Selection of Interface RS422 preset | RS422 | J14 | open |
| | | | J15, J27, J28, J29 | bridge1 - 2 |
| | | RS232 | J27, 28 | offen |
| | | | J14, J15, J29 | Brückr 2 - 3 |
| JP3 | 8 pin socket | connection with host by RJ45 | | |

### 2.2.3 Plug contacts

| Power supply | | CAN interface CAN 1 / CAN 2 | | RS422 / RS232 interface | | | TCP/IP Host | |
|---|---|---|---|---|---|---|---|---|
| 3 pin plug ST1 | | 9 pin D-SUB pin-type plug P1 / P2 | | 9 pin D-SUB pin-type plug P3 RS422 | | RS232 | 8 pin RJ45 JP3 EtherNet (socket) | |
| 1 | +24V | 1 | - | 1 | - | - | 1 | OP |
| 2 | 0V | 2 | CAN - L | 2 | - | RX | 2 | ON |
| 3 | screen | 3 | CAN - GND | 3 | S+ | TX | 3 | IP |
| | | 4 | - | 4 | - | - | 4 | - |
| | | 5 | - | 5 | S- | GND | 5 | - |
| | | 6 | - | 6 | - | - | 6 | IN |
| | | 7 | CAN - H | 7 | E- | - | 7 | - |
| | | 8 | - | 8 | E+ | - | 8 | - |
| | | 9 | CAN - VCC | 9 | - | - | | |

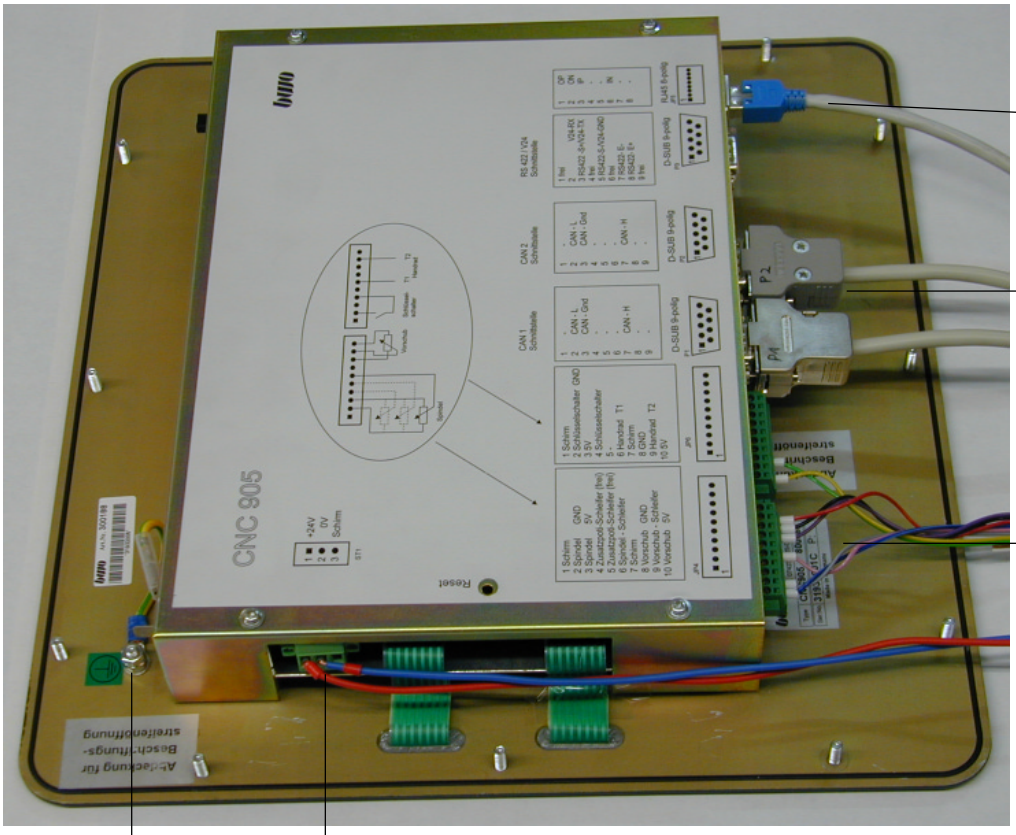



| | 10 pin terminal strip JP4 | 10 pin terminal strip JP6 |
|---|---|---|
| 1 | Screen | Screen |
| 2 | Spindle GND | key-operated switch GND |
| 3 | Spindle 5V | 5V |
| 4 | Suppl. poti slider (free) | key-operated switch |
| 5 | Suppl. poti slider (free) | - |
| 6 | Spindle slider | Handwheel T1 |
| 7 | Screen | Screen |
| 8 | Feed GND | GND |
| 9 | Feed slider | HandwheelT2 |
| 10 | Feed 5V | 5V |

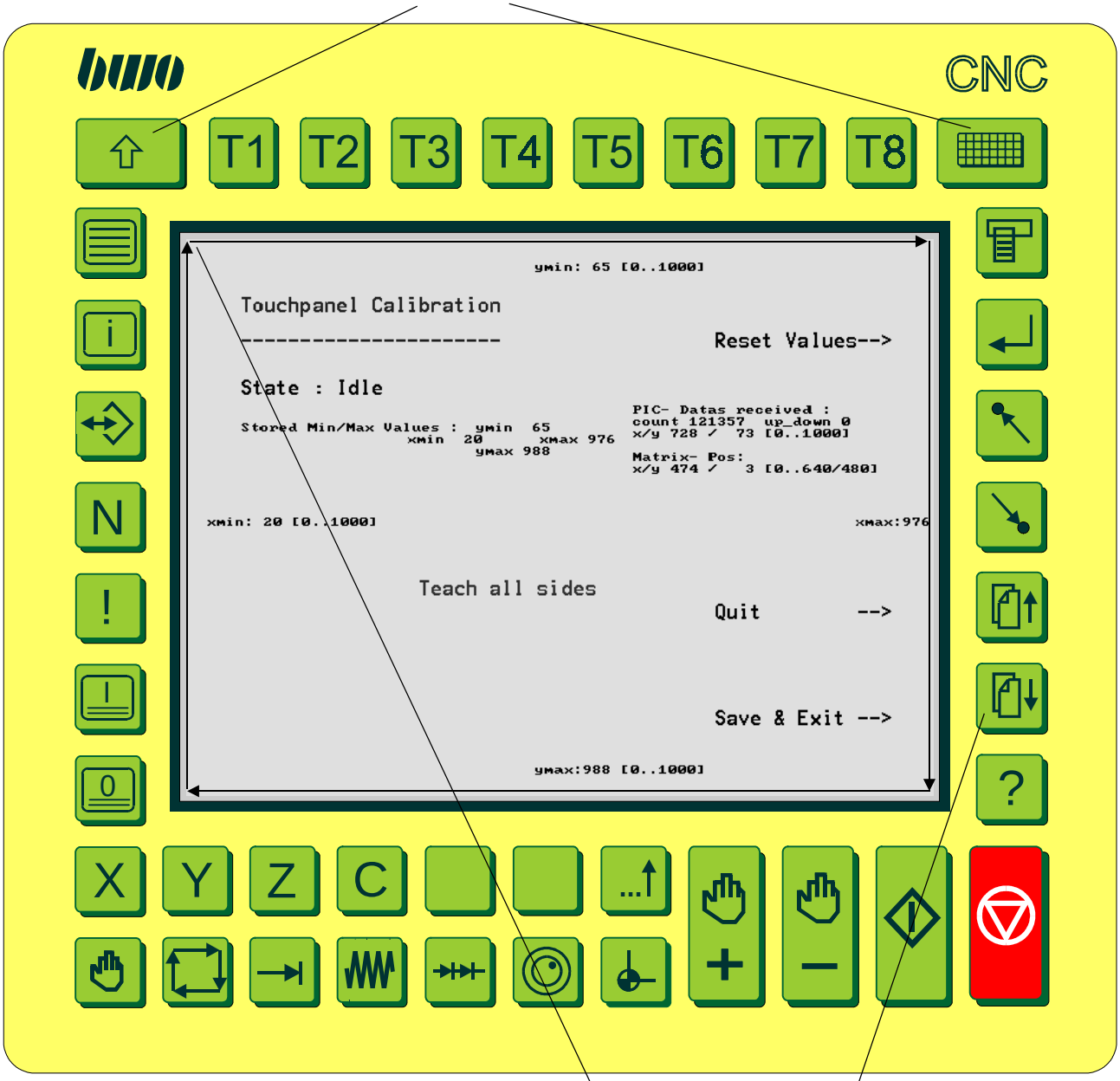
## 2.2.4 Connections



## 2.3 Touch-Screen calibration

The Touch screen is calibrated in the factory before the distribution. Being after some time malfunctions occur, can be repeated the calibration.

For calibrating the two keys simultaneous press. Then this picture appears.



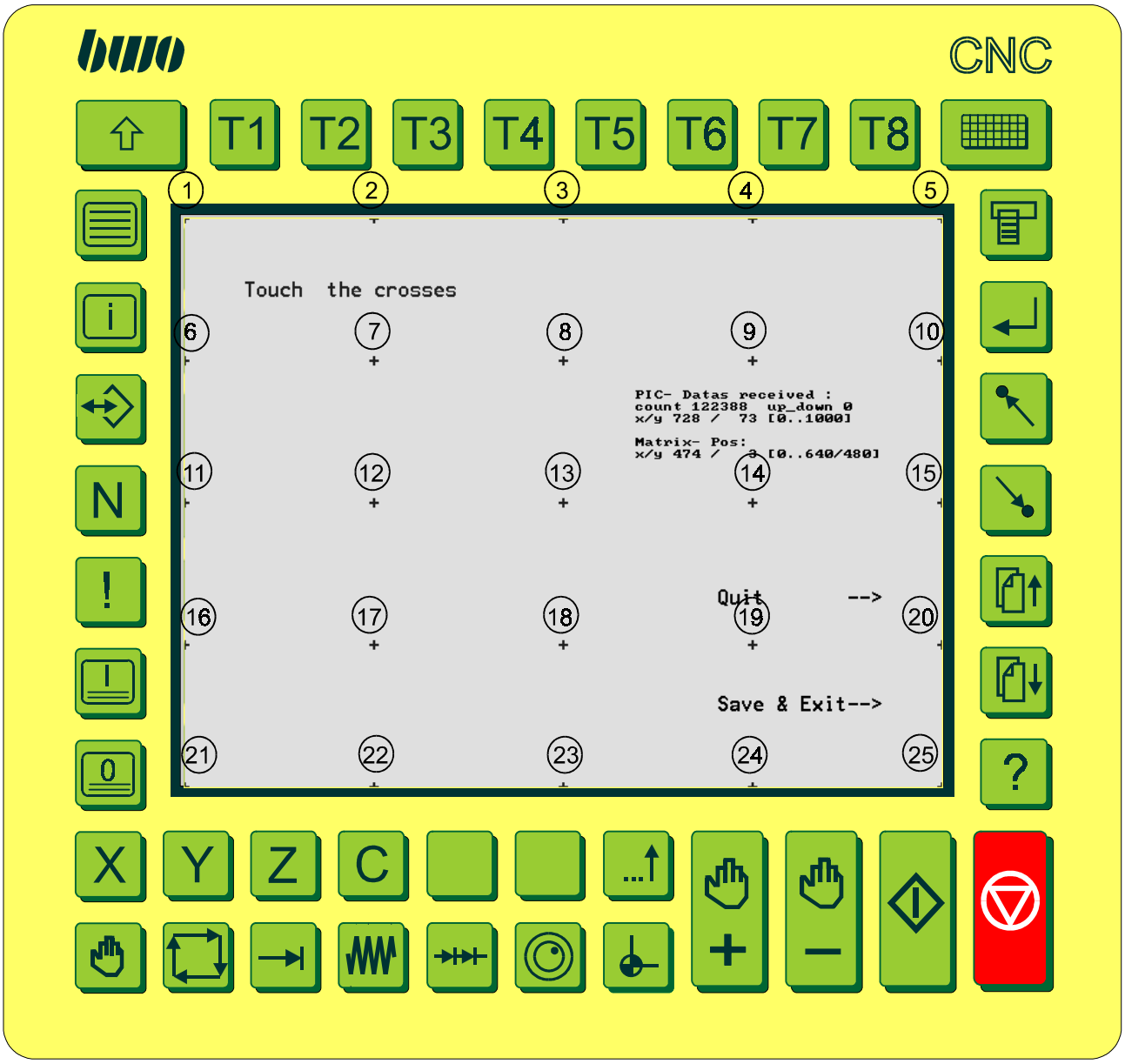

**Touch screen area** (Xmin - Xmax / Ymin - Ymax) determine:
In addition with a pointed soft item from on the left of above close at the edge in direction of arrow around the display drive.

With key ‘Save & Exit‘ the next picture appears.

## 2.3 Touch-Screen calibration

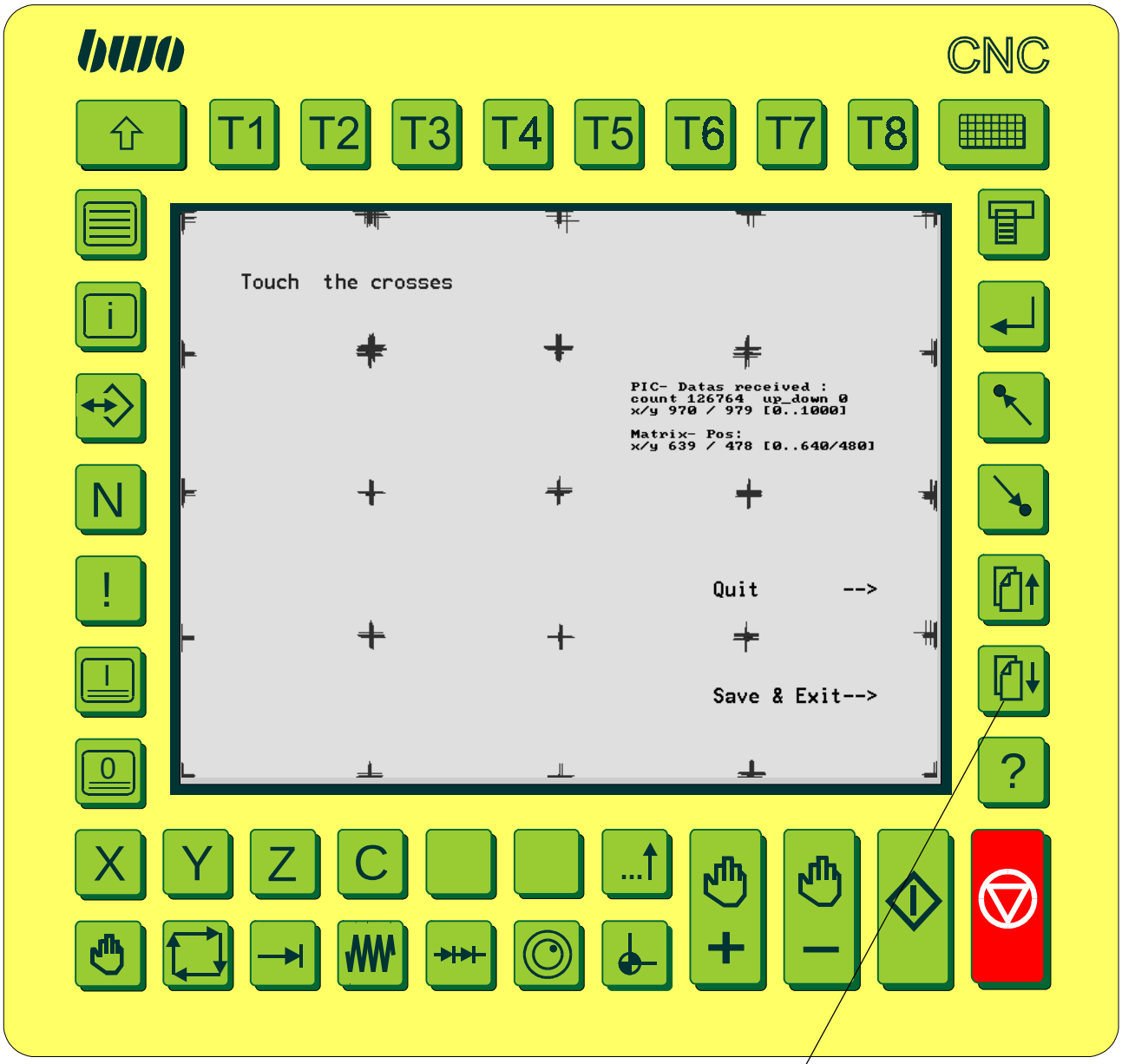
In this picture the **calibration points** appear. The total area actual into 16 subranges divided. The markings (crosses) of the subranges with a pointed soft item touched lightly in the order

1 - 2 - 7 - 6 - 1
2 - 3 - 8 - 7 - 2
3 - 4 - 9 - 8 - 3
4 - 5 - 10 - 9 - 4
etc.



## 2.3 Touch-Screen calibration

It is recorded when each touching lightly on cross. This cross command as close ones as possible at the given mark point (cross) is situated.
The marking process can be repeated, in order to keep the dispersion as small as possible.




The calibration is terminated with press the keys ‘Save & Exit‘.

To net curtain aborted with key ‘Quit‘ the process without saving.

## 3. CAN bus I/O level

The CAN bus I/O level of the CNC 902 / CNC 903 / CNC 904 / CNC 905 contains the following stages of development.

5 CAN nodes with in each case

| | | | |
|---|---|---|---|
| 64 | Digital inputs | 8 | 8 Channel digital input clips |
| 64 | Digital outputs | 8 | 8 Channel digital output clips |
| 2 | Analog inputs | 1 | 2 Channel analog input clips |
| 2 | Analog outputs | 1 | 2 Channel analog output clips |

## 3.1 I/O configuration

The configuration and initialization of the field bus couplers as well as the pertinent I/O level are determined by a configuration file. This has the designation ‘ canconf ‘ and finds itself in the general statement of the CNC.

Example of a CAN I/O configuration

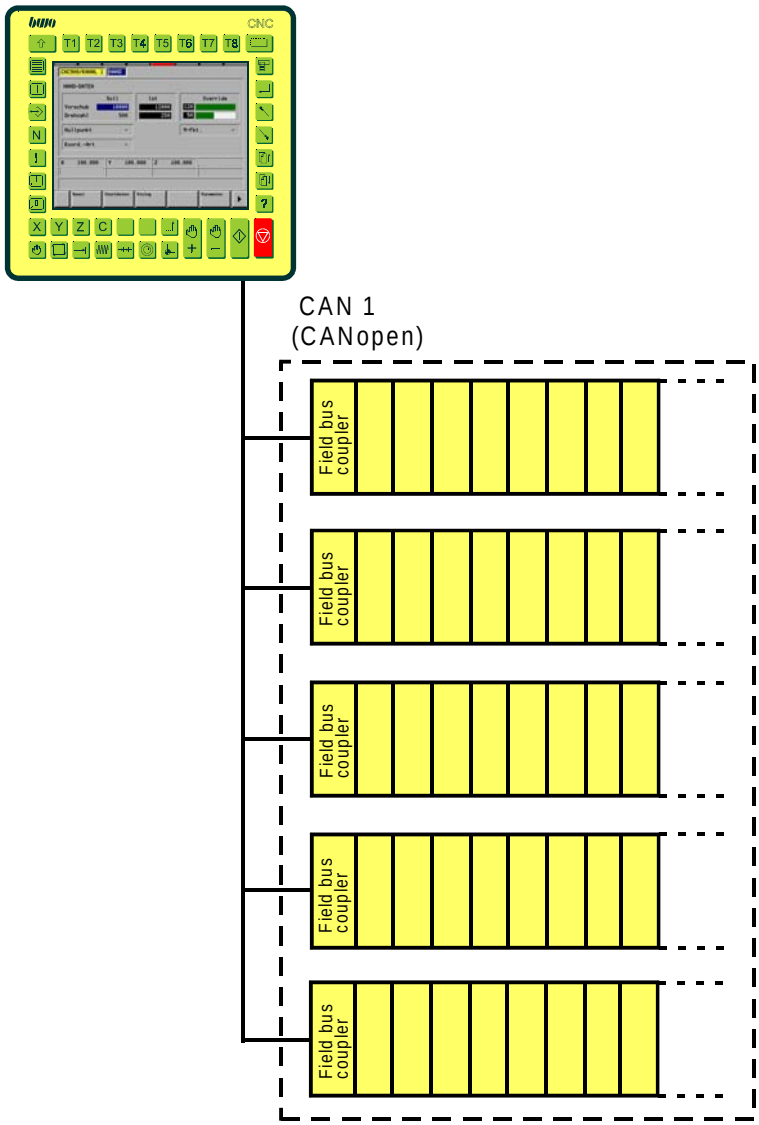
CAN node 1:
5 x 8 Channel digital input clips
4 x 8 Channel digital output clips

CAN node 2:
3 x 8 Channel digital input clips
3 x 8 Channel digital output clips

CAN node 3:

CAN node 4:

CAN node 5:



## 3.2 Program 'canconf'

```
##########################################
## CAN-Konfiguration  fuer                ##
## Knoten 1:                              ##
## Knoten 2:                              ##
##########################################
#
## Steckplatz-Nummer, CAN-Modul, 0=selbstsuchend ##
[slot]
0
#
## Kanal-Nummer, CAN-Modul ##
[channel]
2
#
## Baudrate 0=1000kB, 1=800kB, 2=500kB, 3=250kB, 4=125kB, 5=100kB ##
[baudrate]
2
#
## Knoten 1-5, PDO-Adressen Digitale Eingaenge ##
[input_pdos]
0x181
0x182
#0x183
#0x184
#0x185
#
## Knoten 1-5, PDO-Adressen Digitale Ausgaenge ##
[output_pdos]
0x201
0x202
#0x203
#0x204
#0x205
#
## Knoten 1-5, PDO-Adressen Analoge Eingaenge  ##
[analog_in]
#0x281
#0x282
#0x283
#0x284
#0x285
#
```

## 3.2 Program 'canconf' (continued))

```
## Knoten 1-5, PDO-Adressen Analoge Ausgaenge ##
[analog_out]
#0x301
#0x302
#0x303
#0x304
#0x305
#
#
## CAN-Knoten 1, Digitale Ein- und Ausgaenge      ##
## mit Zuordnung der BWO  E/A-Adressen     ##
i8
i8
i8
i8
i8
o8
o8
o8
o8
#
#
## CAN-Knoten 2, Digitale Ein- und Ausgaenge      ##
## mit Zuordnung der BWO E/A-Adressen             ##
i8
i8
i8
o8
o8
o8
#
```

# Programming CNC

CNC 902 / CNC 903 / CNC 904 / CNC 905

# 1 Compact controls CNC 902 / CNC 903 / CNC 904 / CNC 905

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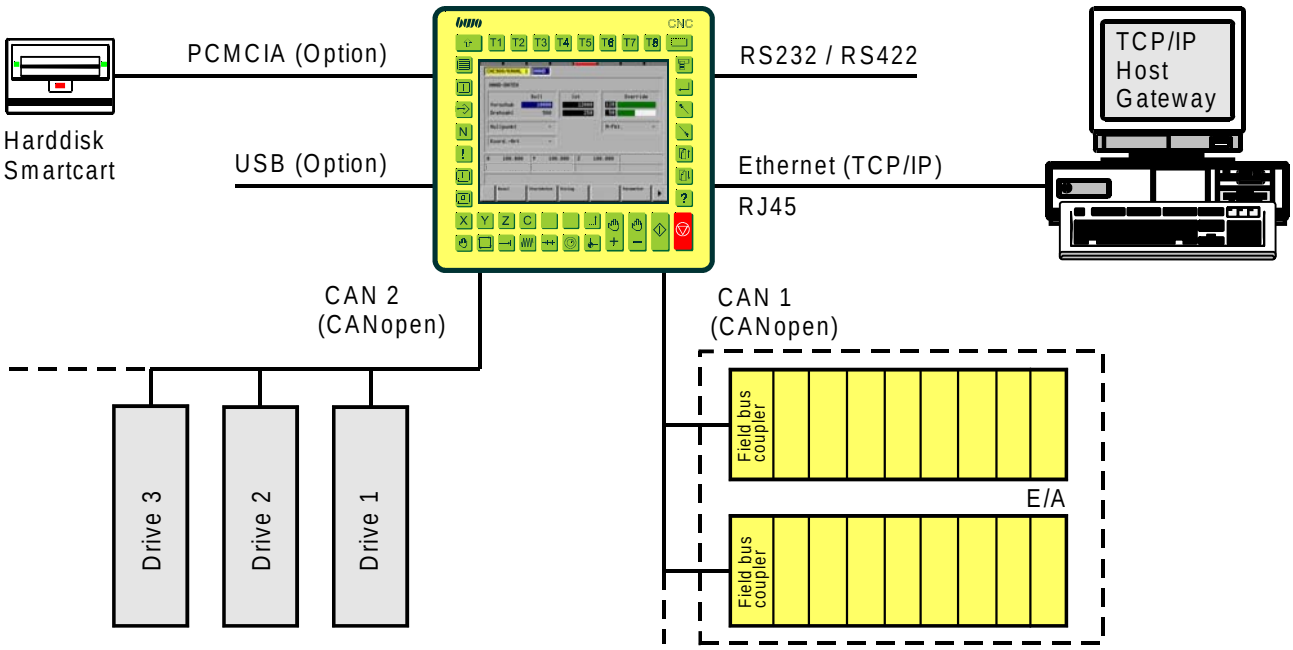


Interfaces

| | |
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| Ethernet | (TCP/CIp) RJ45 |
| Serially | RS232, RS422 |
| PCMCIA | e.g. for external hard disk (CNC 905 option) |
| USB | (CNC 905 option) |

## 1.2 Characteristics and functions

### Functions of the control

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- Logs TCP/IP stack, CANopen stack
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- Construction of a simple CNC controller in connection with soft PLC and soft NC
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### CPU data

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|---|---|
| Static RAM | 512kB |
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| Flash-disk-memory<br>for operating system and control surface | 8MB |
| Flag memory | 60kB |
| NC memory | 193kB |
| Remanent flags | 4096 |
| Parameter | 20000 |

### Programmable box bus coupler

| | | |
|---|---|---|
| I/O knot for input/outputs | | 5 |
| with in each case | digital inputs | 64 |
| | digital outputs | 64 |
| | analog inputs | 2 x16bit |
| | analog outputs | 2 x16bit |

## 1.2 Characteristics and functions

| Versions | CNC 902 | CNC 903 | CNC 904 | CNC 905 |
|---|---|---|---|---|
| NC channel | 1 | 1 | 1 | 1 |
| Axes / Spindles | 4 | 4 | 8 | 8 |
| Spindle in C axes operation | 1 | 1 | 1 | 1 |
| Linear interpolation (Axes) | 3 | 3 | 3 | 3 |
| Cirkular interpolation (Axes) | 2 | 2 | 3 | 3 |
| Screw interpolation (Axes) | 2+1 | 2+1 | 2+1 | 2+1 |
| Spline interpolation | - | - | • | • |
| Polynominal interpolation | - | - | • | • |
| Polar transformation | - | - | • | • |
| Scara transformation | - | - | • | • |

Symboles: • Functions are possible
- Functions are not possible

### CNC Characteristics and functions

- Tangential axis
- Axes couple, reflect and exchange
- Restarting after abort
- Feed, corners, circle and outline dynamics
- Electronic gears and Handwheel
- Polar coordinates system
- Axes simulation
- Coordinates turn, reflect and shift
- Measuring and processing cycles
- Interpolation plane selection
- Tool radius path correction
- Automatic selection of linear and circular interpol.
- Zero points / zero shift
- Outline path short programming
- Parameter calculation
- Diagnostic functions
- Graphic cycle programming
- Graphic simulation

## 1.2 Characteristics and functions

### Operating panel data

LCD display in TFT version.

| | | |
|---|---|---|
| Resolution | 640 x 480, 256 off 4096 colours | |
| display size with | CNC 902 / CNC 904 | 6.4” |
| | CNC 903 / CNC 905 | 10.4” |
| Touch screen with resolution of | 1024 x1024 | |

42 function keys, of it 15 freely shapable,
PLC keys with display on LCD display,
Operating voltage 24V
Battery buffer for the clock

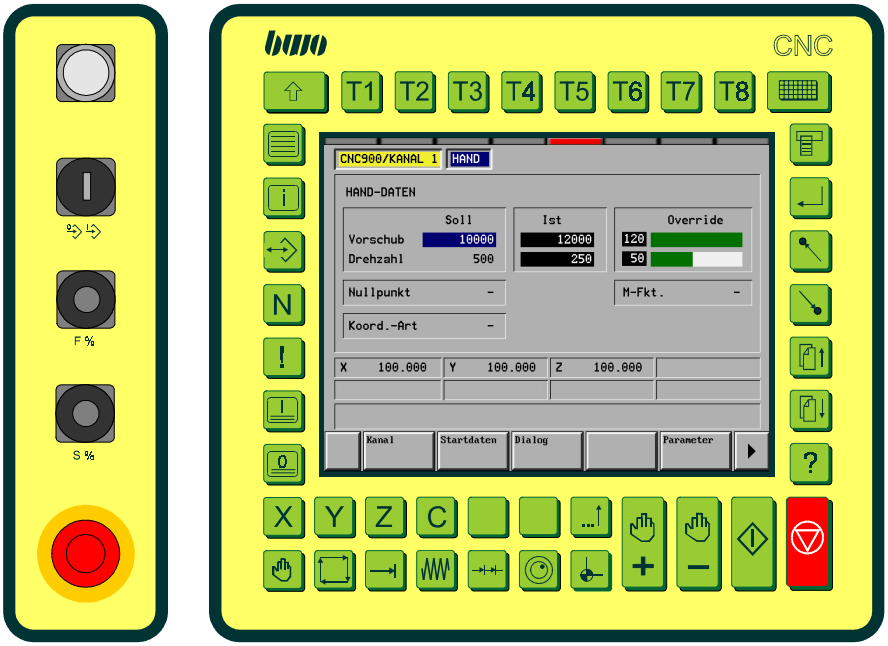
### Connections

(CNC 903 / CNC 905 on separate machine operating panel)
4 Override Potentiometer
1 Handwheel (TTL level cable length 1m, +5V)
1 Key-operated switsch
1 Joystick (in place of 3 override Potentis)

## 1.2 Characteristics and functions


Compact controls CNC 902 / CNC 904

Dimensions (B x H in mm) 277 x 227




Compact controls CNC 903 / CNC 905 with additional machine operating panel

Dimensions (B x H in mm) 328 x 310
Machine operating panel (option) 80 x 310

## 1.3 Software

### Programming software XPLC

XPLC actual a programming software for the compact controls CNC 902 / CNC 903 / CNC 904 / CNC 905. The software actual on PC executably.

With XPLC all functions of the control with stored program (PLC) with the compact controls can be taken in operation.

Details in addition in this manual paragraph 4. and 5.

### Standard interface for CNC

The standard adaption contains a list of the free, pre-allocated and reserved flag areas.

Details in addition in this manual paragraph 6.

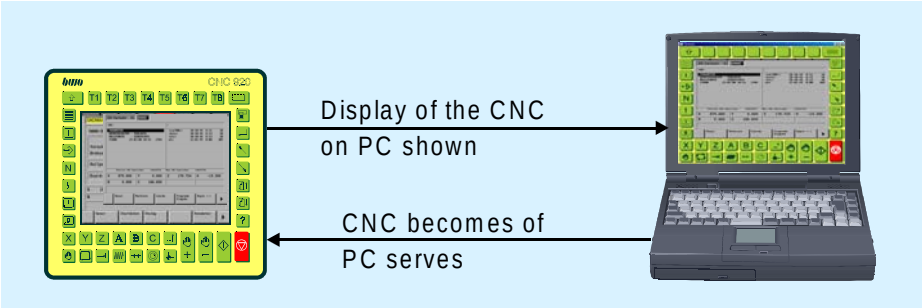
### Programming software NC

With the programming software can NC programs with the available functions in the compact controls be created. Details in addition in the NC manual.

## 1.3 Software

### Operating system management program WINBV

Software on a PC to controlling of the CNC.



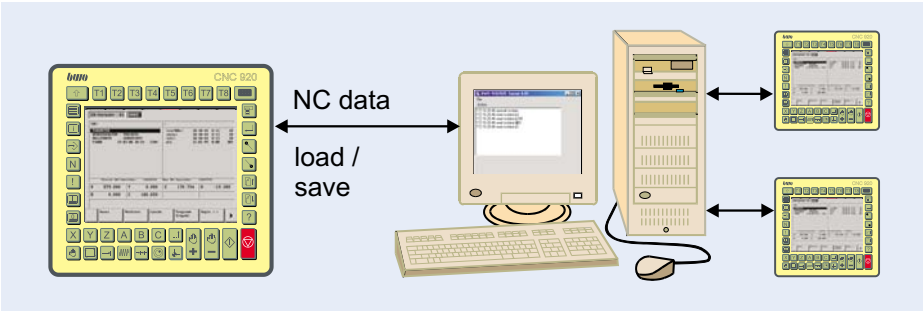

The display of the CNC is illustrated on a PC. The control can be served then from the PC.

Thus can be implemented:
- Diagnosis locally
- On-line remote diagnostics
- Operating system care
- Data adminstration
- Data protection
- NC archiving

Details in addition in this manual paragraph 7.

### Data transfer on one SERVER

Software on a PC for data transfer with the CNC.




By the CNC can be accessed the drive assemblies of a server. Several controls can be connected at a server and load NC data from the server or save on the server.

## 1.4 Notes for the line-up

Memory resets (see the also following pages)

With the line-up and with unclear conditions in the FLASH memory the following steps should be executed:

- Passing through of the switching on check with test parameter: No Restore
  test NC memory: No Restore

Reset parameter and NC memory without store back of machine data and NC programs from the FLASH memory.

- Loading of the machine data (channel descriptors, axis definitions, axis data) over I/O traffic.

- Machine and axis configuration check.

- Memory of the characterized machine data into the FLASH memory of the CPU (see q10).

- System switch off and restart.

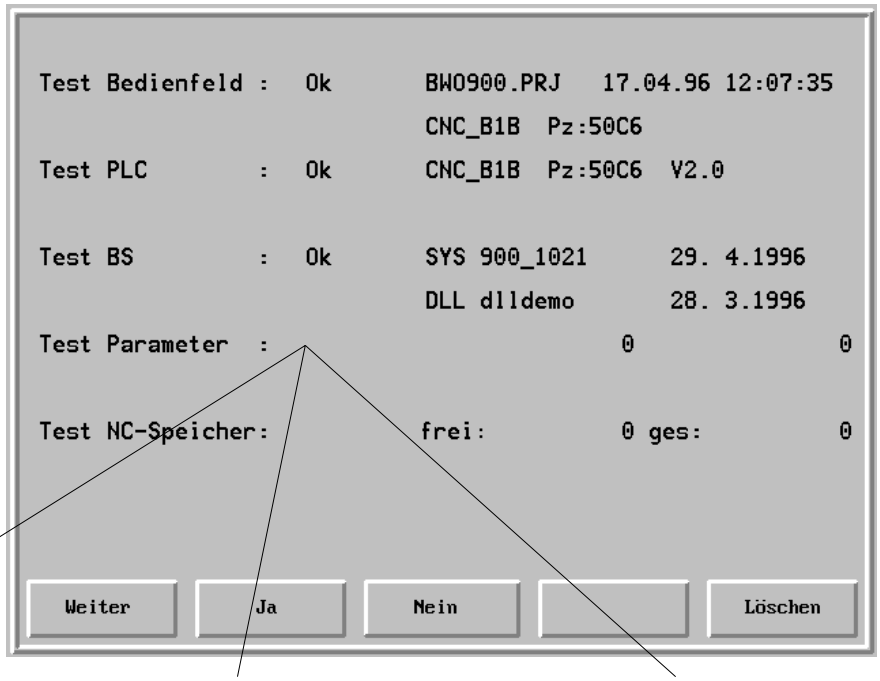
- In the switching on checks in the test parameter ‘ resetting ‘ ‘ input Yes ‘
  and in the test NC memory ‘ resetting ‘ ‘ input Yes ‘.

## 1.4 Notes for the line-up (continuation)

### Test parameter

Possible internal messages with the passing through of the switching on checks with the displays of ‘ ok ‘ or ‘ defect ‘:

- ‘ far ones ‘
- ‘ resetting ‘ with Restore
- ‘ resetting ‘ without Restore




Display **Ok**

Key of ‘ far ones ‘ (F1) press

Effect:
- The parameter values remain received.

- Machine data becomes from THE FLASH memory <u>not</u> loaded.

- Channels and channel descriptor are defined in accordance with parameter value.

Display **Ok / Defect**

Key (reset) press
**Reset??**

Key ‘ Yes ‘ (F2) press

Effect:
- The total parameter memory is cleared.

- Parameter basic adjustment one executes.

- Machine data becomes from the FLASH memory loaded (Restore) (q10).

- Channels and channel descriptor are defined in accordance with parameter value.

display **Ok / Defect**

Key (reset) press
**Reset??**

Key (picture off) press
**NO Restore??**
Key ‘ Yes ‘ (F2) press

Effect:
- The total parameter memory is cleared.

- Parameter basic adjustment one executes.

- Machine data becomes from the FLASH Memory <u>not</u> loaded (No Restore).

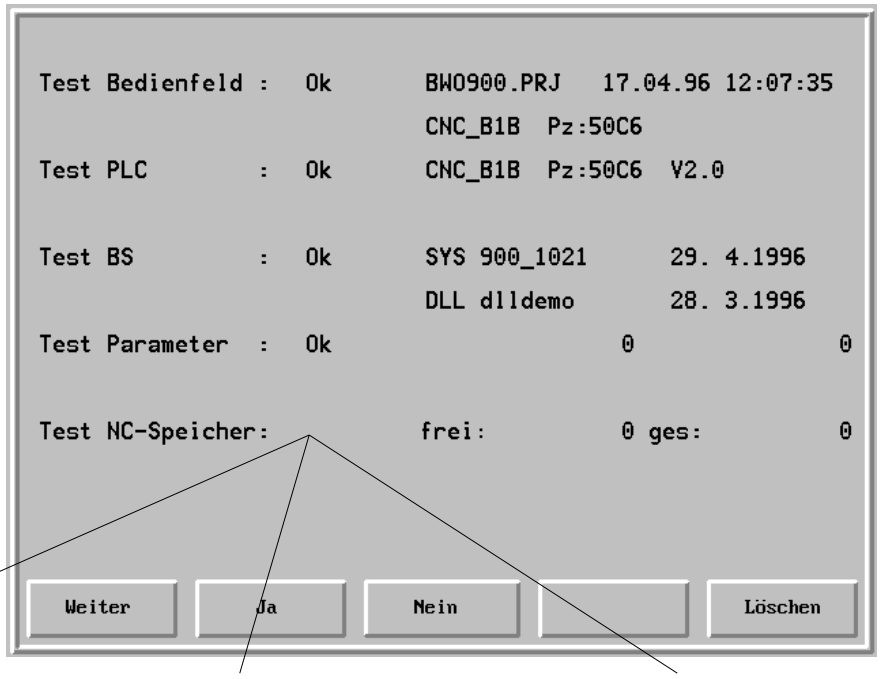
- channels and channel descriptor are defined in accordance with parameter reason in position.

## 1.4 Notes for the line-up (continuation)

### Test NC memory

Possible internal messages with the passing through of the switching on checks with the displays of ‘ ok ‘ or ‘ defect ‘:

- ‘ far ones ‘
- ‘ resetting ‘ with Restore
- ‘ resetting ‘ without Restore




| display **Ok** | display **Ok / Defect** | display **Ok / Defect** |
|---|---|---|
| | Key (reset) press **Reset??** | Key (reset) press **Reset??** |
| | | Key (picture off) press **NO Restore??** |
| Key of ‘ far ones ‘ (F1) press | Key ‘ Yes ‘ (F2) press | Key ‘ Yes ‘ (F2) press |
| Effect: | Effect: | Effect: |
| - the NC programs remain received. | - the total NC memory one resets. | - the total NC memory one resets. |
| | - NC programs become from the FLASH memory into the NC RAM memory loaded (Restore) (see also q10). | - NC programs become from the FLASH Memory <u>not</u> into the NC RAM memory loaded (NO Restore), (see q10). |
| | | NC memory remains empty. |

## 2. Operating

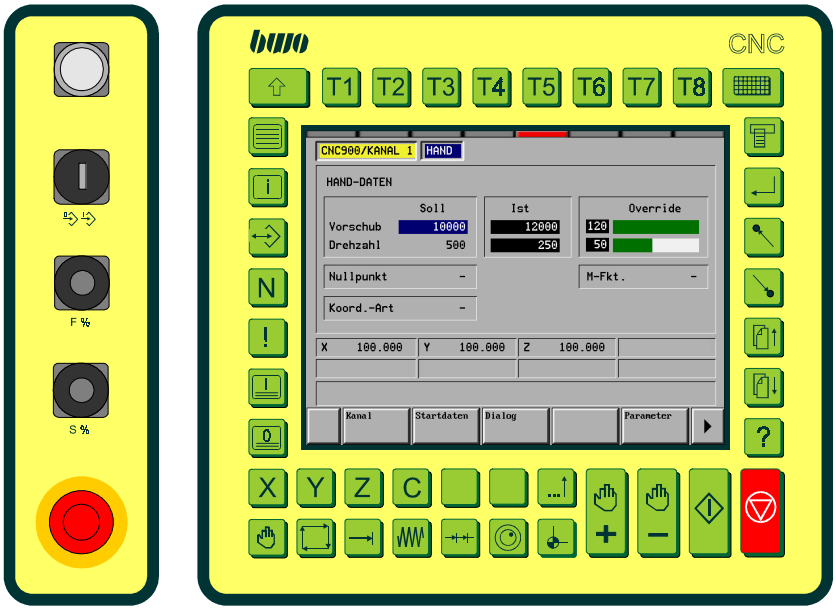
## 2. Operating

## 2.1 Compact controls CNC 902 / CNC 903 / CNC 904 / CNC 905

The compact controls CNC 902 / CNC 903 / CNC 904 / CNC 905 are conceived for the application with CAN Bus. Communicate to they over the CAN Bus with the drives and the I/O bus.
The CNC Control actual in the operating panel integrates. The operating panels have fully graphicable color LC displays and foil keyses with mechanical pressure point.


Compact controls CNC 902 / CNC 904

Dimensions (B x H in mm) 277 x 227




Compact controls CNC 903 / CNC 905 with additional machine operating panel

Dimensions (B x H in mm) 328 x 310
Machine operating panel (option) 80 x 310

## 2.1.1 Machine operating panels

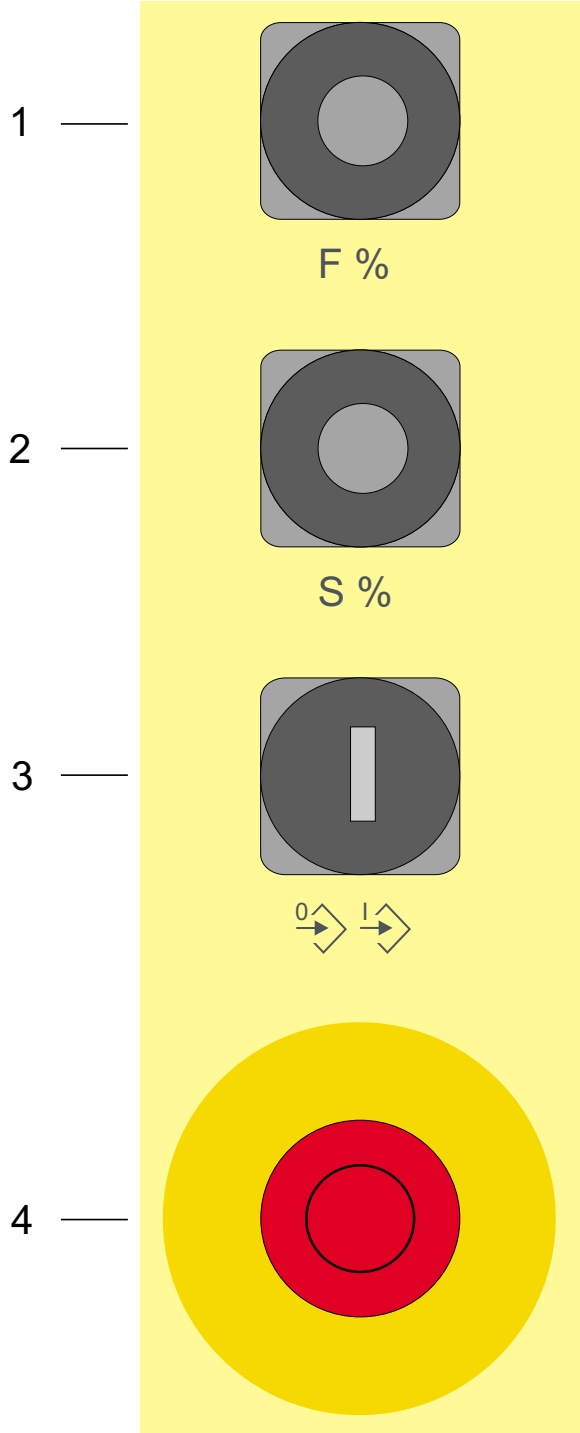
### Machine operating panel CNC910

1 Feed override

2 Feed override

3 Code switch
Program block-free

4 Emergency-stop key




Note:

| | |
|---|---|
| Code switch | 1 opener (21/22) freely |
| Emergency stop | 2 openers (11/12 and 21/22) freely |

## 2.1.1 Machine operating panels

**Separate machine operating panel CNC920**

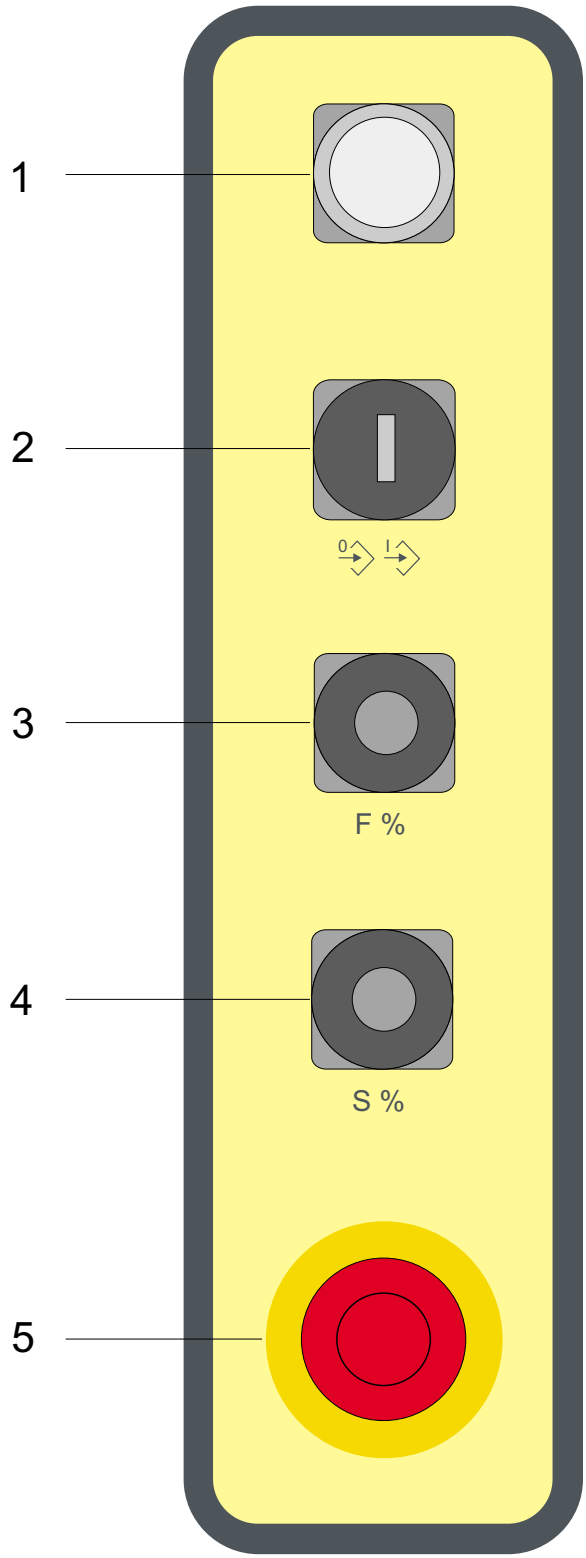
1 Illuminated push button

2 Code switch
Program block-free

3 Feed override

4 Spindle override

5 Emergency-stop key

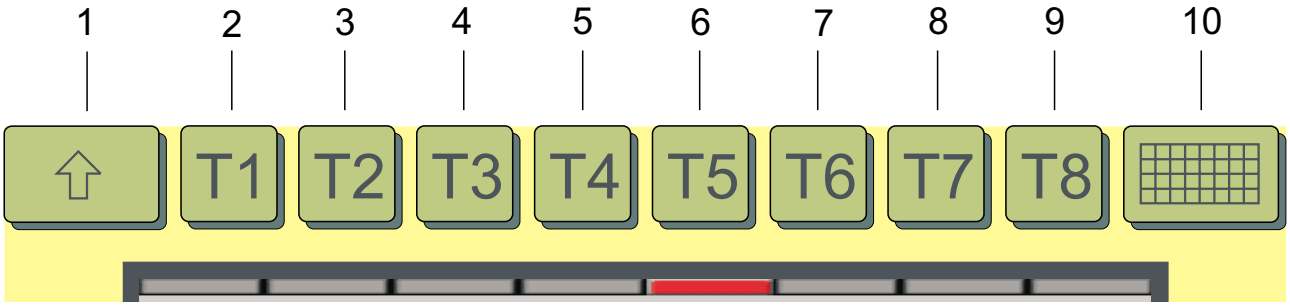



Note:

| | |
|---|---|
| Code switch | 1 opener (21/22) freely |
| Emergency stop | 2 openers (11/12 and 21/22) freely |

## 2.1.2 Control keys

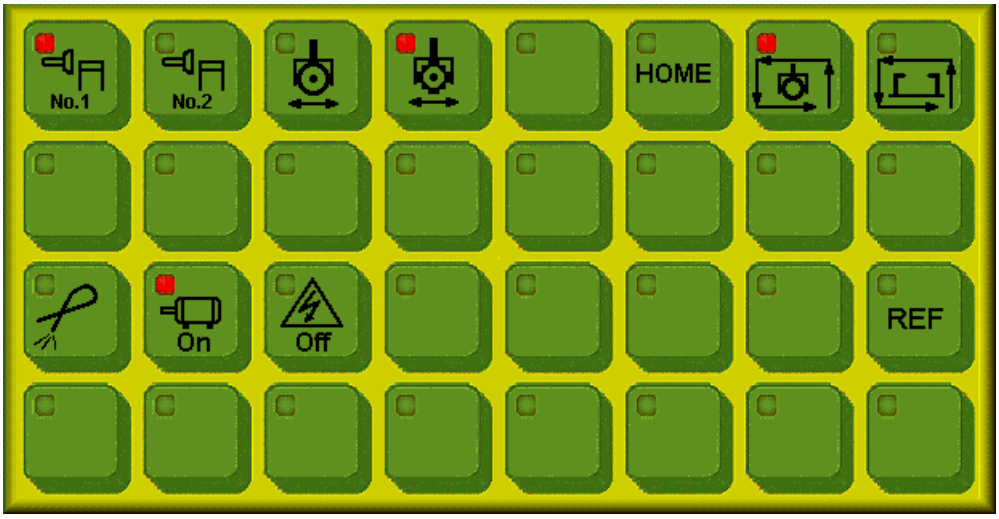
### Control keys for PLC functions




1 Shift
In connection with further keys special functions can be released, e.g. can with editor on / off the touch screen activated or deactivated become (to the cleaning of the screen).

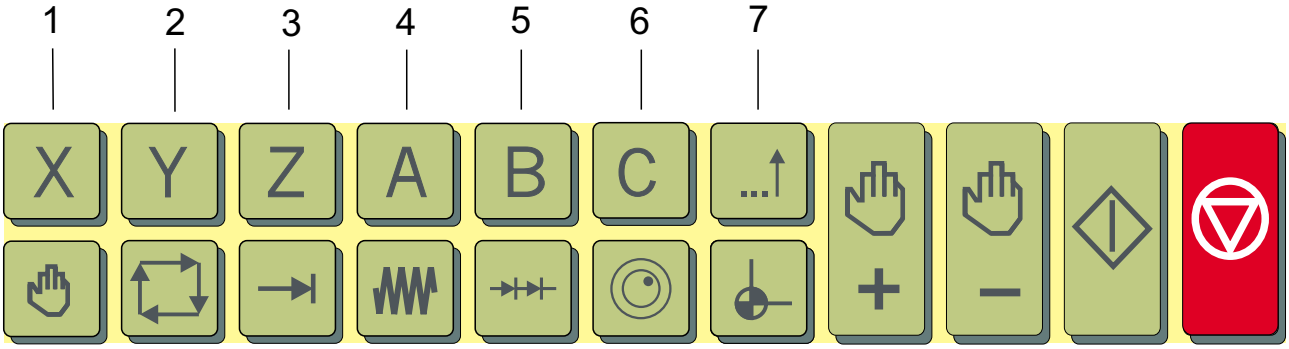
2 to 9 8 PLC keys with LED on the display can by the user as desired be marked (with label strip e.g. T1 to T8).

10 additional 32 PLC keys with LED on the Touch screen
The PLC additive keys can be designated by the user as desired, e.g.:



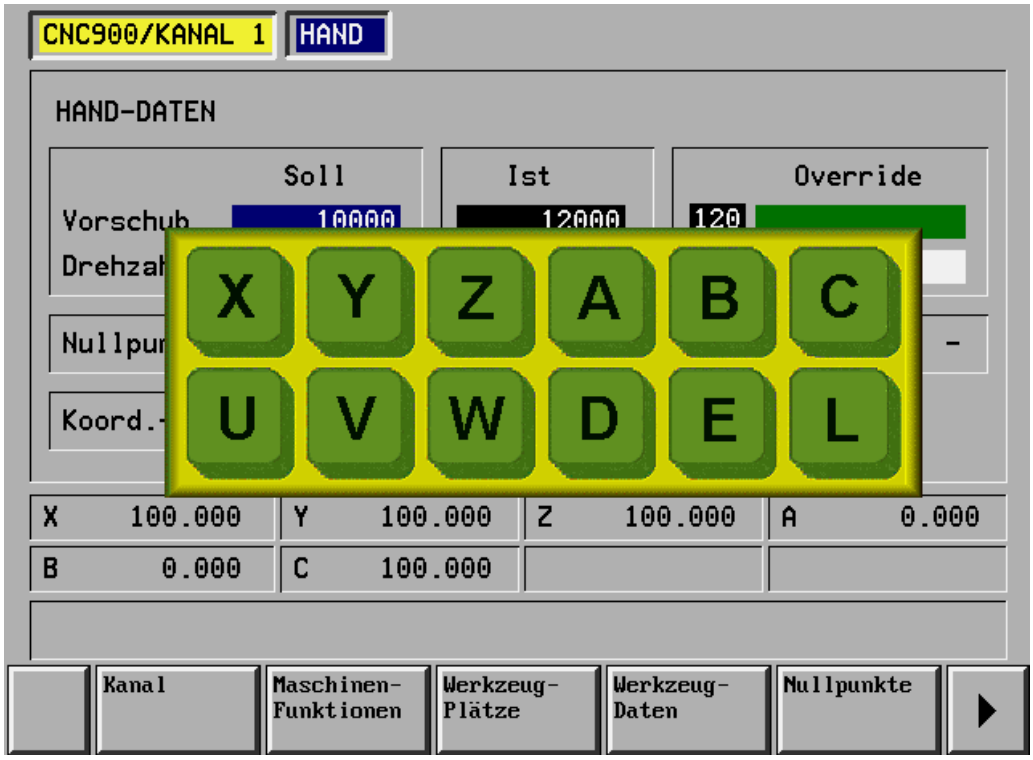
## 2.1.2 Control keys

### Control keys for axis selection



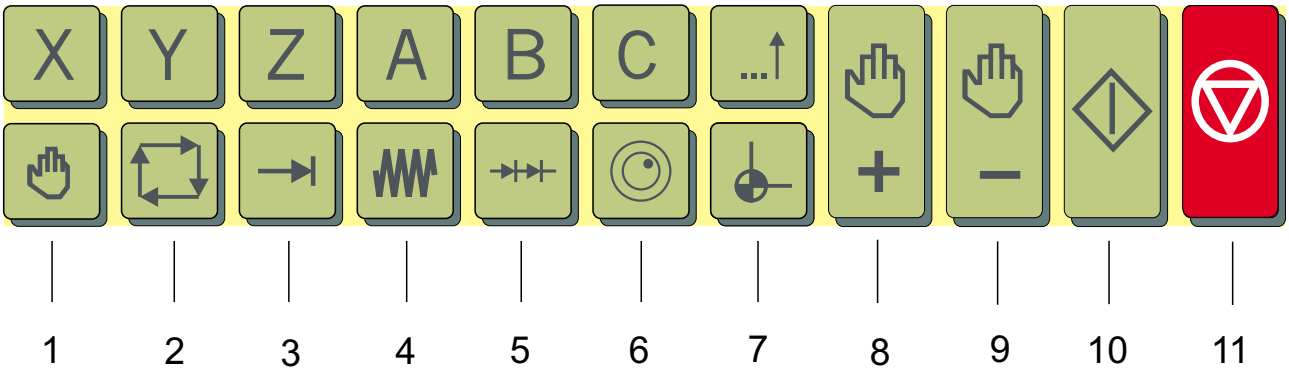

1 bis 6 6 axis keys
Can by the user as desired be marked (with label strip e.g. X, Y, Z, A, B, C).

7 12 axis keys on the Touch screen, can by the user as desired be marked
e.g.:



## 2.1.2 Control keys

### Control keys for modes of operation

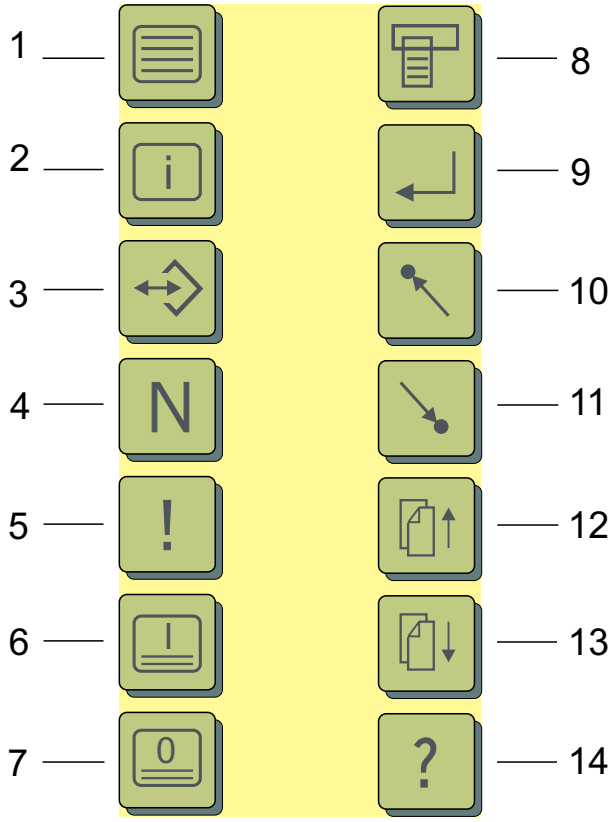



| | | |
|---|---|---|
| 1 | Manual mode | |
| 2 | Switching in automatic mode: | With the 1. Pressures becomes the sequential block adjusted. Afterwards becomes when each pressing key between sequential block and single block back and forth switched. |
| 3 | Switching in positioning mode | |
| 4 | Continuous traversed in the manual mode | |
| 5 | Step by step traversed in the manual mode, incrementations freely definably | |
| 6 | With handwheel traversed | |
| 7 | Automatic home position and travel of point of reference | |
| 8 und 9 | Push buttons for traversing the selected axis with manual mode | |
| 10 und 11 | start and stop<br>The automatic program sequence is started or stopped<br>- in the positioning mode:<br>- in the automatic mode: | <br><br>The NC block in the indication area is processed.<br>The selected NC program is worked on. |

## 2.1.2 Control keys

### Control keys for program input and data communication

| | |
|---|---|
| 1 | Key function freely shapable, e.g. graphic simulator. |
| 2 | Key function freely shapable, e.g. cycle or info. pictures. |
| 3 | I/O circulation<br>Selection of the I/O menu to the data communication |
| 4 | Block editor |
| 5 | Diagnosis<br>Information about conditions, interfaces, parameters. |
| 6 | Editor on |
| 7 | Editor off |
| 8 | Menu selection |
| 9 | Enter |
| 10 und 11 | Beginning / end |
| 12 und 13 | Picture up / down |
| 14 | Additional information<br>Information about lining up NC program. |

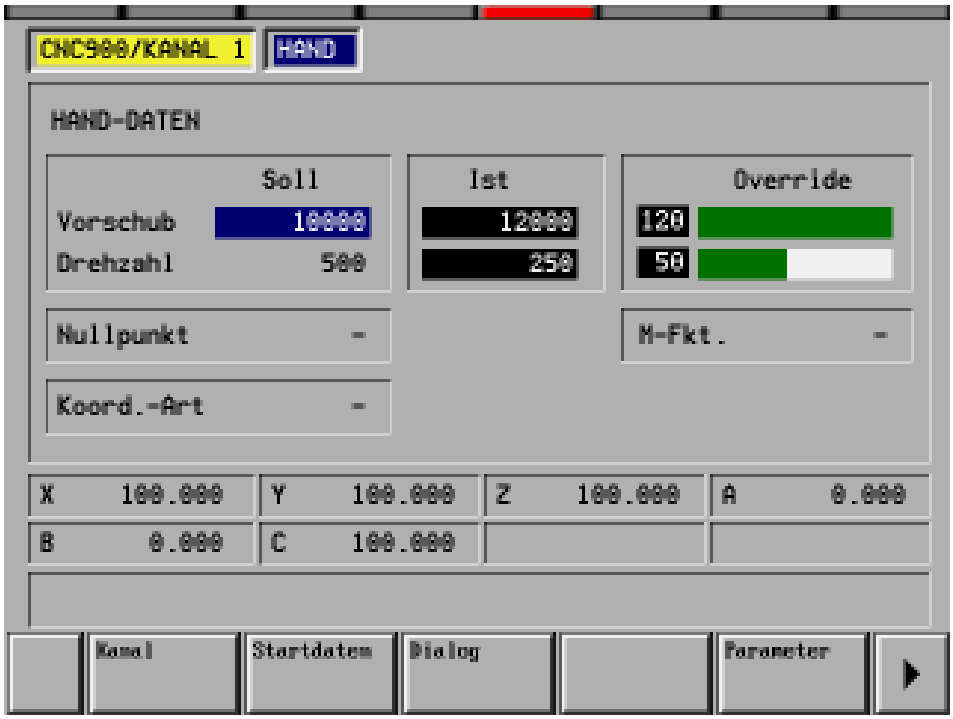


## 2.1.3 Touch screen keys

### Touch screen keys for manual mode and program input

Opening display
Selection menu

Menu screen 1




Selection keys on the touch screen

Menu screen 2

Switching between the menu screens with key ▸ (roll function)

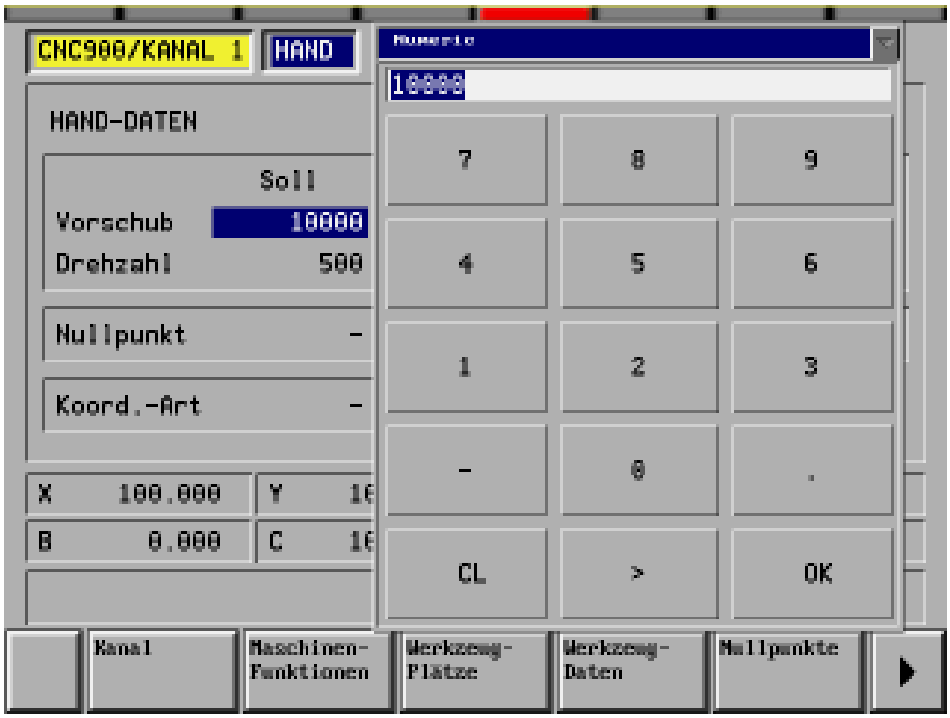
## 2.1.3 Touch screen keys

### Touch screen keys for input with numeric keyboard

The cursor press and shift on a wished input field .

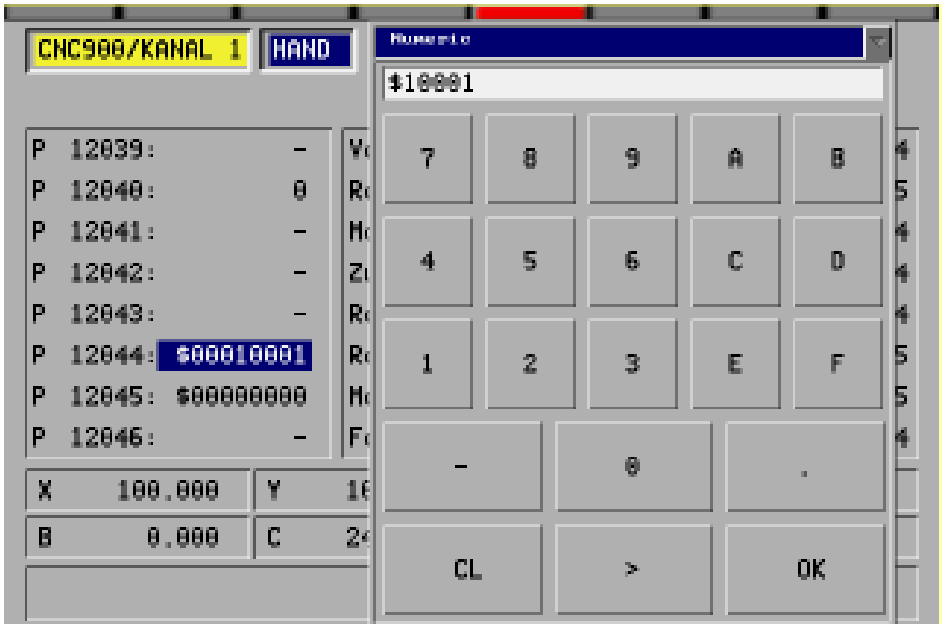
The numeric keyboard will during contact an input field faded in.

Input break off:
With the finger press on not with input fields occupied place on that display.




Requires the input field hexadecimal input, will the hexa-decimal keyboard faded in.

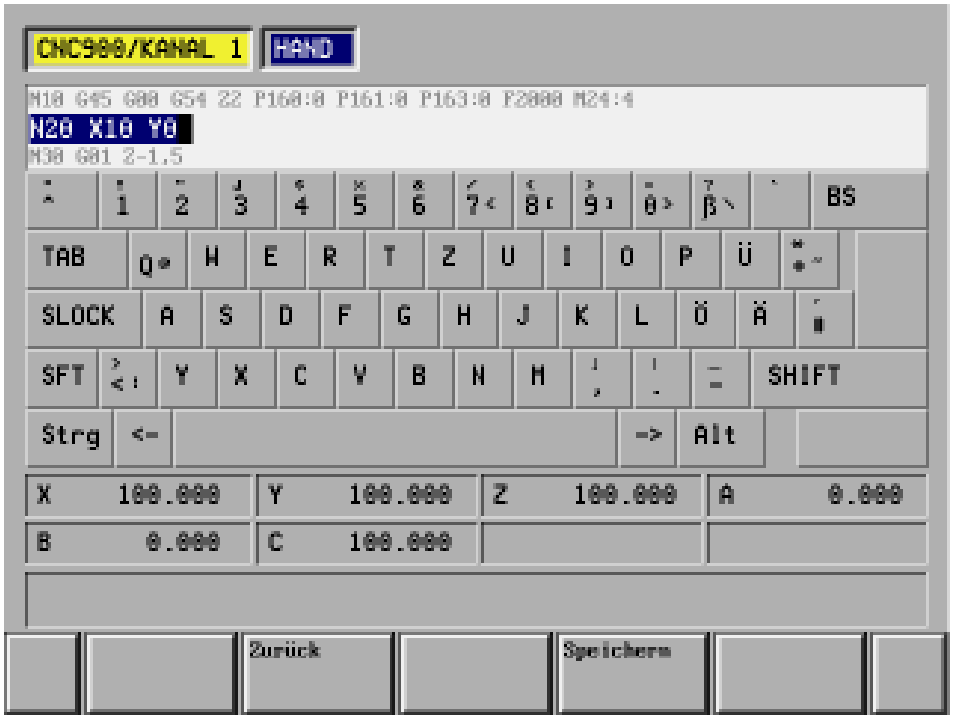
With 2 x pressures on ‘ - ‘ indication becomes between decimally and hexadecimal keyboard around switched.



## 2.1.3 Touch screen keys

### Touch screen keys for input with ASCII keyboard

With the program input will a ASCII keyboard faded in.




Special functions with WINTERM

The ASCII keyboard can be switched by hand: on / off

The contrast of the announcement of the ASCII keyboard can be adjusted.
It can be struggled so far that the keyboard appears only as background picture.

The key functions remain.
However one can read now also the text, which is under the keyboard.

Contrast of the announcement: more brightly more darkly

## 2.2 Power on tests

The display field is activated after swichting on the control. The control starts a self-test. The position of the key-operated switch 1 (P11000) determines the course.

### 2.2.1 Automatic power on tests

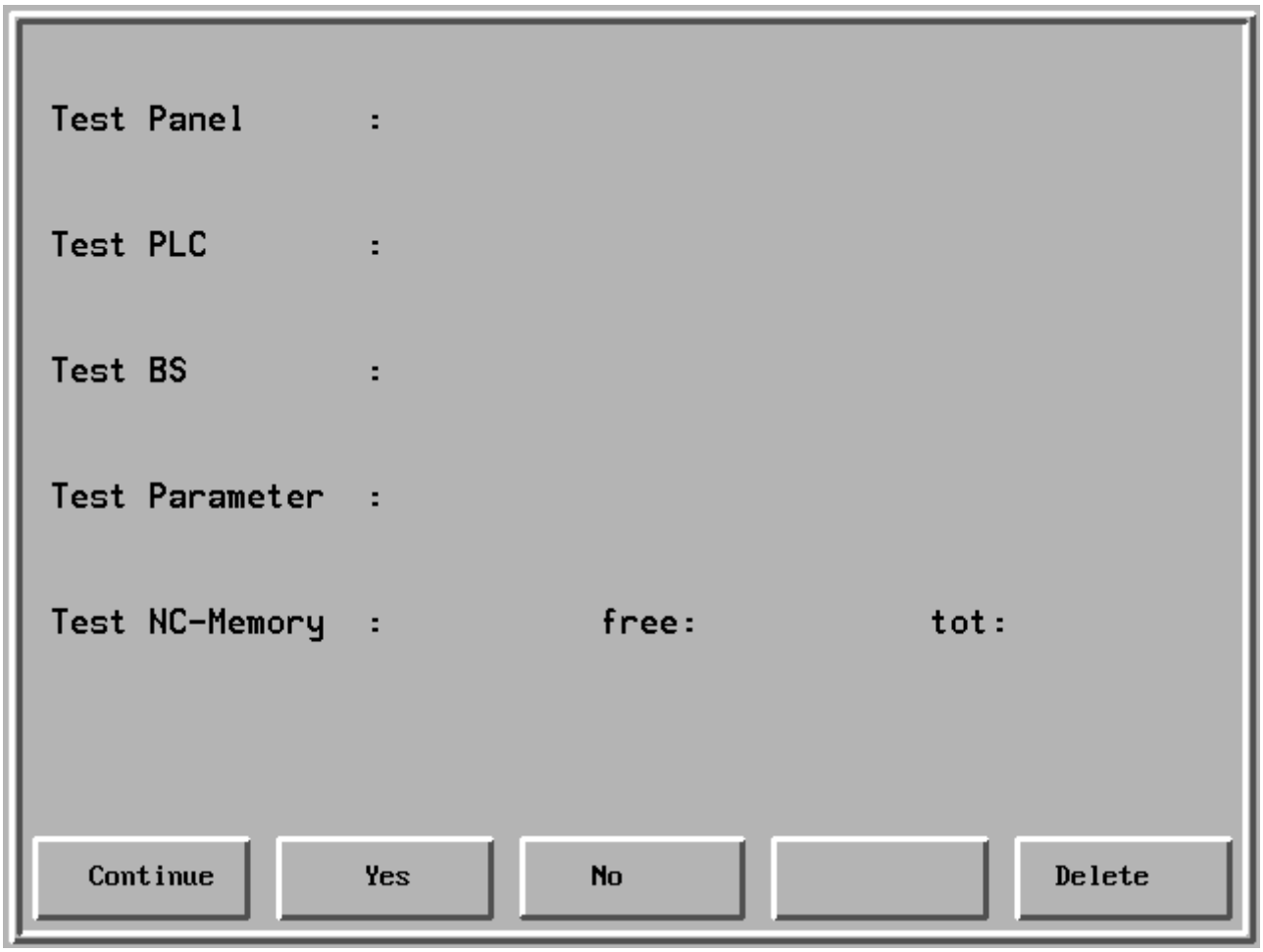
If the key-operated switch is closed (position 1), the power on tests are running automatically, if no errors appear (e.g. def. parameter or def. NC memory).

| | | |
|---|---|---|
| Closed switch | Position 1 | Automatic power on test |
| Open switch | Position 0 | Power on test has to be activated with pressing a key. |

### 2.2.2 Power on test with confirmation

Test operating panel

First, the operating panel is tested (takes some seconds).

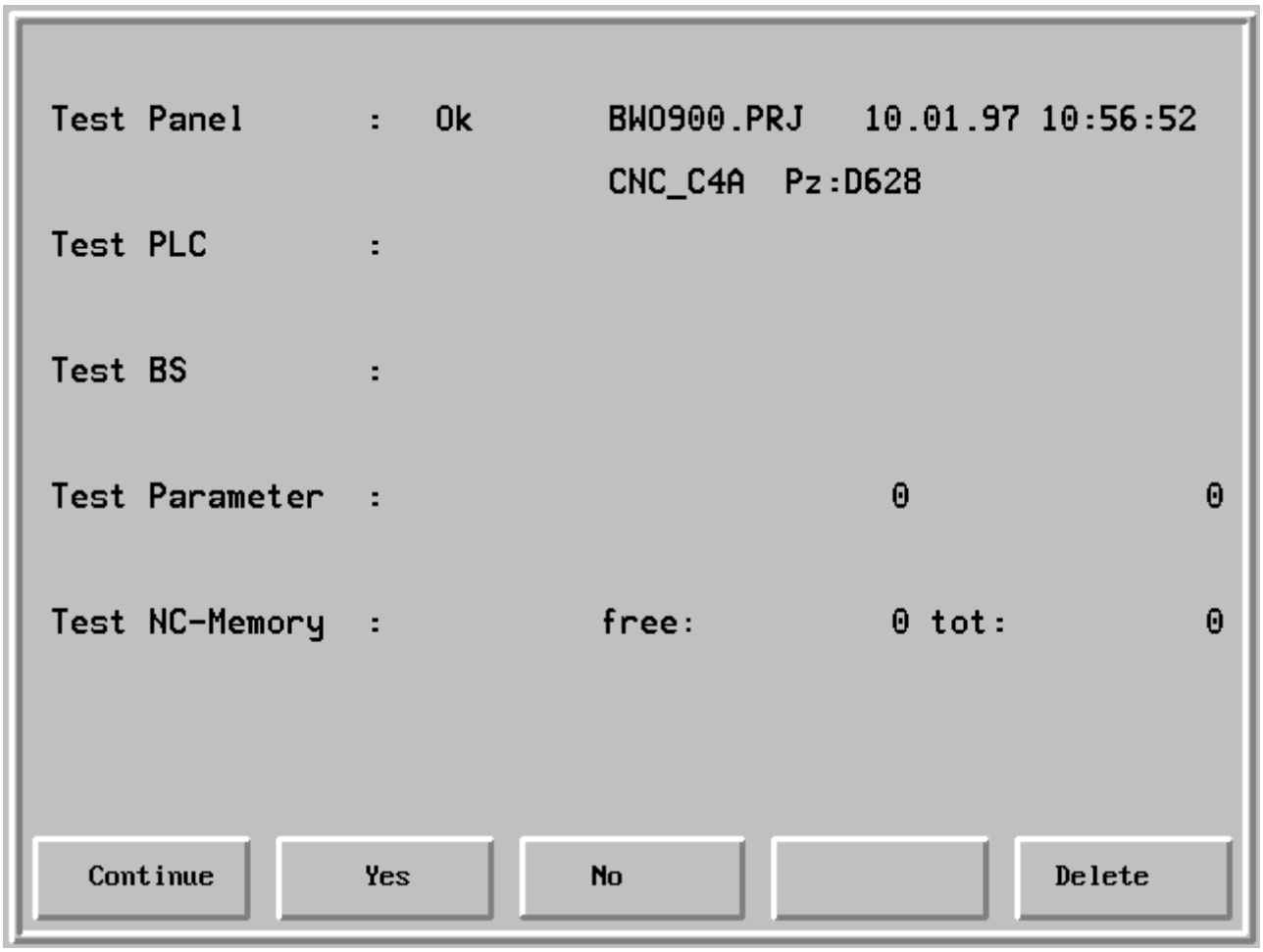



Here the function keys “Continue” and “Yes” and “No” are used combined with the key (Delete).

## 2.2.2 Power on test with confirmation (continued)

Test operating panel

After a successful test, the following display appears:




Meaning:

Line 1 Project name of the PROMA surface
with date and time of making the surface (SHOW_E).

Line 2 PLC program, from which the symbols are taken, with check sum.

## 2.2.2 Power on test with confirmation (continued)

### Test PLC program

After a successful test, the following display appears:

```
Test Panel       :   Ok       BW0900.PRJ   10.01.97 10:56:52
                              CNC_C4A  Pz:D628
Test PLC         :   Ok       CNC_C3E  Pz:D755  V2.0

Test BS          :

Test Parameter   :                         0              0

Test NC-Memory   :           free:         0 tot:         0

   Continue      Yes      No                        Delete
```

Meaning:

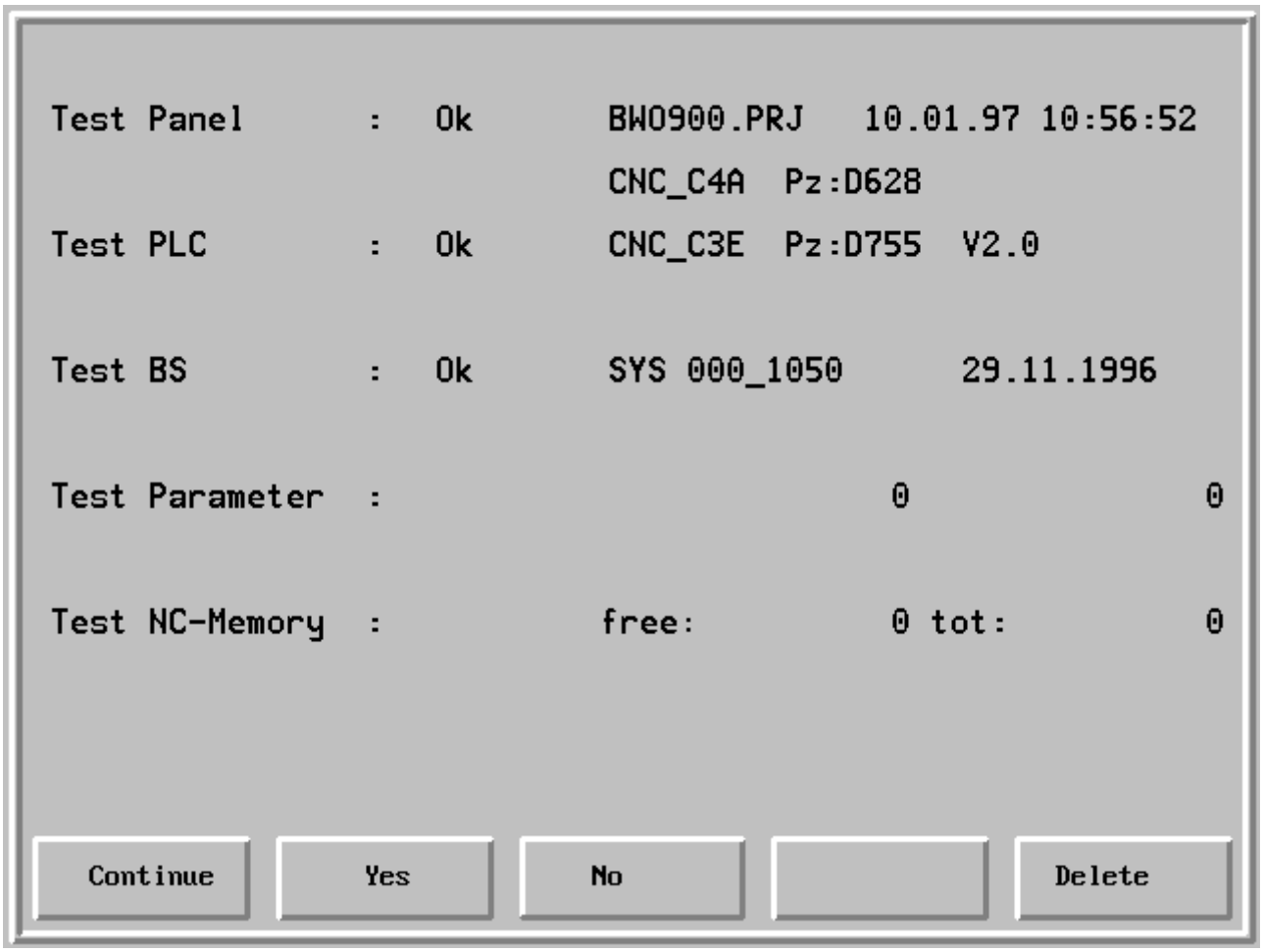
Line 3 Actual PLC program with check sum and number of version

**Note:** Program name and check sum of the PLC program (operating panel) from which the symbols are taken, and of the actual PLC program should be the same (line 2 and 3).
If the names or check sums are different, it has to be checked if the symbols used in the surface have the same position as they do in the actual NC program.

## 2.2.2 Power on test with confirmation (continued)

### Test operating system

After a successful test, the following display appears:




Meaning:

Line 4 CNC standard operating system with version and date

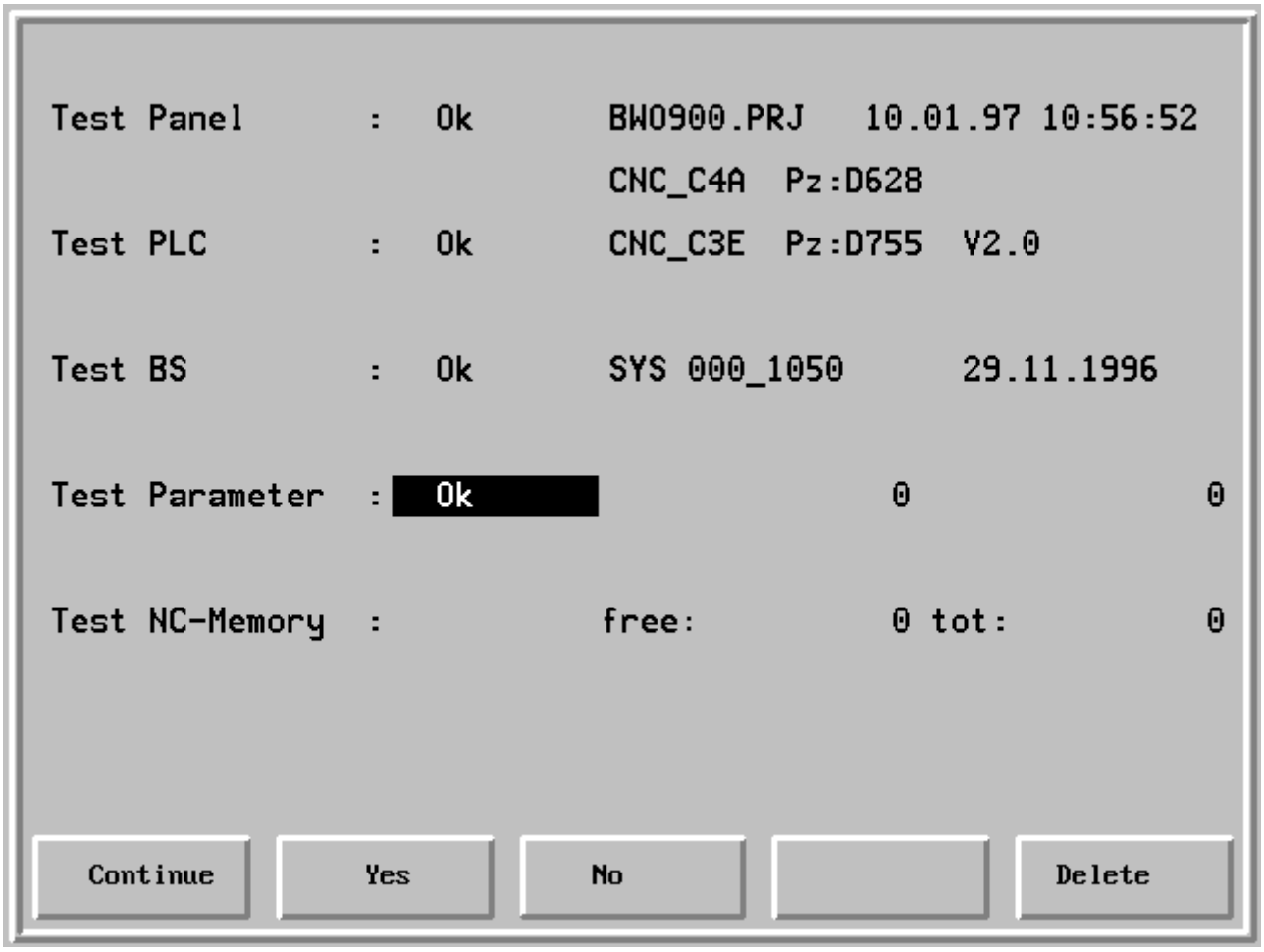
Line 5 Option: DLL-software for customer-specific operating system enlargements with name and date

## 2.2.2 Power on test with confirmation (continued)

### Test parameter

After pressing the function key “Continue”, the parameter memory is checked.

The following display appears after a successful test:




Meaning:

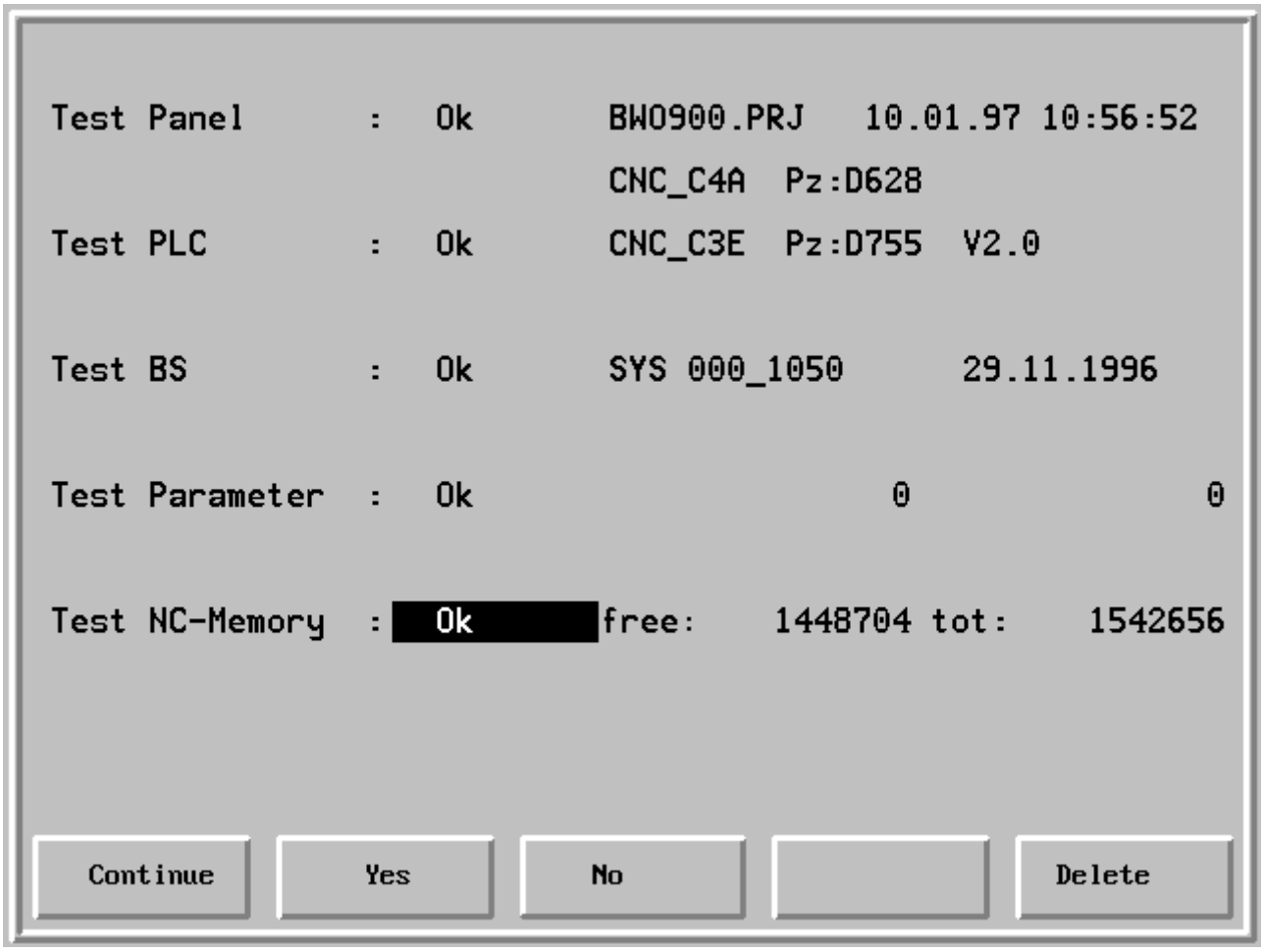
Line 6 The parameter memory is all right.

## 2.2.2 Power on test with confirmation (continued)

### Test NC memory

After pressing the function key “Continue”, the NC memory is checked.

The following display appears after a successful test:



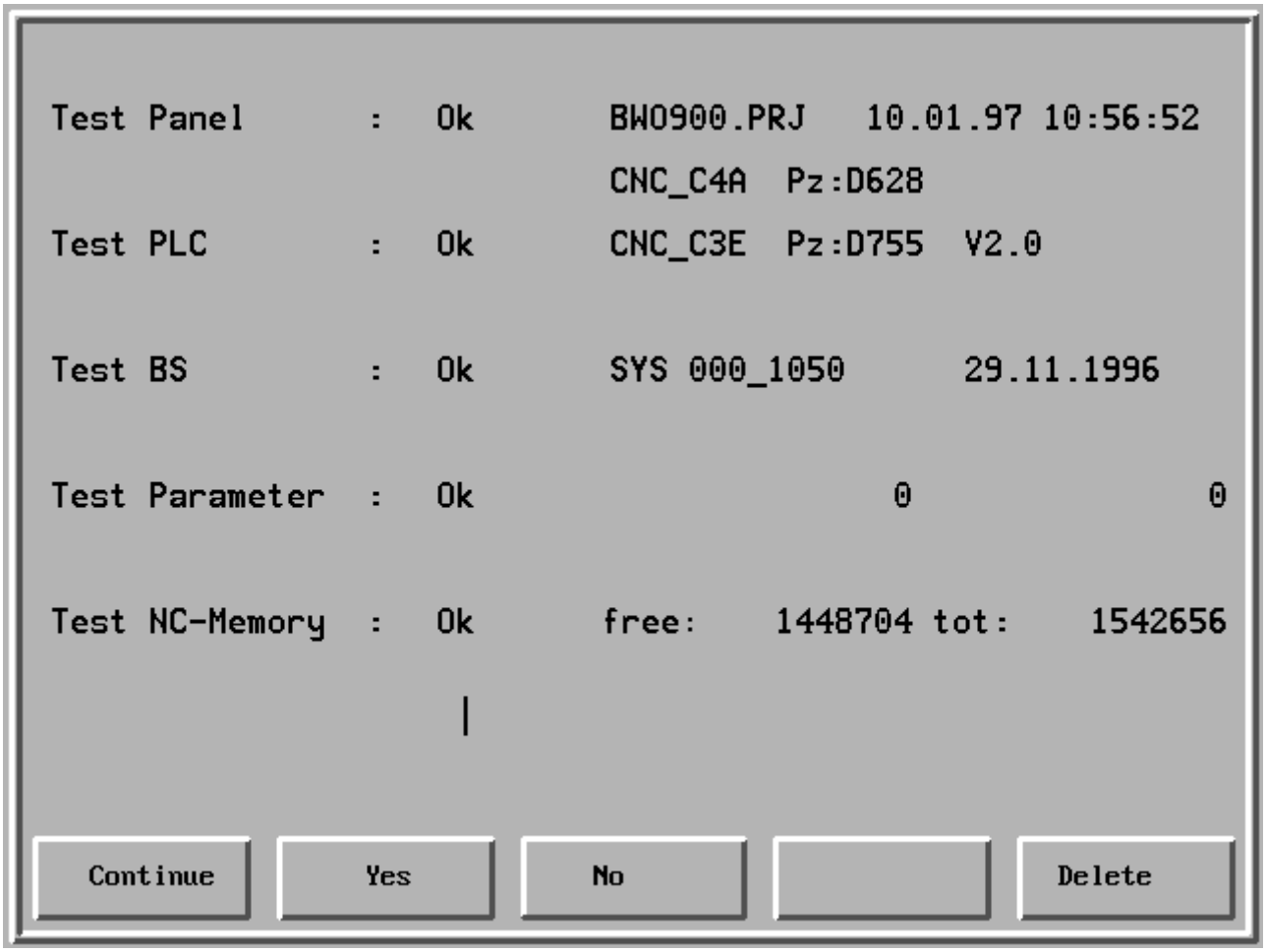

Meaning:

Line 7 NC memory is all right
Indicating free memory and complete memory

## 2.2.2 Power on test with confirmation (continued)

### Finish power on test

After pressing the function key “Continue” the power on test is finished and the system is loaded (takes some seconds).
The following display appears after a successful test:

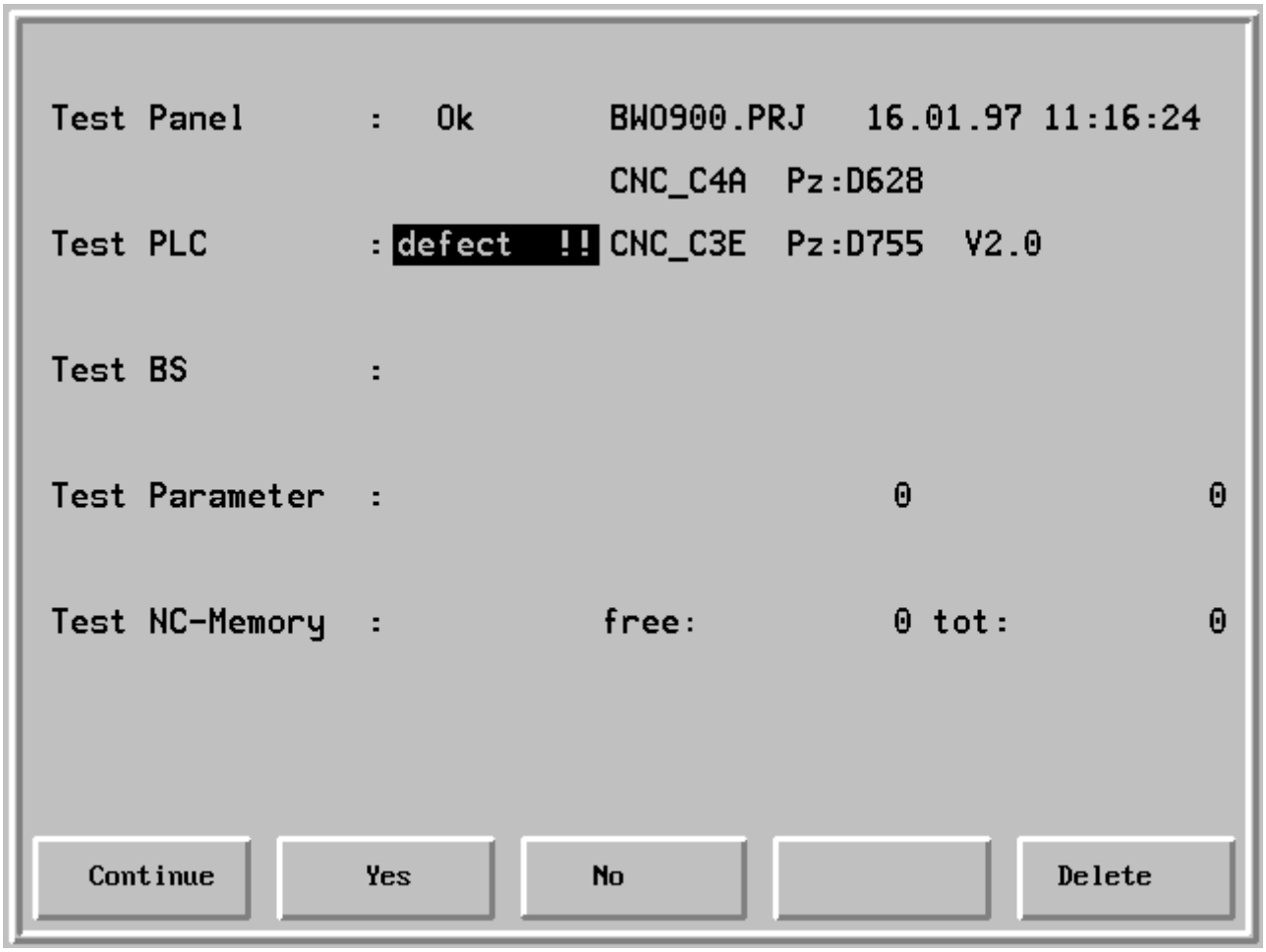



Then, the company sign appears.

### 2.2.3 Power on test with error

**PLC test**

If the following display appears, the PLC program is defective. The power on test is stoped.
In this case, the PLC program has to be loaded again and has to be stored in the EEPROM.



## 2.2.3 Power on test with error (continued)

### Parameter test

The following display appears if the parameter memory is defective. The power on test is stoped.

```
Test Panel       :  Ok      BW0900.PRJ   16.01.97 11:16:24
                            CNC_C4A  Pz:D628
Test PLC         :  Ok      CNC_C3E  Pz:D755  V2.0

Test BS          :  Ok      SYS 000_1050      29.11.1996

Test Parameter   :  defect !!            1          29995

Test NC-Memory   :          free:        0 tot:         0

 Continue   Yes   No                      Delete
```

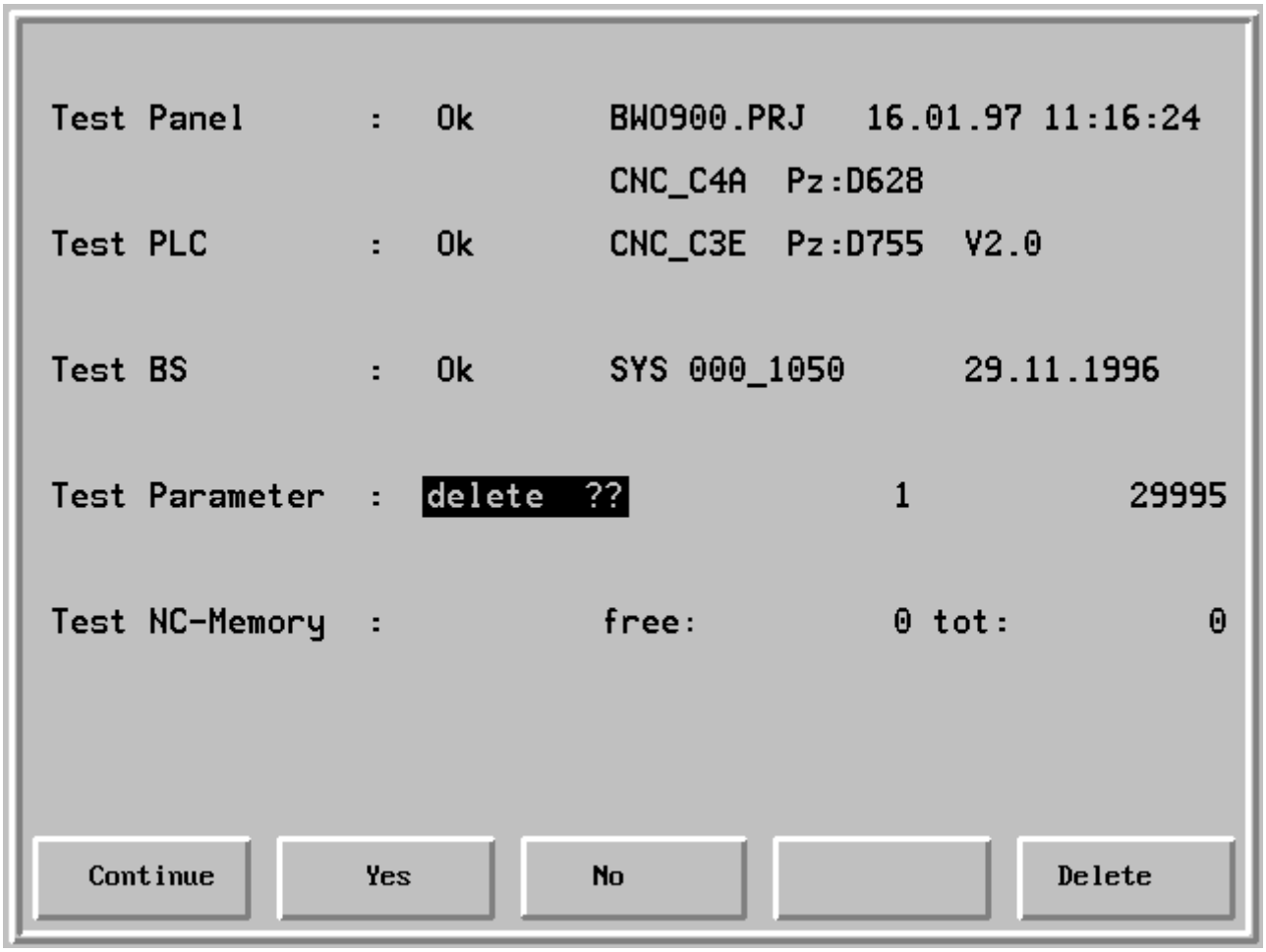
Meaning:

Line 6 Display of the first defective parameter (q) and the number of defective parameters.

## 2.2.3 Power on test with error (continued)

### Parameter test

The power on test is only continued if the key (Delete) is pressed. The following display appears.




Delete ??

Key “Yes” Delete the complete parameter memory

Key “No” The parameter memory is not deleted.
Go on to test NC memory with pressing the key “Continue”

## 2.2.3 Power on test with error (continued)

### Parameter test

After Delete ? and pressing the key “Yes” the following functions are loaded
- BWO presettings
- customer-specific data from the EEPROM.


Go on to test NC memory with pressing the key “Continue”

## 2.2.3 Power on test with error (continued)

### Test NC memory

The following display appears if the NC memory is defective. The power on test is stoped.

```
Test Panel       :  Ok      BW0900.PRJ   16.01.97 11:16:24
                            CNC_C4A  Pz:D628
Test PLC         :  Ok      CNC_C3E  Pz:D755  V2.0

Test BS          :  Ok      SYS 000_1050      29.11.1996

Test Parameter   :  Ok                   0              0

Test NC-Memory   : defect  !! free:      33 tot:        0

 Continue   Yes   No                     Delete
```

Meaning:

Line 7 Error code (33) and additional information (0)

## 2.2.3 Power on test with error (continued)

### Test NC memory

### Meaning of the error codes

| Code | Meaning |
|---|---|
| 02 | Program not found |
| 05 | End of program or Write-/ Read indicator > program size |
| 06 | No free memory |
| 07 | Faulty check-sum |
| 10 | Error when reading from NC memory |
| 11 | Error when writing on NC memory |
| 15 | No program input , e.g. key-operated switch locking |
| 16 | Program should be opened for writing, but is already opened |
| 25 | Key-operated switch interlocking |
| 30 | Defective directory chain |
| 31 | Defective program chain |
| 32 | Defective list of free blocks |
| 33 | Defective check-sum of system data |
| 35 | Blocks in program system are double-chained |

## 2.2.3 Power on test with error (continued)

### Test NC memory

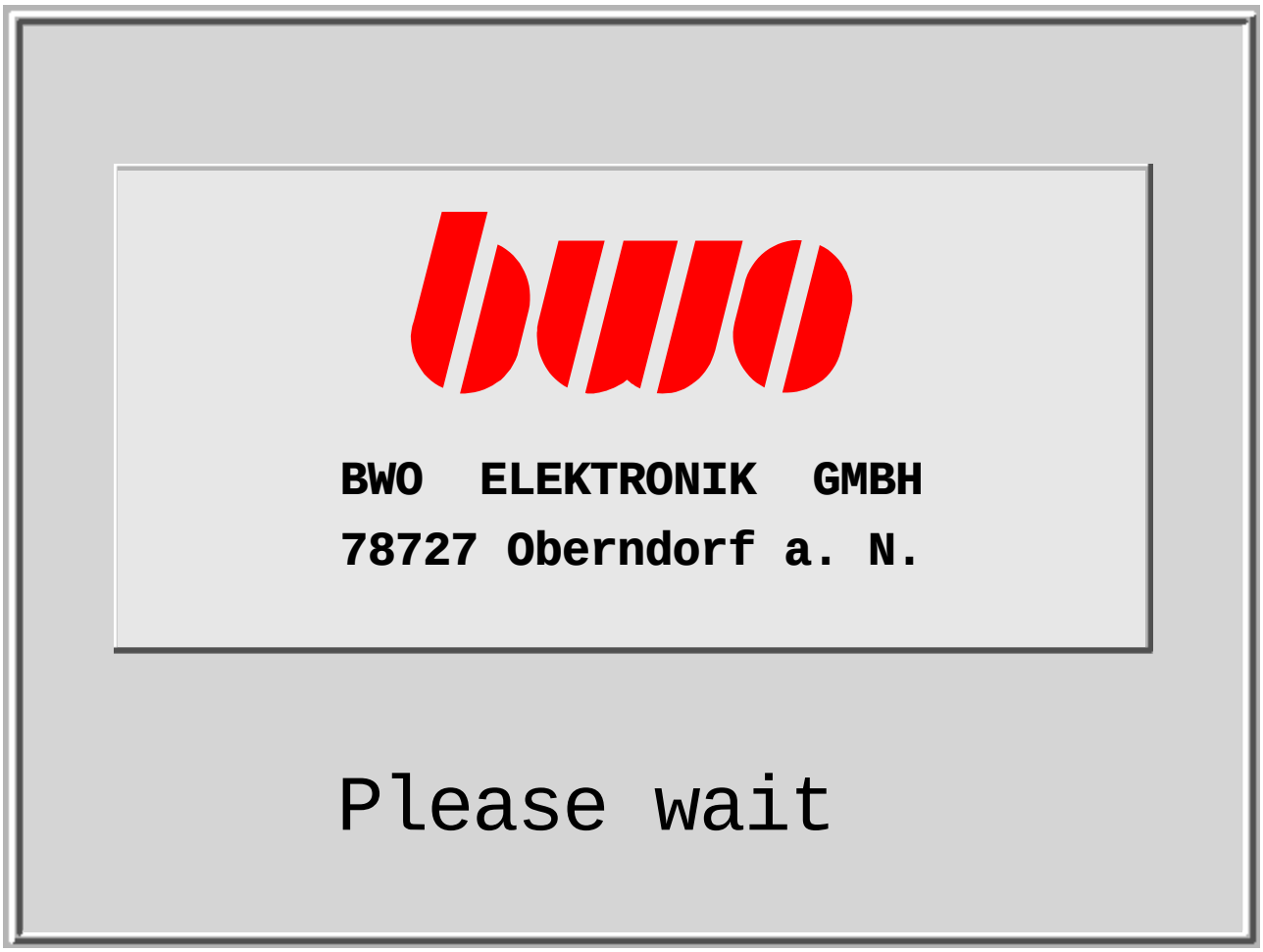
The power on test is only continued if the key (Delete) is pressed. The following display appears.


Delete ??

Key “Yes” Delete complete NC memory

Power on test is finished with pressing the key “Continue” and the company sign appears.

### 2.2.4 Company sign



## 2.3 Reference points

Reference points are machine-specific mechanical fixed points.

After the power on tests, you have to approach with each axis the corresponding reference point, if the machine works in the incremental measuring system.
The reference point is stored and the actual value display is set with the correct value.
In the first line of the display field, the axes of which the reference point is not stored, are shown.

Because the traverse directions for taking reference points are depend on the machine, the following explanation can only be an example.

Note: The reference point must not be identical with the machine zero point.

### 2.3.1 Approaching reference points automatically

The reference points can be approached automatically, if a corresponding program is stored in the PLC. The key  is reserved for this program.

## 2.3.2 Manual approaching of reference points

### Requirements

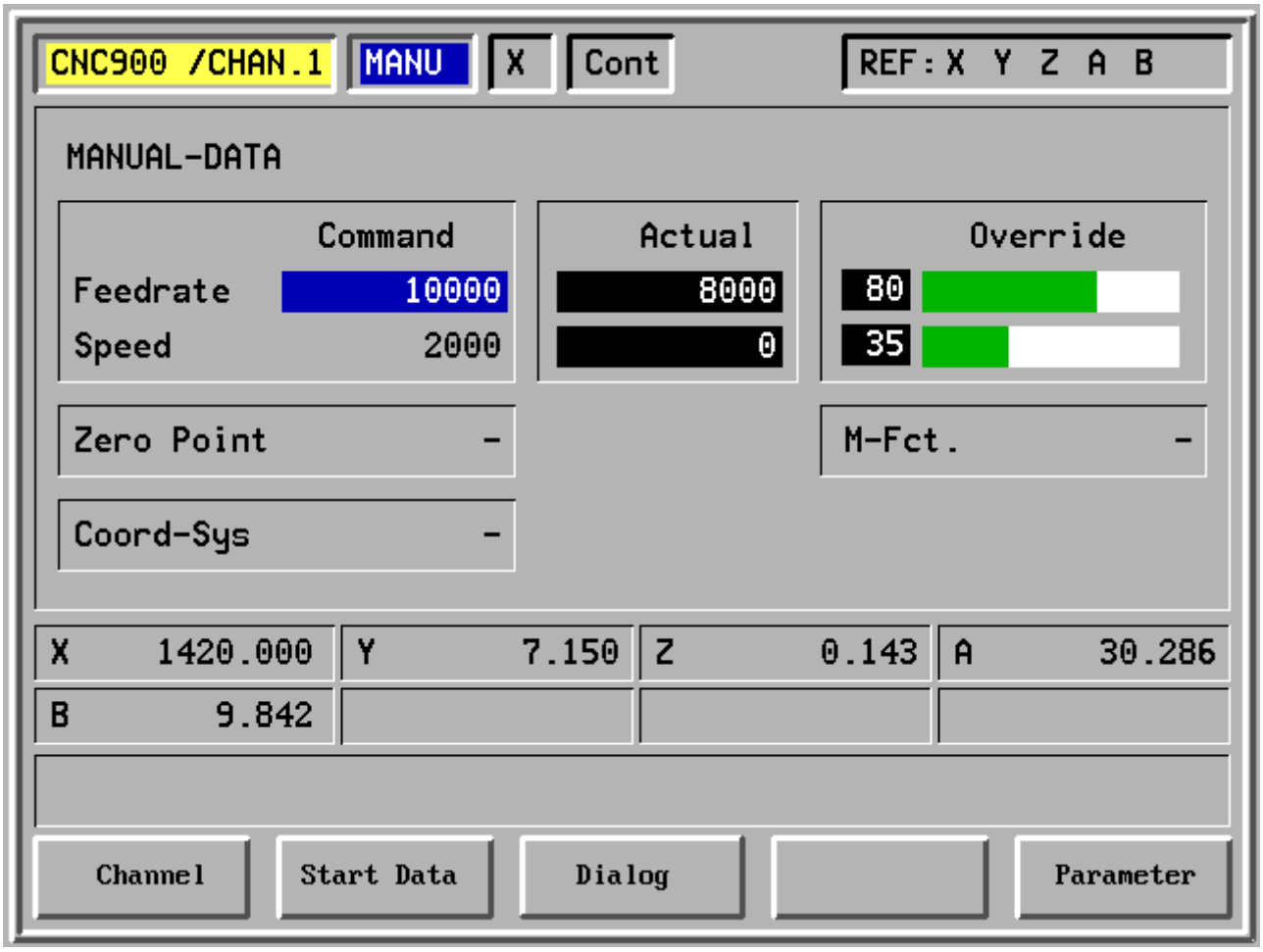
- Power on tests are ready.
- The control is switched on (key “Control on” is pressed)
- The operating mode “Manual” is set.
- The feed for manual mode is given, feed override > 0.
- The drive mode is set (e.g. “continually”).

### Approach reference point of an axis, e.g. X-axis

Press key “X”

Display: MANUAL X Cont Ref: X Y Z A B

Press key “Manual” until max. end position of the X-axis is reached.



## 2.3.2 Manual approaching of reference points (continued)

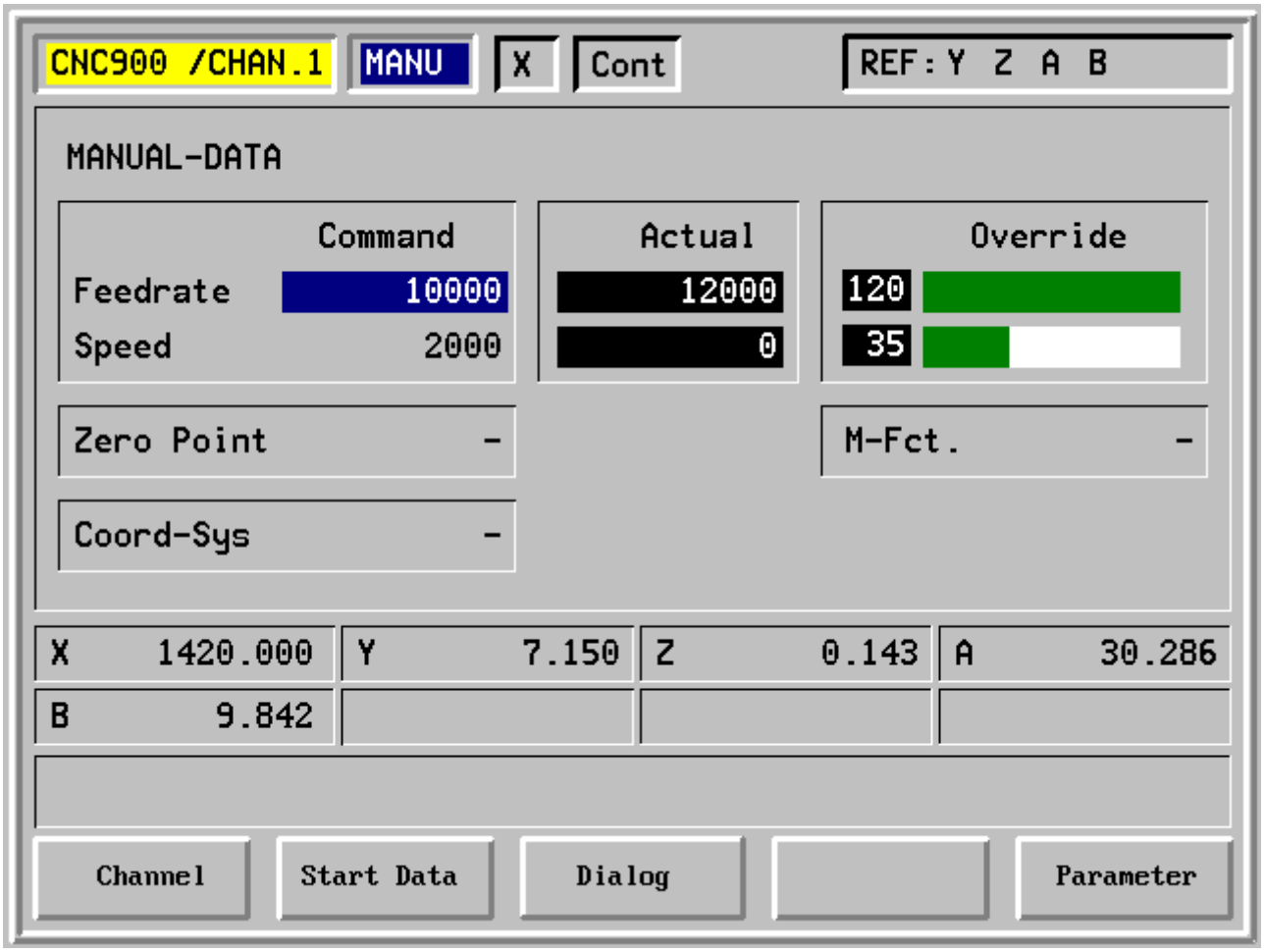
Approach reference point of an axis, e.g. X-axis

Then press “Manual” until the X disappears from the display.

Display: Manual X Cont REF: Y Z A B

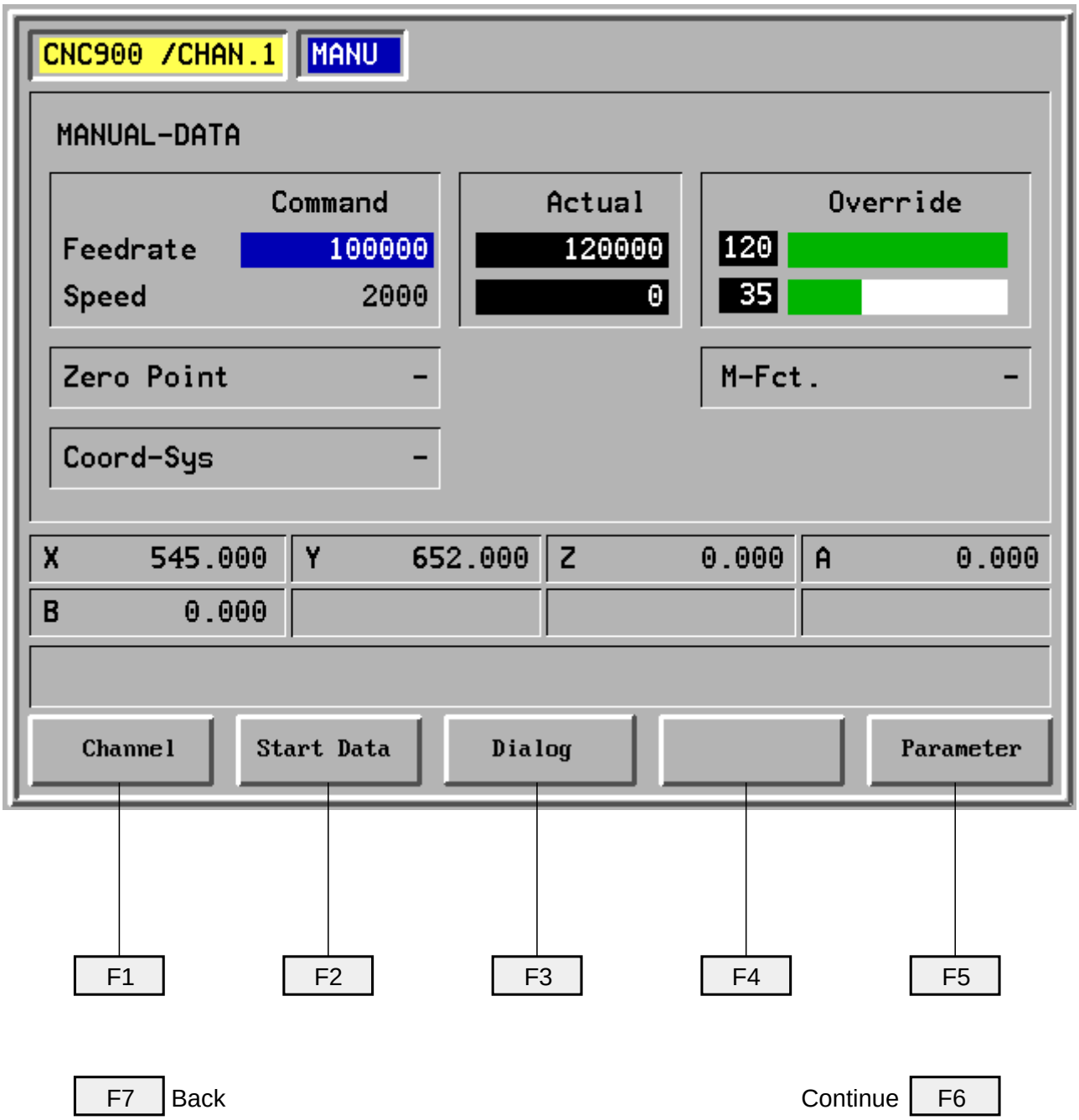
Now the reference point for the X-axis is stored.

The same procedure is valid for the other axes.



## 2.4 Screen keys and screen displays

### 2.4.1 Position of the function keys in the screen frame



### 2.4.2 Setting the screen brightness

The brightness of the screen can be set continuously.

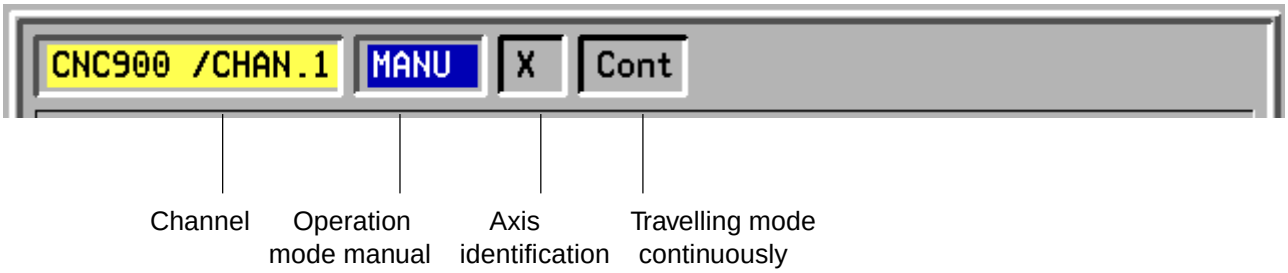
When pressing the function key “**F6**” and

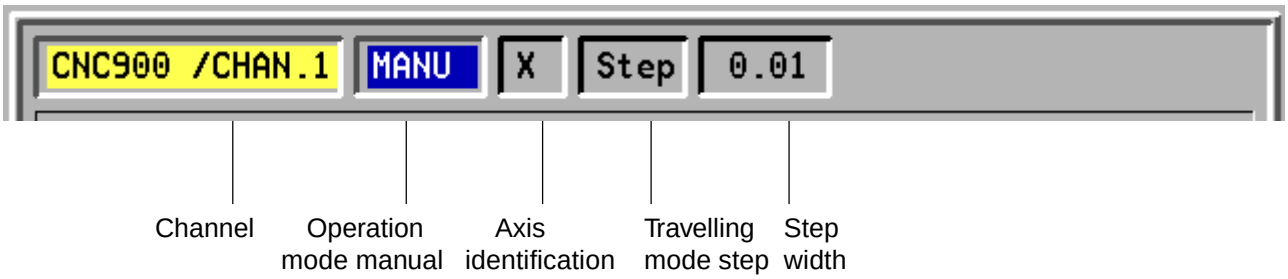
 (Page up) the creen becomes brighter,

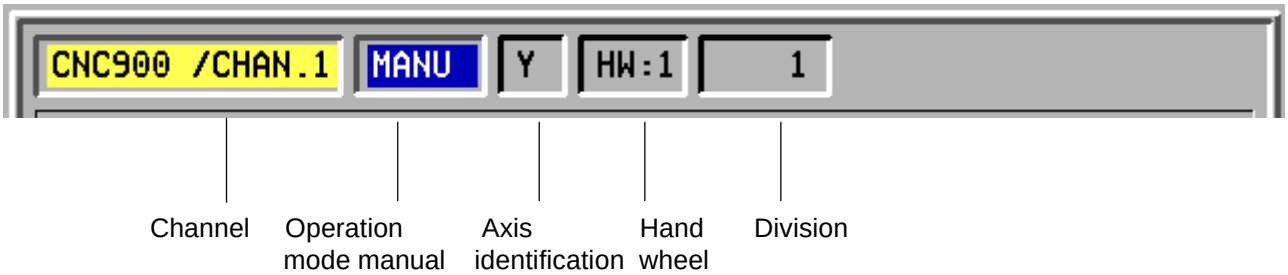
 (Page down) the screen becomes darker.

## 2.4.3 Screen display in the headline

### Displays in manual mode

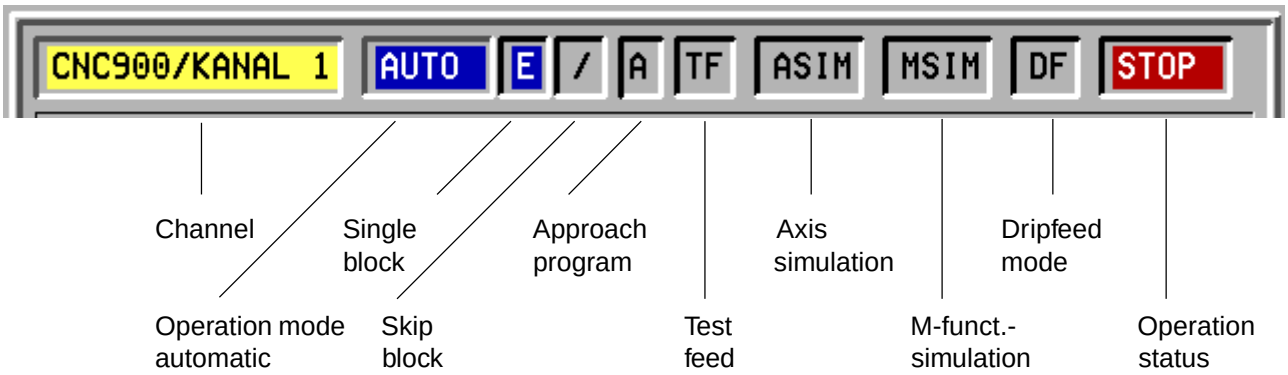


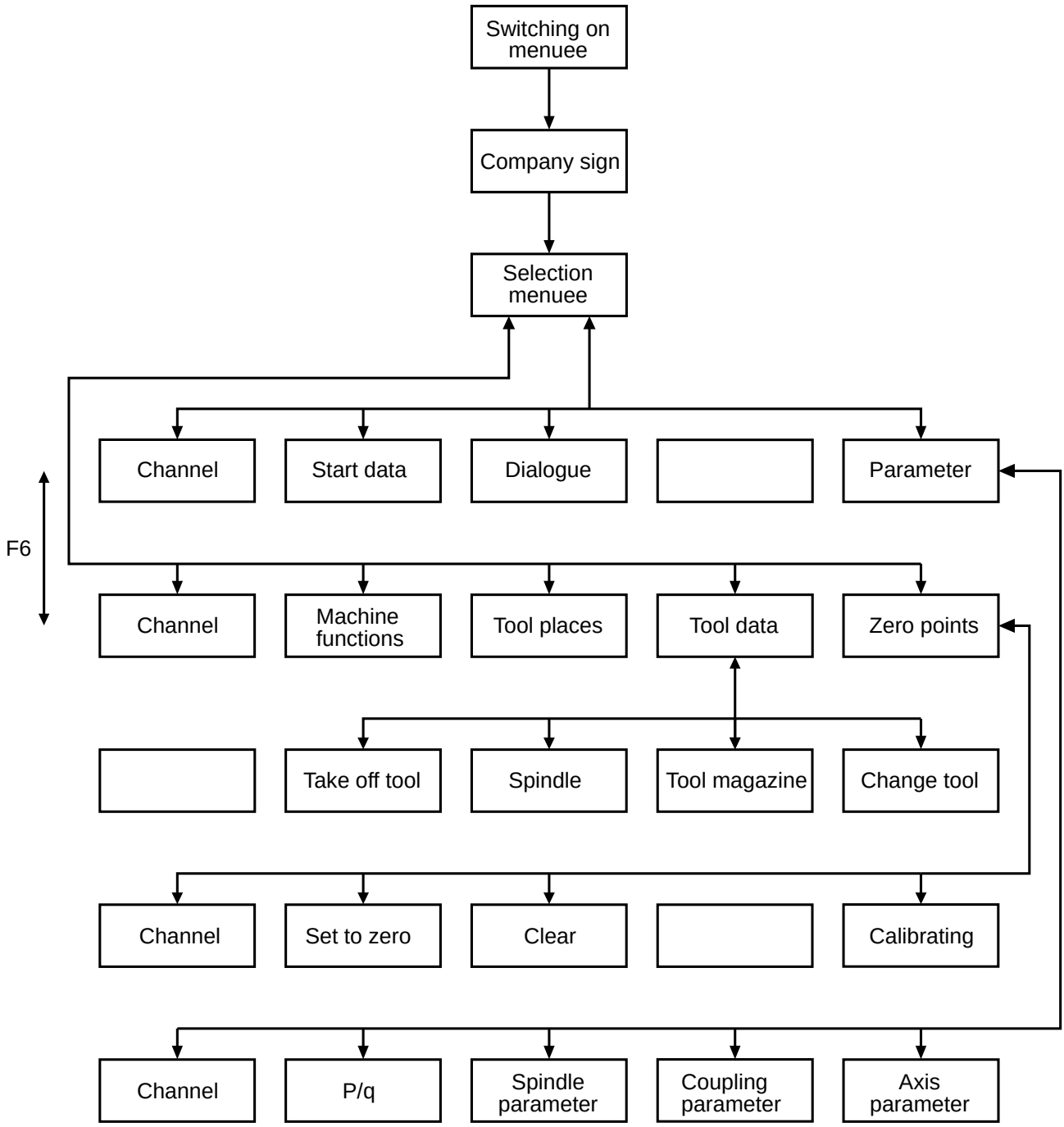
## 2.4.3 Screen display in the headline (continued)

### Displays in automatic mode



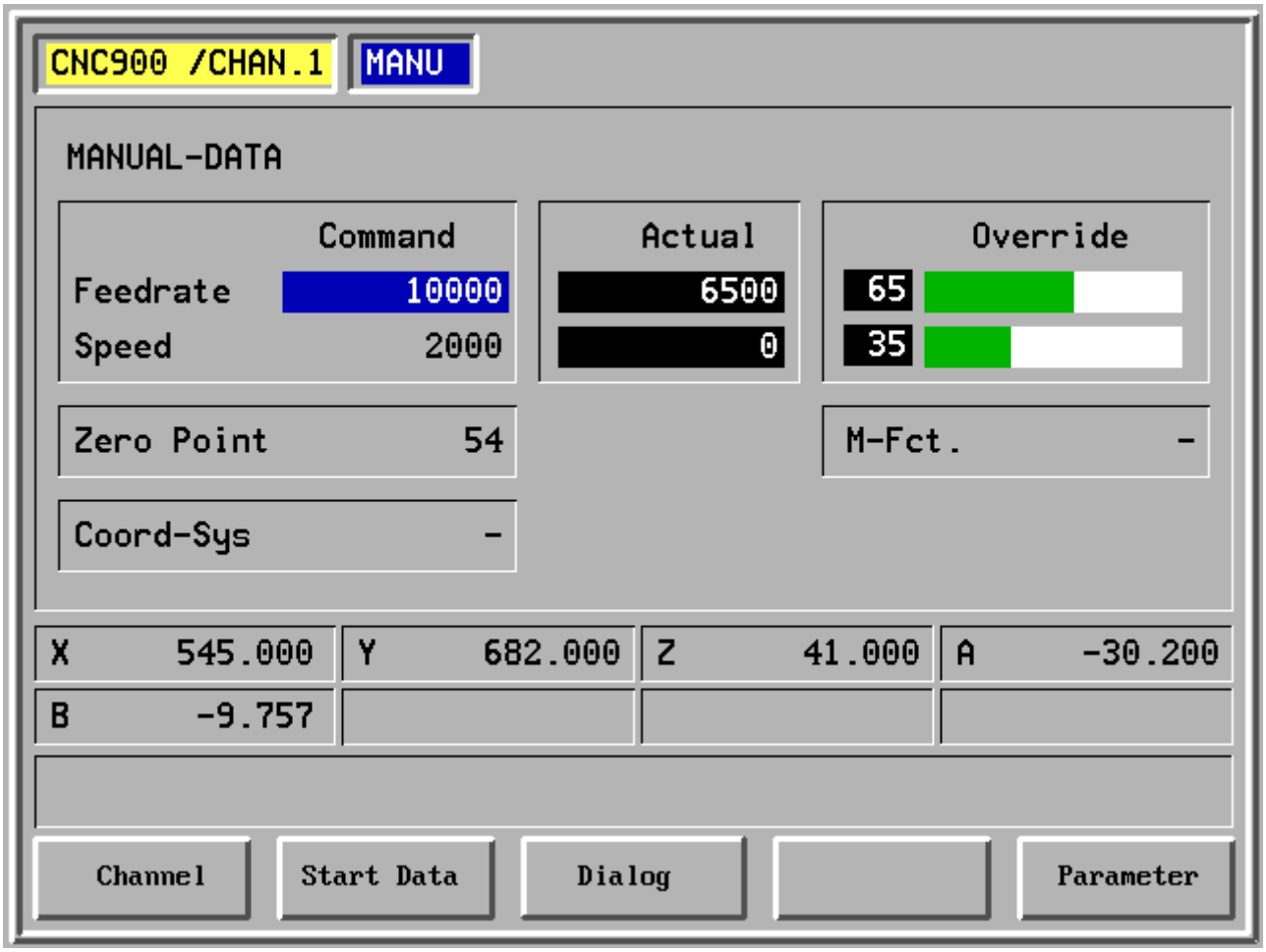
## 2.5 Selection menue

### Menue tree



## 2.5 Selection menue (continued)

All functions can be selected with the selection menue with the function keys F 1 to F7.
The menue consists of two function pictures. **Selection picture 1:**




Selection of

F1 Channel

F2 Start data

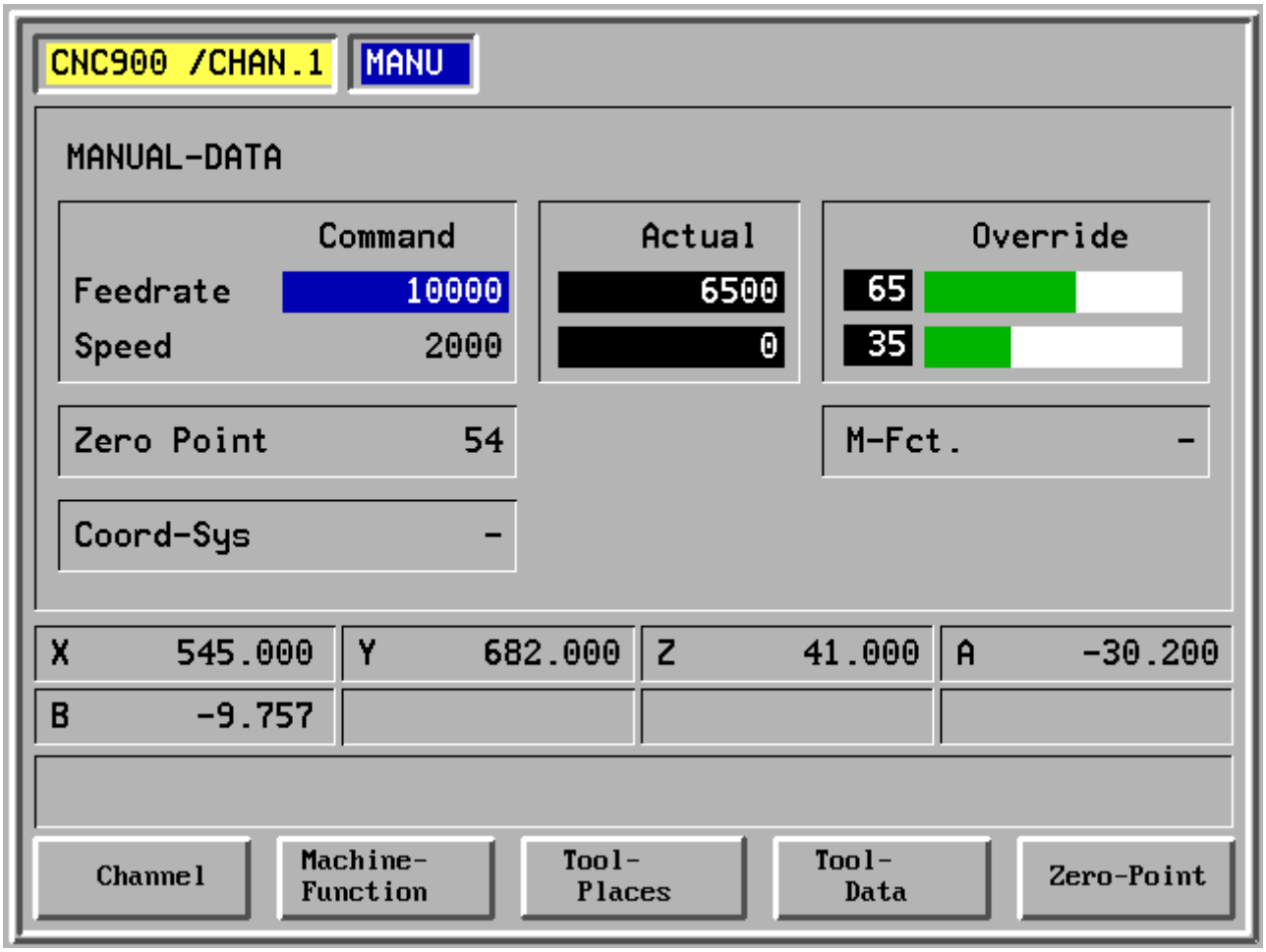
F3 Dialogue

F4 -

F5 Parameter

## 2.5 Selection menue (continued)

**Selection picture 2:**
Switching from selection picture 1 <—> selection picture 2 with function key F6 (roll function)




Selection of

F1 Channel

F2 Machine function

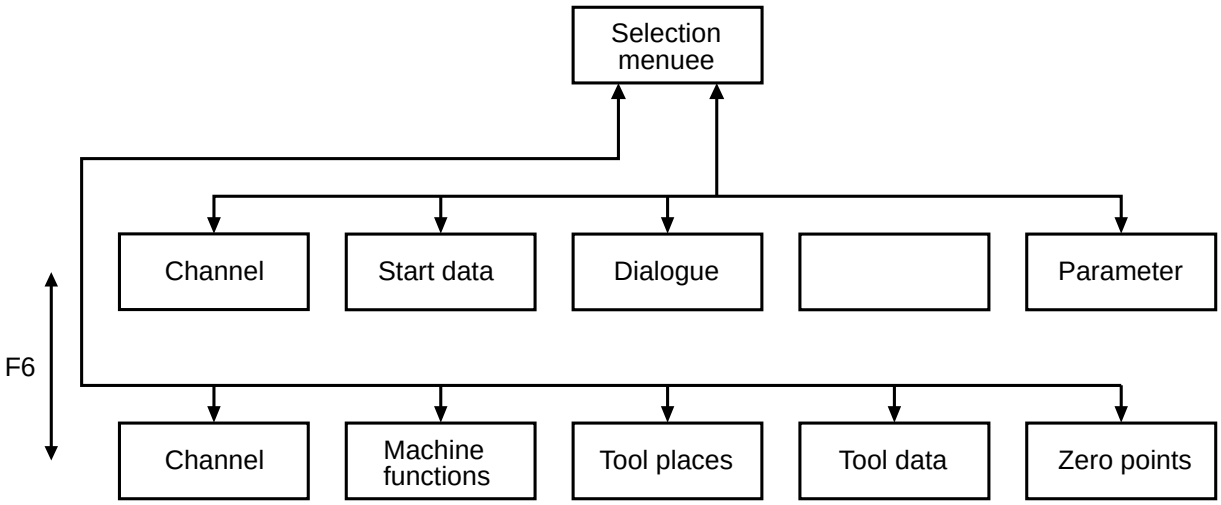
F3 Tool places

F4 Tool data

F5 Zero points

## 2.5 Selection menue (continued)

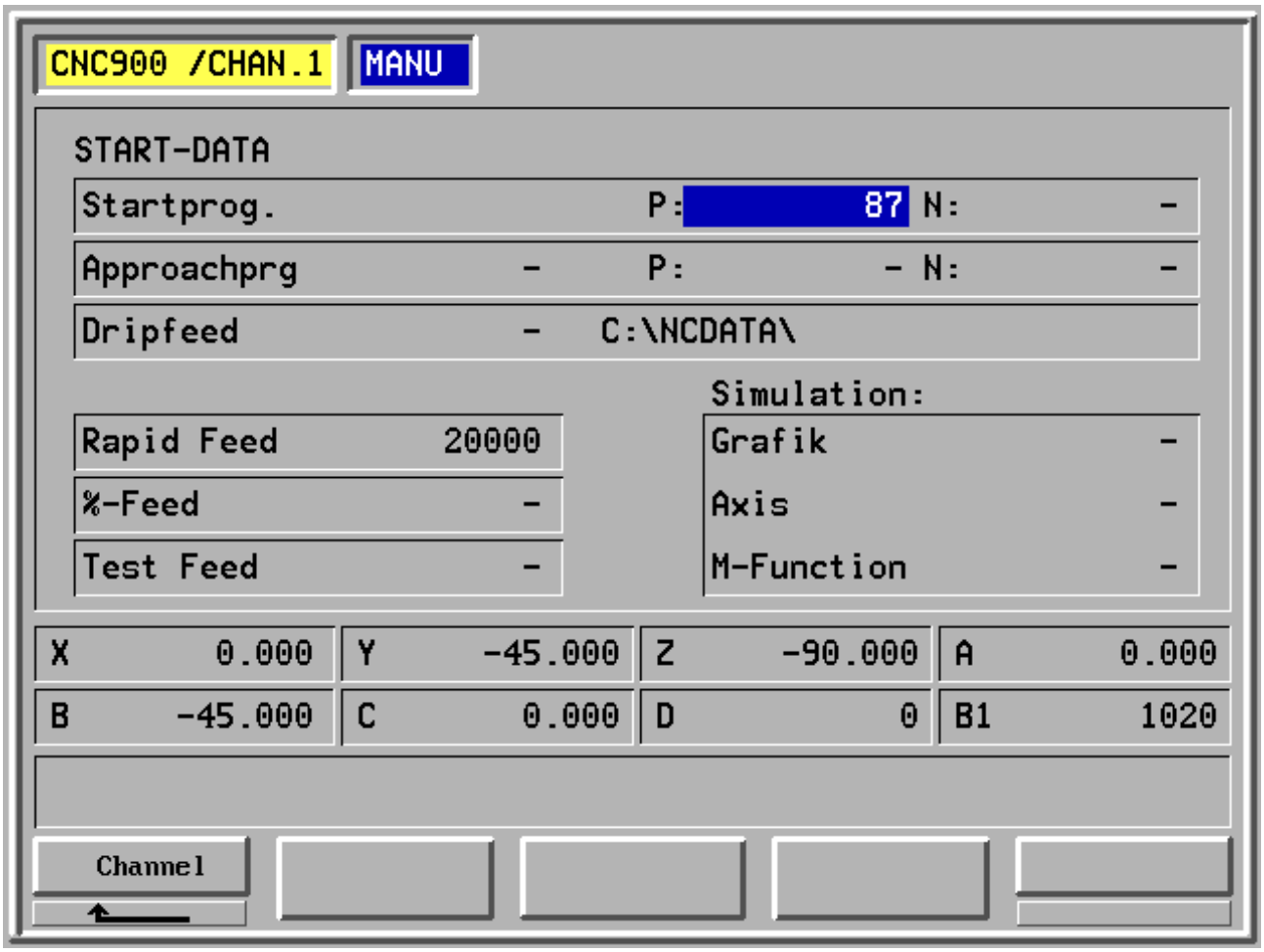
### Menue tree




| Functions | Section |
|---|---|
| Start data | 2.8 |
| Dialogue | 2.9 |
| Parameter | 2.10 |
| Machine functions | 2.11 |
| Tool data | 2.12 |
| Zero points | 2.13 |

### 2.5.1 Start data

The following menue enables setting the start data.




F1 Channel

F2 -

F3 -

F4 -

F5 -

## 2.5.1 Start data (continued)

### Block

Input block number of the starting block. If the value is 0 or deleted, the NC program is started with the 1st block.

### Rapid traverse

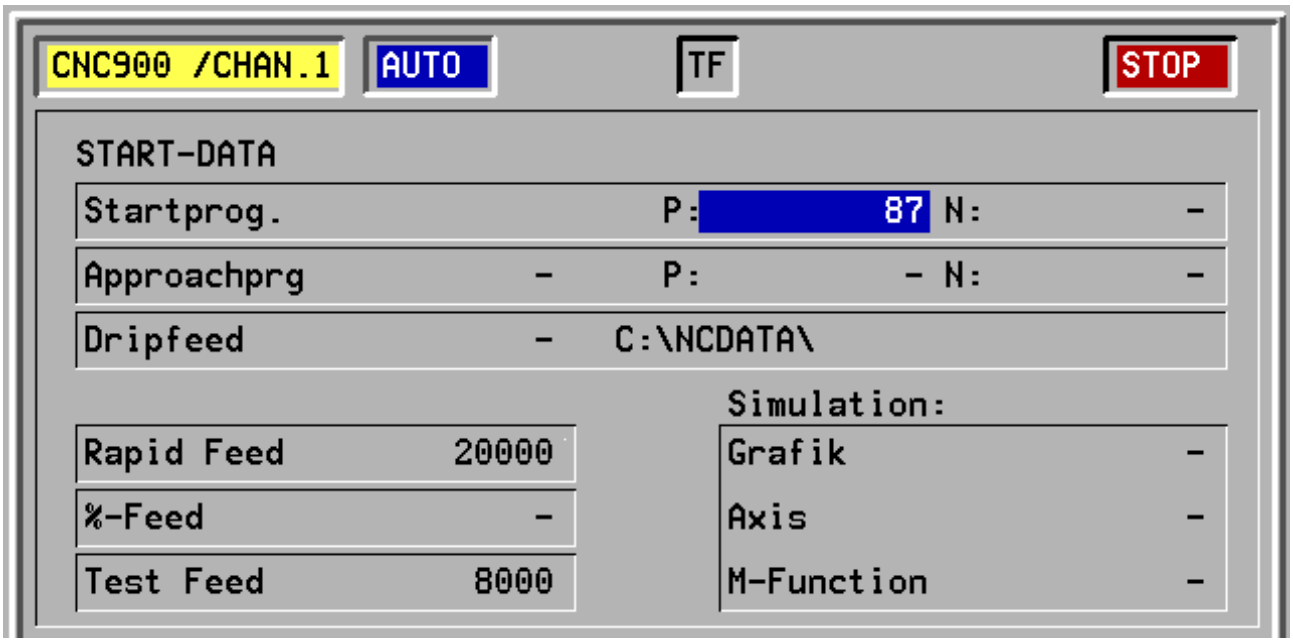
The desired rapid traverse can be input. If the value is 0 or deleted, the manual feed is active.

### % Feed

The programmed feeds in the NC program are modified with the indicated percentage.

### Test feed

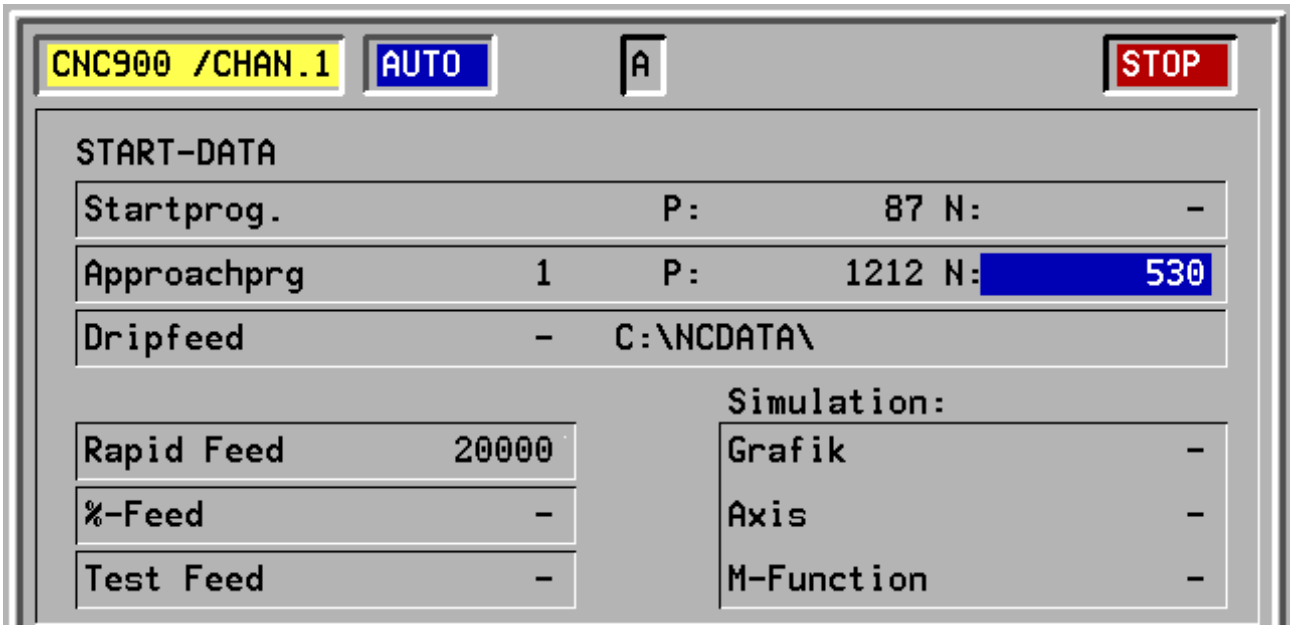
If a test feed is input the programmed feeds in the NC program are ineffective.
The test feed is active. If the value for the test feed is 0 or deleted, the test feed is not active.



## 2.5.1 Start data (continued)

### Reapproach program

In the case of the abort of a current NC program (HAND abort, message) by the system the actual NC program position in the parameters P8802, P8803 and P8807 is stored. The NC program position is displayed in the start data menu. On properly terminated NC program resets this information.




After an NC abort if the restarting mode is switched on (P8804=1)und the NC program started, then the NC program up to the restarting point is simulated, i.e.. no axis movements result.

In the restarting block the simulation is switched off. The restarting position is started on direct path. With achieving the restarting position P8804=0 is settinged.

One re+starts on the initial position of the aborted block.

If the NC program in a process cycle is aborted, then becomes to cycle start started.
When restarting m-functions and m-cycles are treated according to m-Funktionsdefinition (P11050..., P8250...).

## 2.5.1 Start data (continued)

### Dripfeed mode

The NC programs that should be processed are not in the NC memory of the control but in external data carriers.

The operating panel **CNC 900 C** has the NC programs on the hard disk or on a data server.

With the operating panel **CNC 900**, the NC programs have to be read in via I/O (BWO-I/O-socket, NCARC.EXE).

NC programs for dripfeed have to be linear, i.e. block skips and sub-program call-ups are not allowed.

Activating in the start-data menue:

| | | |
|---|---|---|
| Dripfeed | 1 | Dripfeed on |
| Dripfeed | 0 | Dripfeed off |

### Dripfeed mode with operating panel CNC 900 C

- In the start-data menue:
  switch on dripfeed mode,
  input program number,
  check DOS-path-name,
  path-name is indicated in the start-data menue (see also CNC900X.CFG).

- Change of operating mode after AUTOMATIC.
  Now the data transmission to the dripfeed-buffer is started.
- NC start.

### Dripfeed mode with operating panel CNC 900

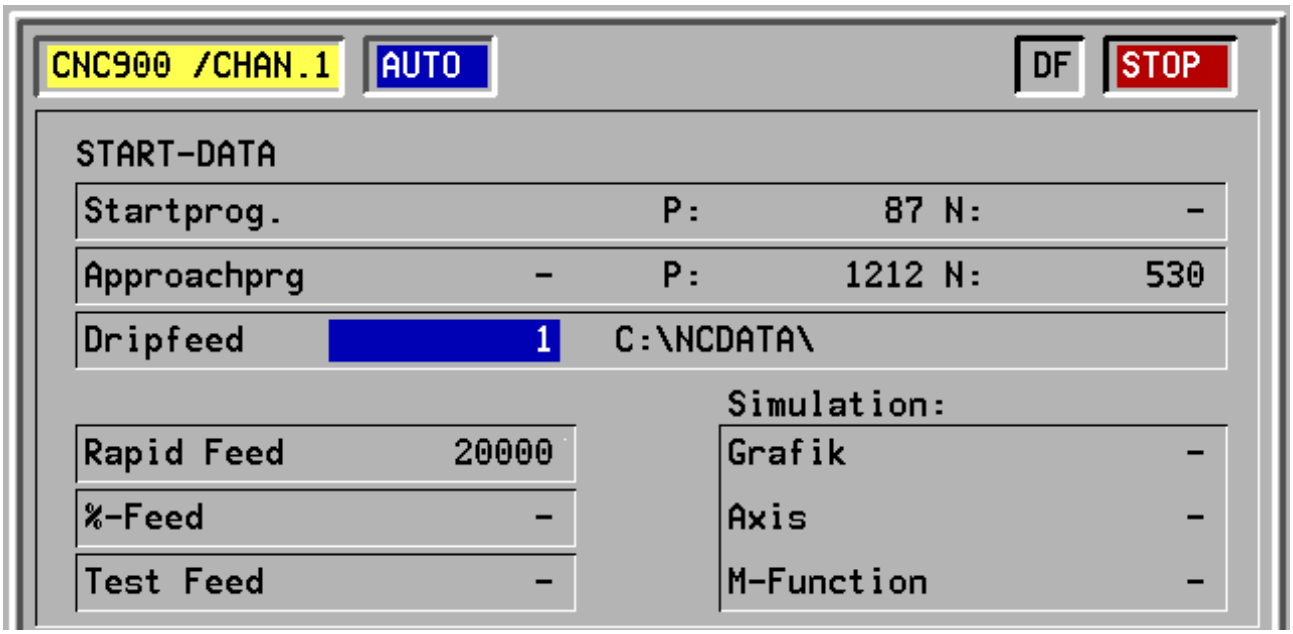
- In the start data menue:
  switch on dripfeed mode

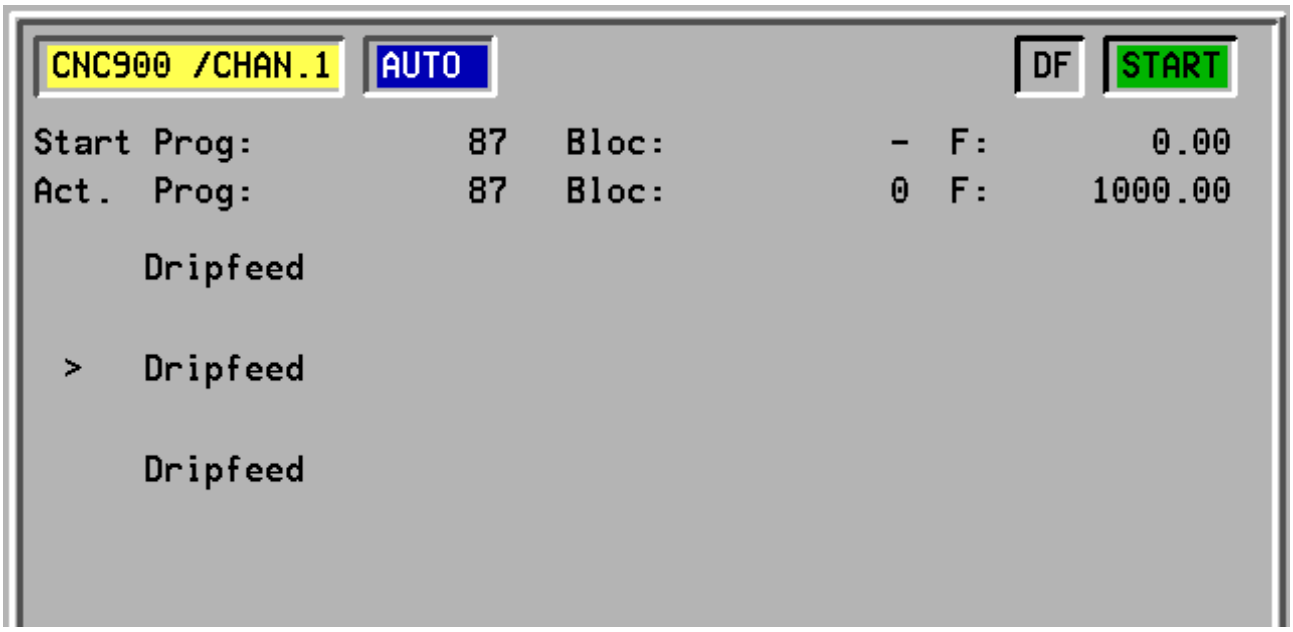
- Check I/O parameters
- Connect external data carrier
- Change of operating mode after AUTOMATIC,
  due to this an I/O-input-start is made automatically.
  The CNC is now waiting on a data transfer.
- Start data transfer at the external data carrier,
- NC start

## 2.5.1 Start data (continued)

**Dripfeed mode**

with operating panel CNC 900 C



## 2.5.1 Start data (continued)

### Simulation

### Graphic

The graphic simulation can be used for controlling optically the program run. Thereby e.g. the axes and the transmission of the M-functions can be switched off for a test run. The The graphic simulation is started in the start menue with ‘1’ and switched off with ‘0’ or ‘deleted’.

With the key you can switch from graphic to normal picture. If the graphic simulation is not switched on in the start menue, the message M4402: ‘Graphic simulation not active’ appears if you press the key .

### Axes

If the simulation of the axes is activated (1), the axes do not move during program run. But the axes movements can be seen on the screen. ‘ASIM’ is written in the headline. The function can be switched off with ‘0’ or ‘deleted’.

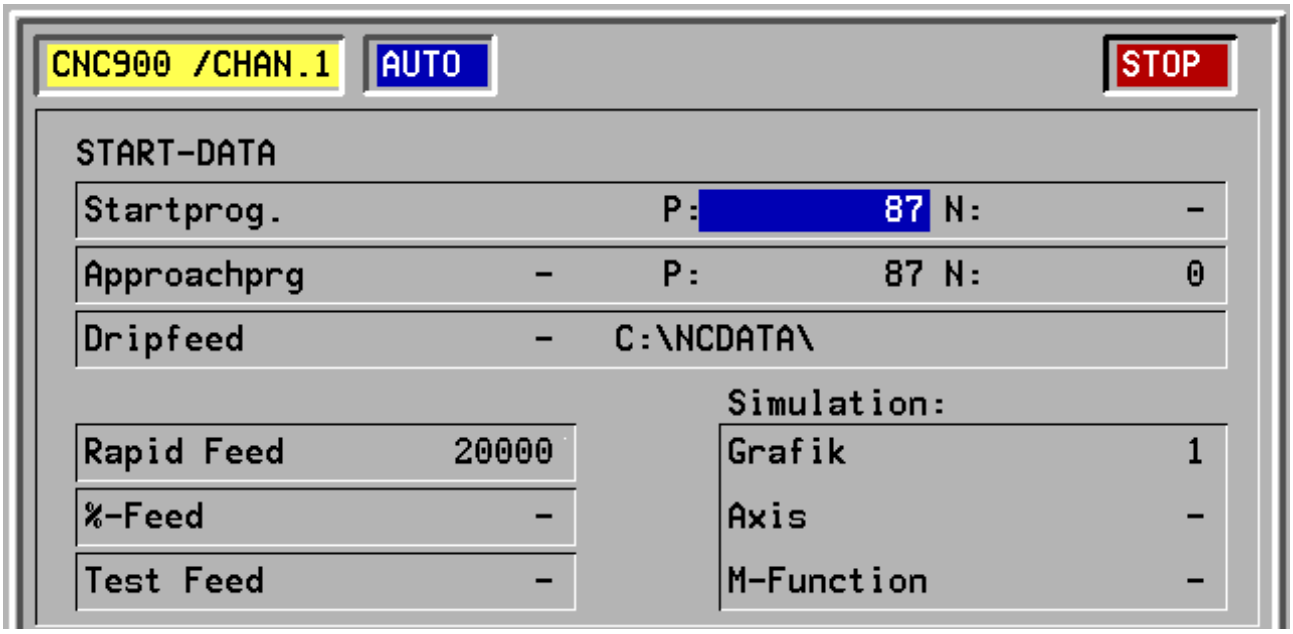
### M-functions

If the simulation of the M-functions is activated (1), the M-functions are not transmitted to the PLC. ‘MSIM’ is written in the headline. The function can be switched off with ‘0’ or ‘deleted’.

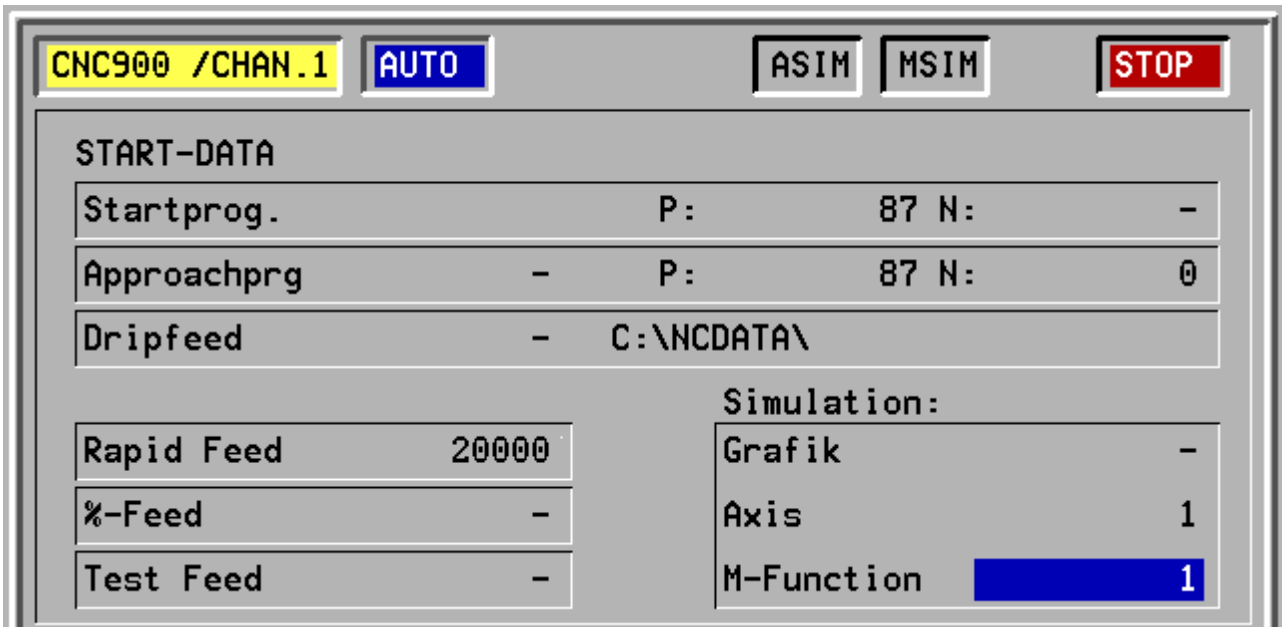
## 2.5.1 Start data (continued)

### Simulation

Graphic on




Axes and M-functions on



## 2.5.1 Start data (continued)

### Graphic simulation

| | | |
|---|---|---|
| **Data input (F2)** | | Input with numerical keys |
| X, Y and Z | | X, Y, and Z origin |
| Size | | Zoom |
| View | 0 | XY-coordinates (G17) |
| | 1 | XZ-coordinates (G18) |
| | 2 | YZ-coordinates (G19) |
| | 3 | 3D |
| A-angle | | turning around X-axis |
| B-angle | | turning around Z-axis |

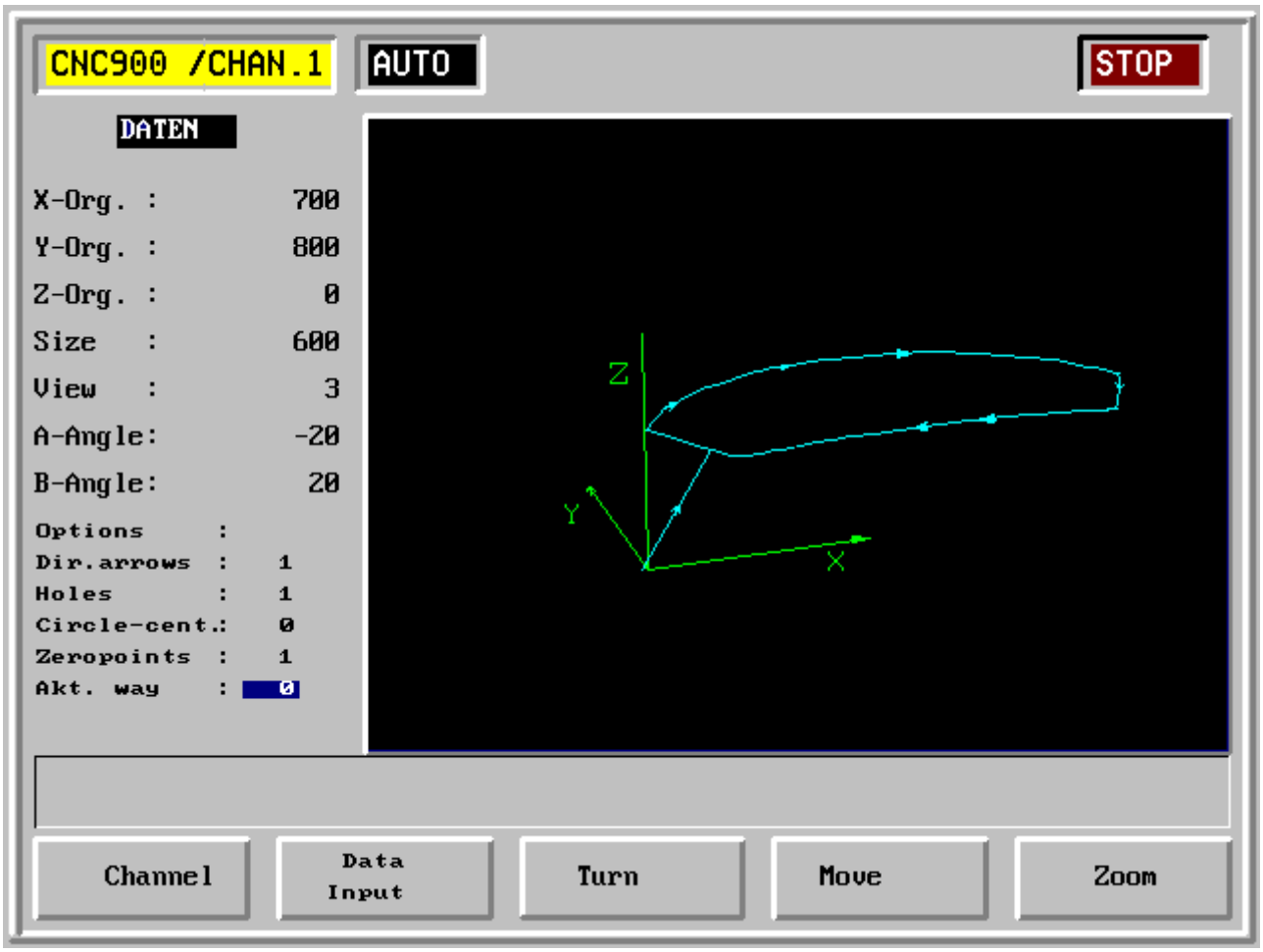
Options

| | |
|---|---|
| Direcion arrows | 1 on, 0 off |
| Holes | 1 on, 0 off |
| Circle centres | 1 on, 0 off |
| Zero points | 1 on, 0 off |
| Actual ways | 1 on, 0 off |

## 2.5.1 Start data (continued)

### Graphic simulation

Display of the target way (turned around X and Z axis)




F1 Channel

F2 Data input Input with numerical keys

F3 Turning Turning around the X-, Z-axis, input with cursor

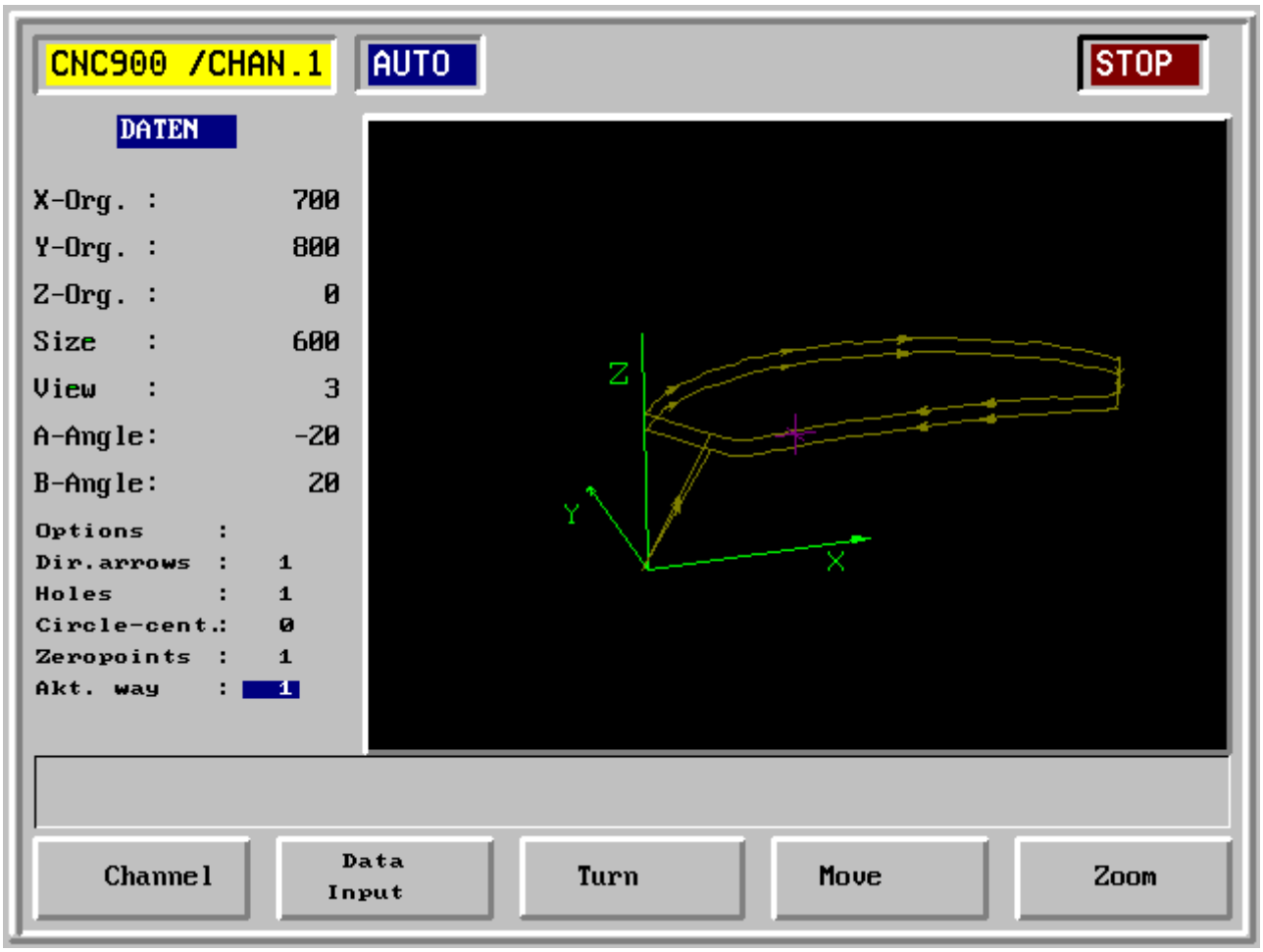
F4 Move X, Y and Z origin, input with cursor

F5 Zoom Size, input with cursor

## 2.5.1 Start data (continued)

### Graphic simulation

Display of the target and actual way (turned around X and Z axis)




F1 Channel

F2 Data input Input with numerical keys

F3 Turning Turning around the X-, Z-axis, input with cursor

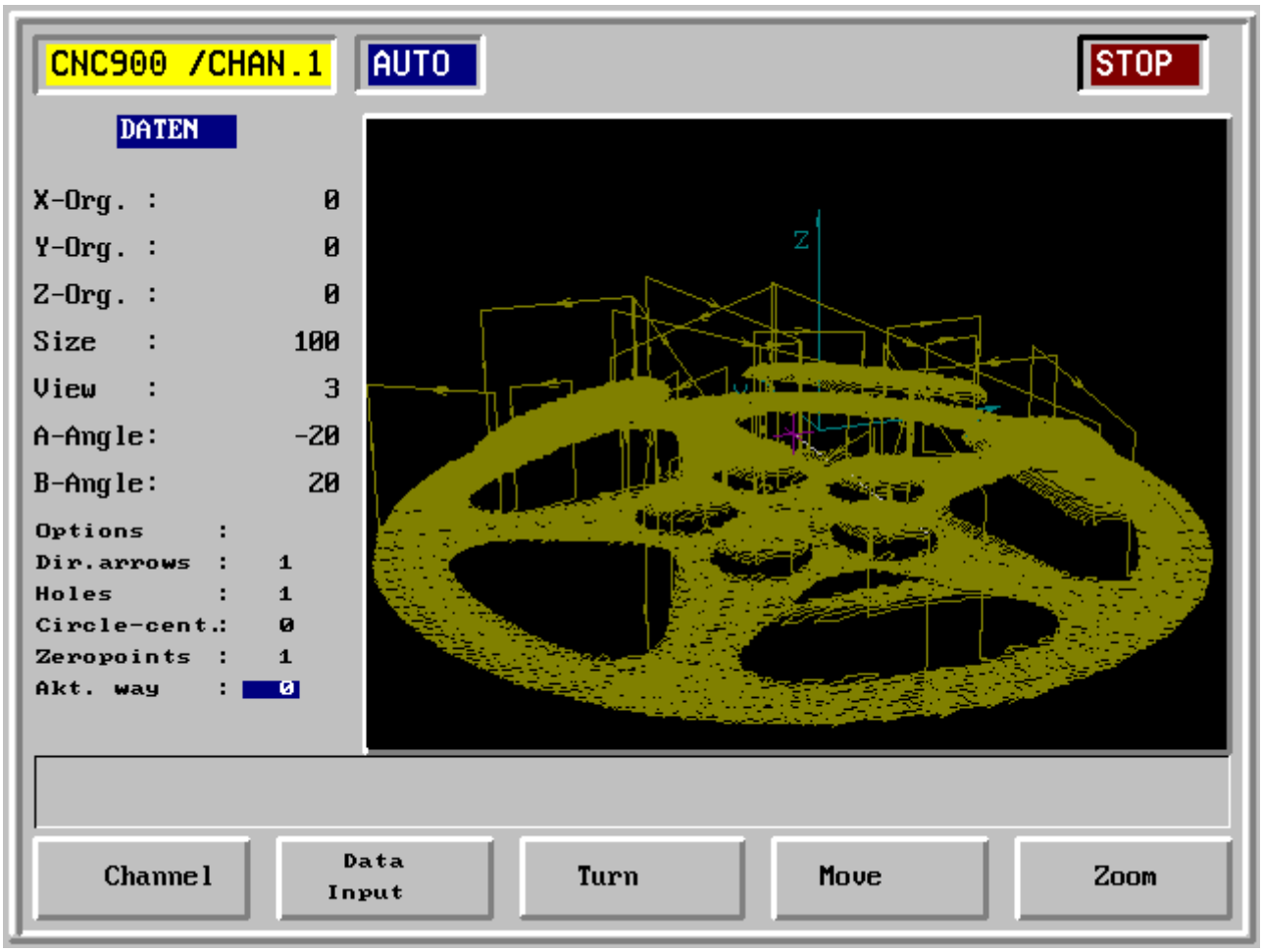
F4 Move X, Y and Z origin, input with cursor

F5 Zoom Size, input with cursor

## 2.5.1 Start data (continued)

### Graphic simulation

Example of a complex workpiece




F1 Channel

F2 Data input Input with numerical keys

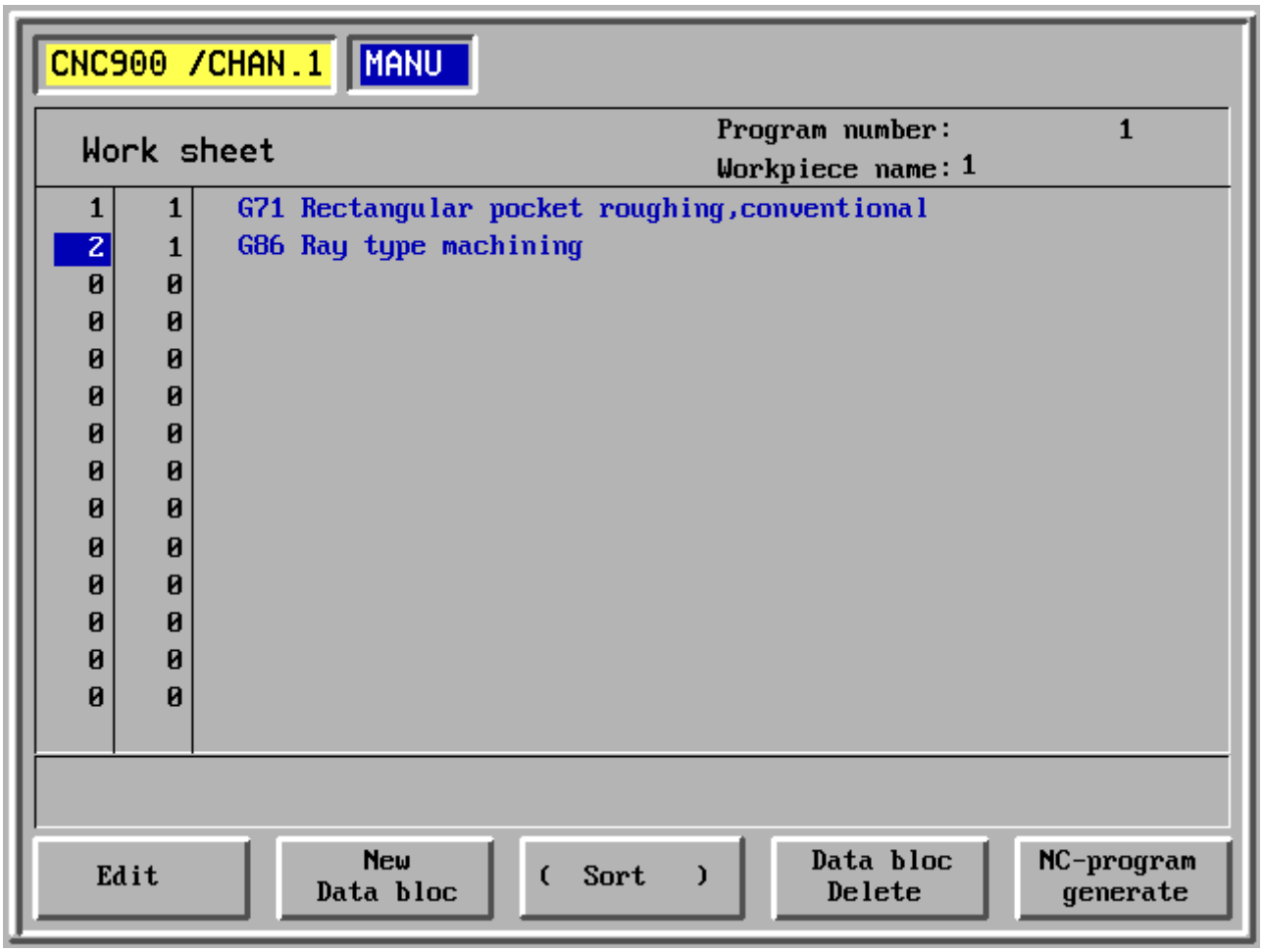
F3 Turning Turning around the X-, Z-axis, input with cursor

F4 Move X, Y and Z origin, input with cursor

F5 Zoom Size, input with cursor

## 2.5.2 Dialogue

Here you get the possibility to switch on a customer-specific dialogue,
e.g. **programming with work sheet**.




F1 Edit

F2 New data block

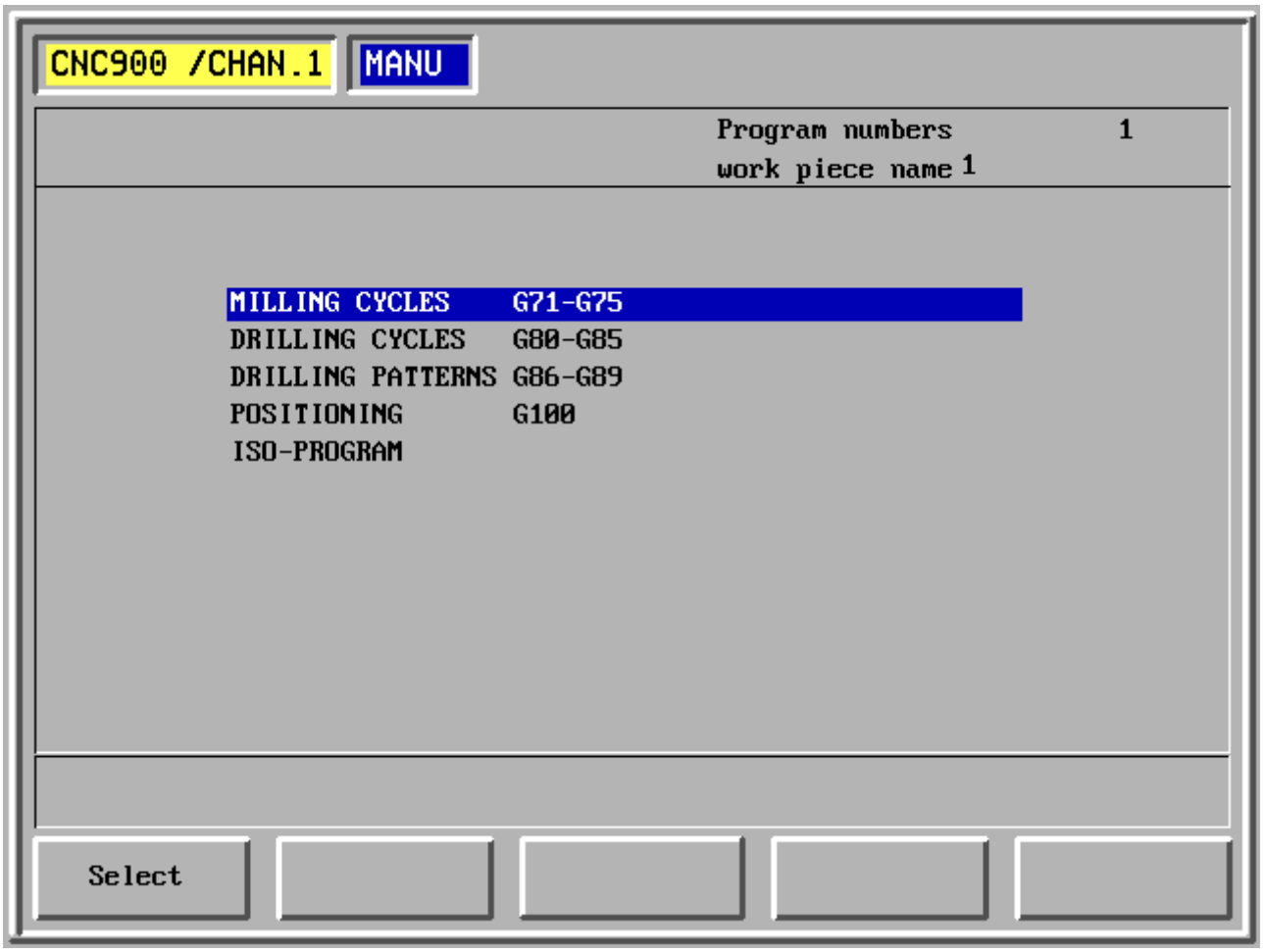
F3 Sort

F4 Delete data block

F5 Generate NC program

## 2.5.2 Dialogue (continued)

**Programming with work-sheet - Selecting the cycle mode**




F1 Selecting cycle mode

F2 -

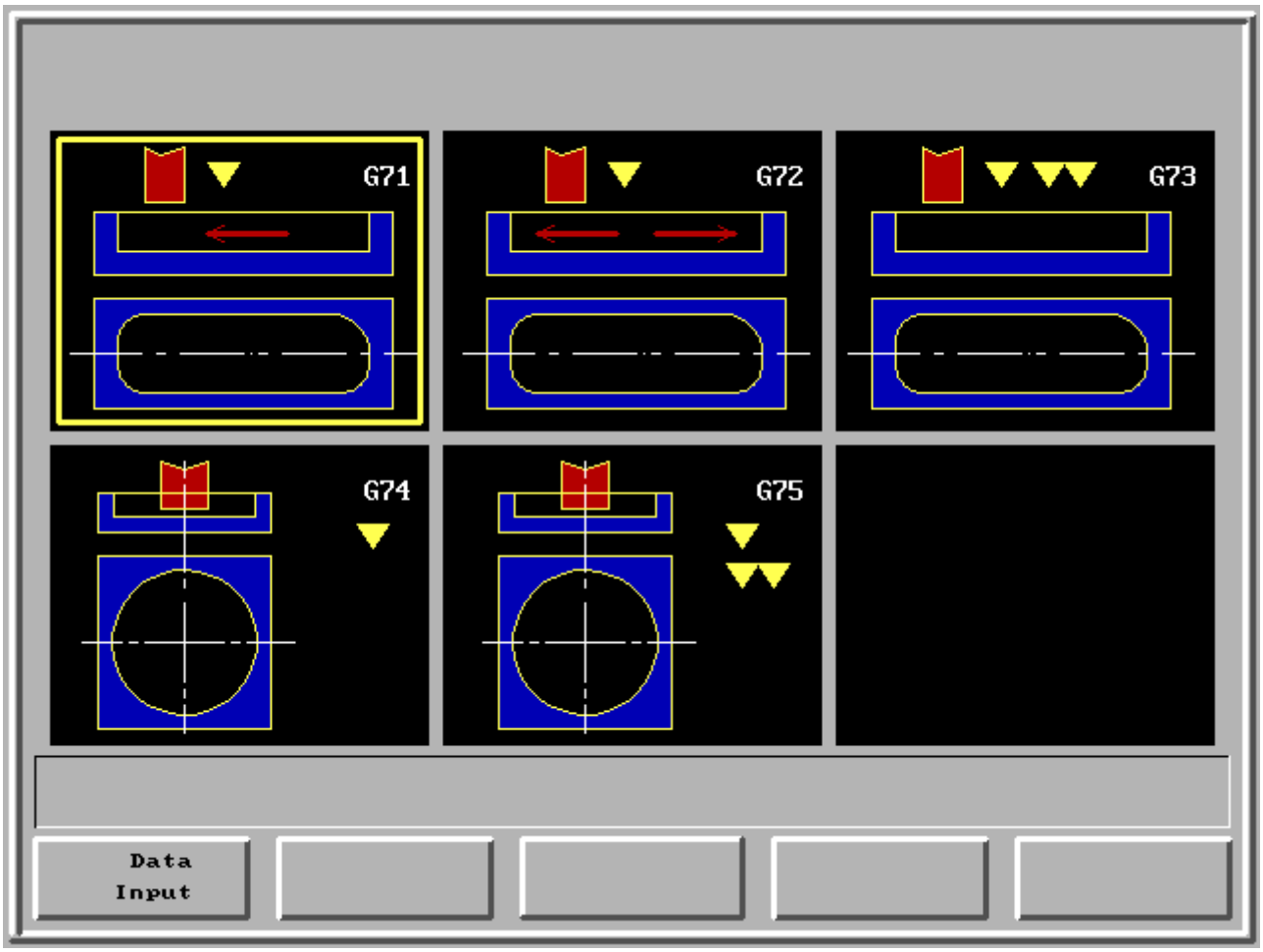
F3 -

F4 -

F5 -

## 2.5.2 Dialogue (continued)

**Programming with work sheet - Selecting the cycle**




F1 Data input

F2 -

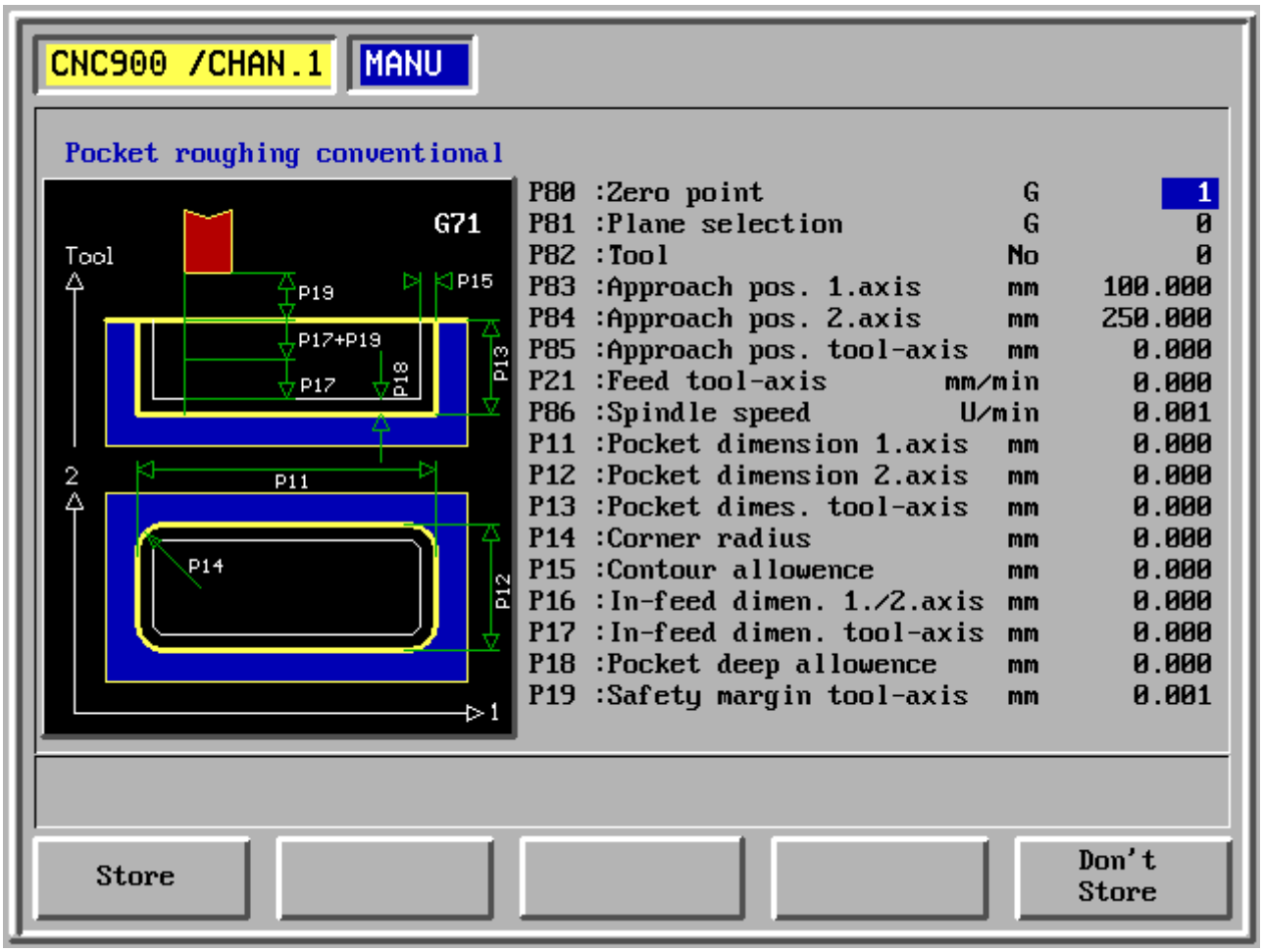
F3 -

F4 -

F5 -

## 2.5.2 Dialogue (continued)

**Programming with work sheet - Selecting the cycle**




F1 Store

F2 -

F3 -

F4 -

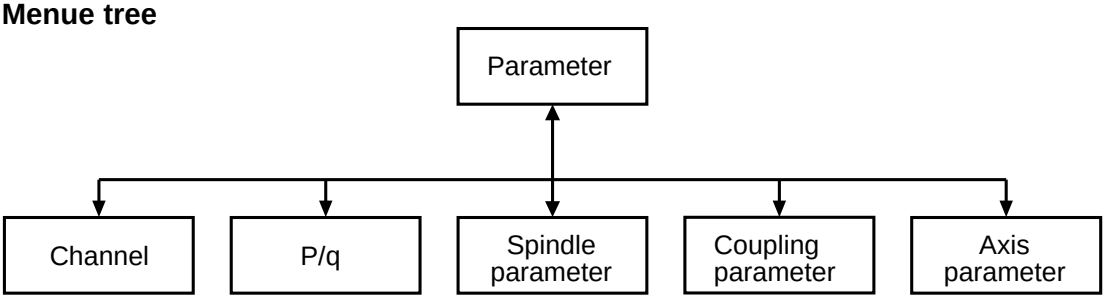
F5 Do not store

## 2.5.3 Parameter

The parameter menue consists of:

- Channel changeover
- Parameter changeover P/q (Channel - / System parameter)
- Spindle parameter
- Coupling parameter
- Axis parameter

**Menue tree**




**System parameter q**

| | |
|---|---|
| 0... 99 | General system configuration |
| 100... 999 | Definition channel descriptor# |
| 1000... 1999 | System settings, system overlapping data |
| 2000... 9999 | Axis data |
| 10000... | Channel parameter |

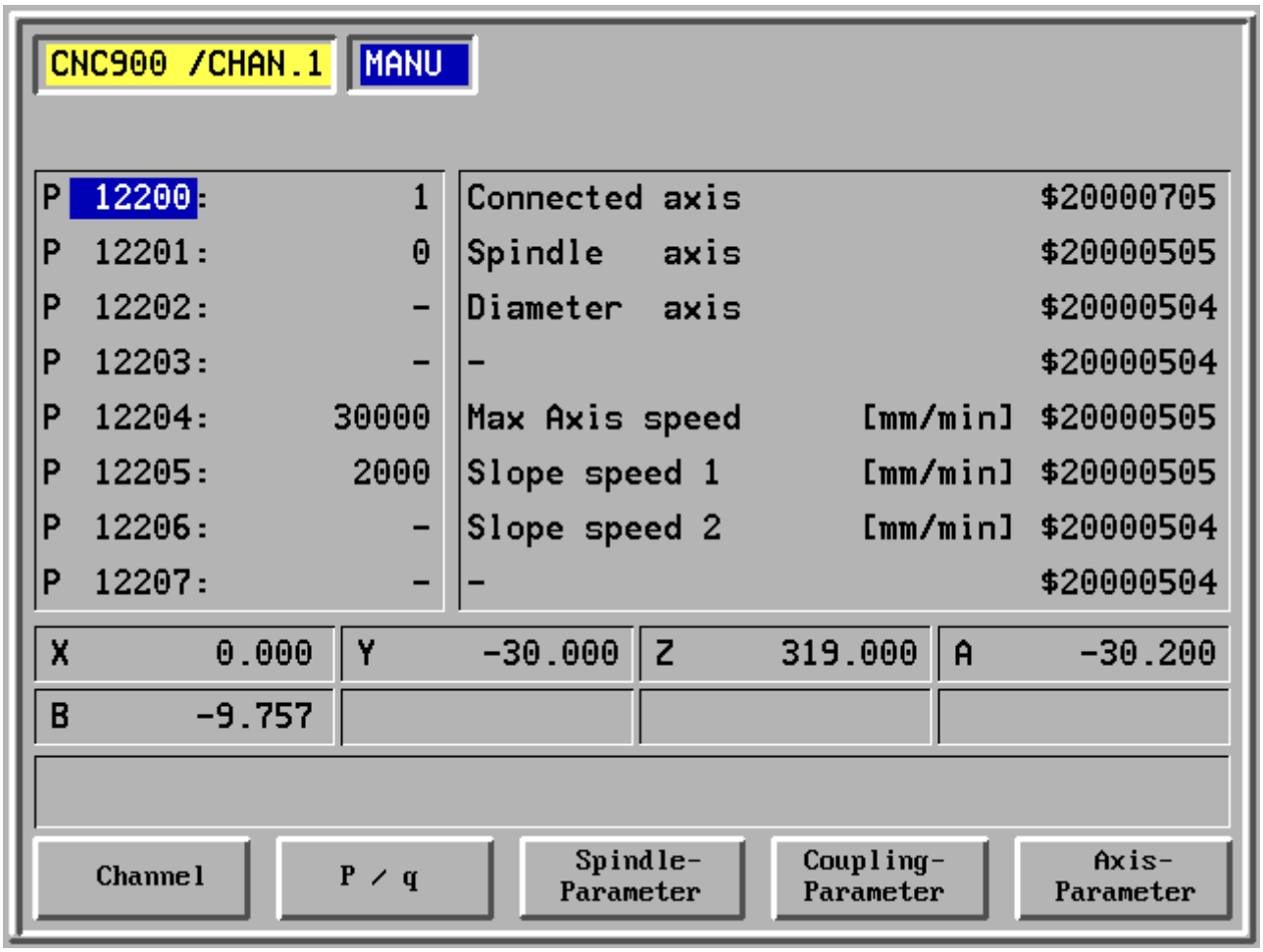
**Channel parameter P**

| | |
|---|---|
| 0... 6999 | User block 1 |
| 0... 499 | Reserved for BWO standard cycles |
| 0... 299 | Cycle-area for cycle interfaces |
| 300... 399 | Area reserved for cycles, area for static, modal data |
| 400... 499 | Area reserved for cycles, area for temporary data |
| 500... 6999 | Area free for the user |
| 7000... 9999 | Fix defined channel parameters |
| 11000...11999 | System overlapping data, common area of all channels |
| 12000...18399 | Axis data |
| 20000...29999 | User block 2 |
| 30000...39999 | User block 3 |

## 2.5.3 Parameter

**Channel parameter P:**

Input addresses, displaying parameters, input values and store.




F1 Channel

F2 P/q Switching between channel (P) and system parameters (q)

F3 Spindle parameter

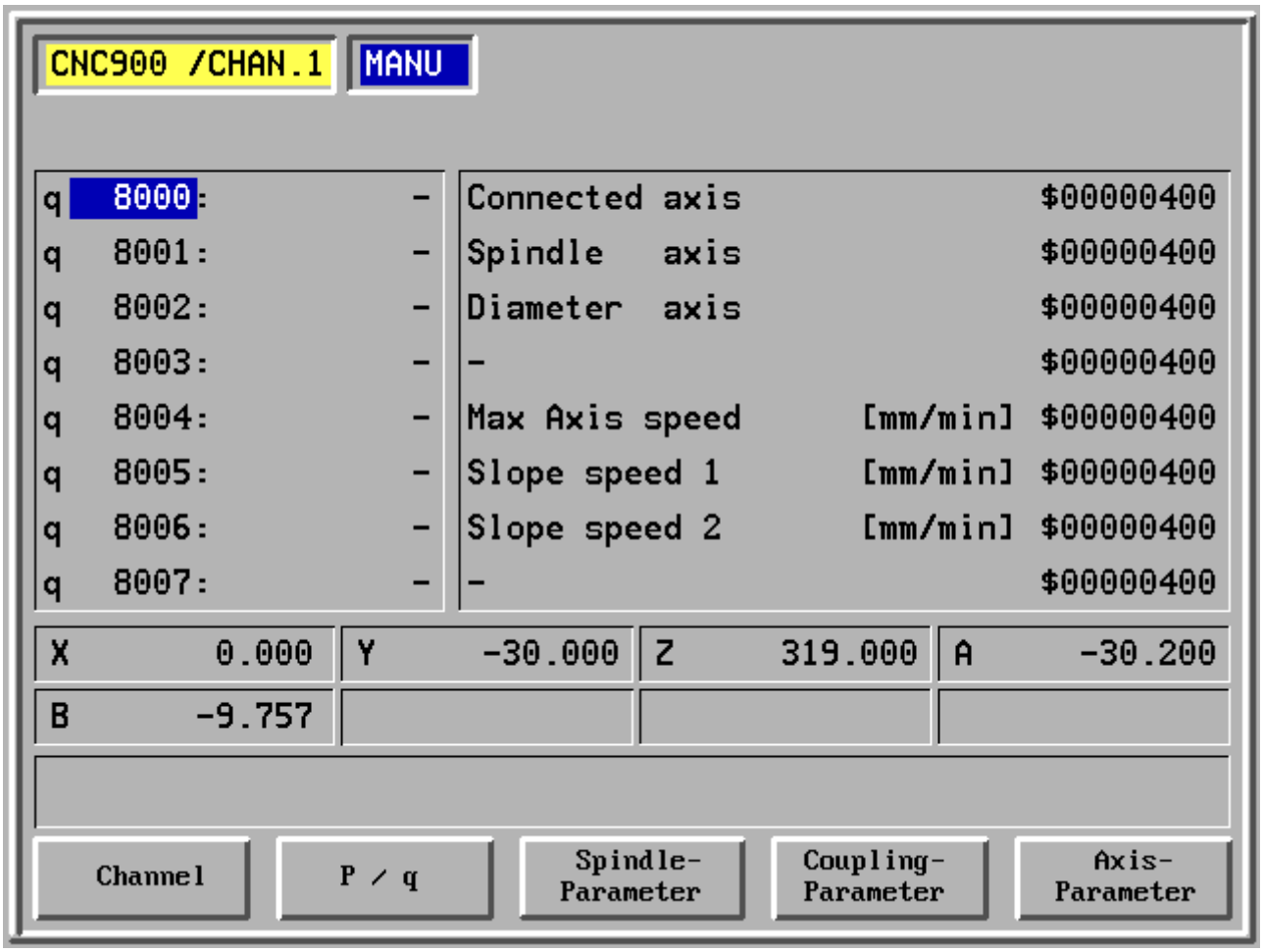
F4 Coupling parameter

F5 Axis parameter

## 2.5.3 Parameter (continued)

**System parameter q:**

Input addresses, displaying parameters, input values and store.




F1 Channel

F2 P/q Switching between channel (P) and system parameters (q)

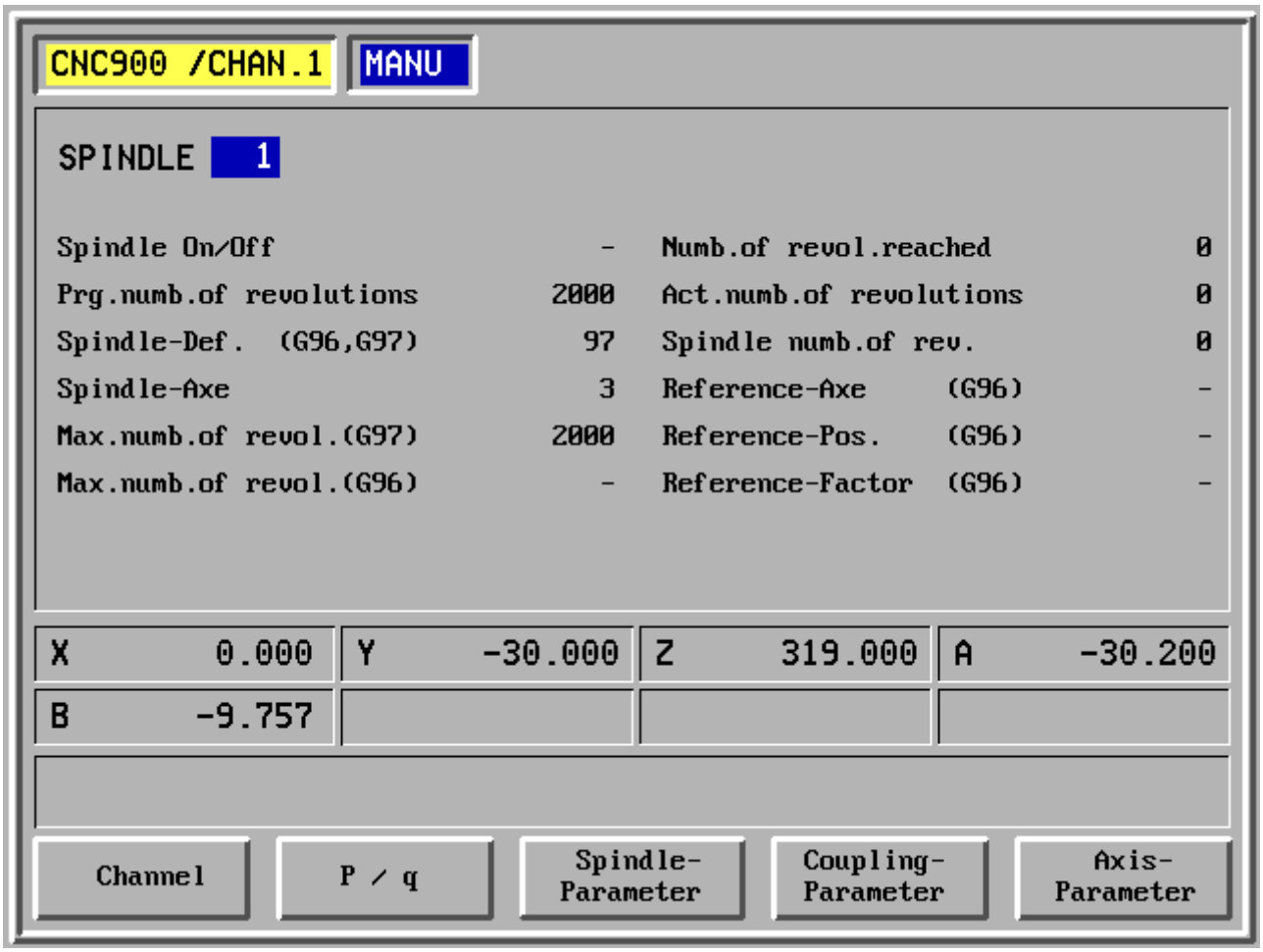
F3 Spindle parameter

F4 Coupling parameter

F5 Axis parameter

## 2.5.3 Parameter (continued)

Inputing spindle data is possible in this menue.




F1 Channel

F2 P/q Switching between channel (P) and system parameters (q)

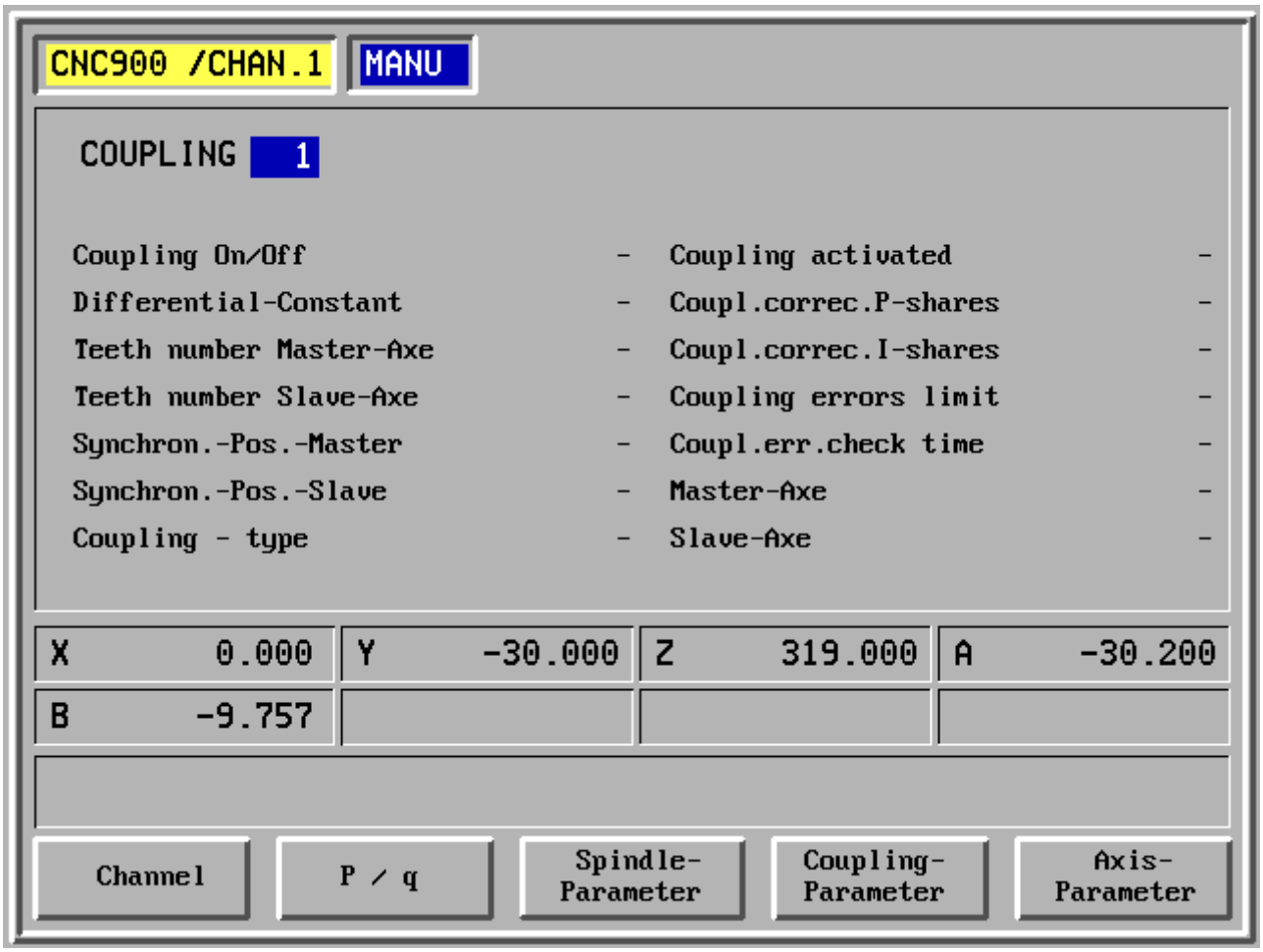
F3 Spindle parameter

F4 Coupling parameter

F5 Axis parameter

## 2.5.3 Parameter (continued)

Inputing coupling data is possible in this menue.




F1 Channel

F2 P/q Switching between channel (P) and system parameters (q)

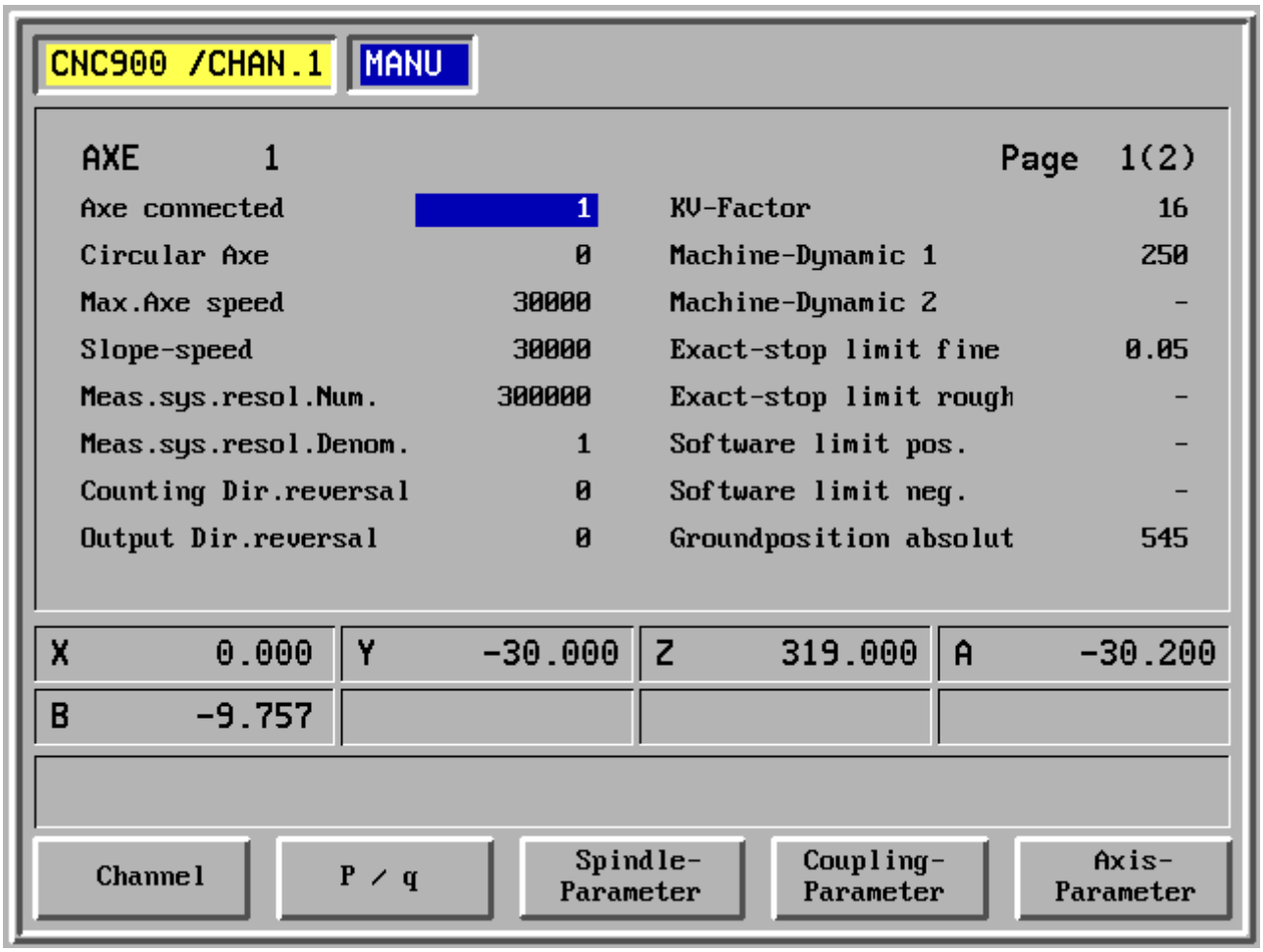
F3 Spindle parameter

F4 Coupling parameter

F5 Axis parameter

## 2.5.3 Parameter (continued)

Inputing axis data is possible in this menue. Page 1




F1 Channel

F2 P/q Switching between channel (P) and system parameters (q)

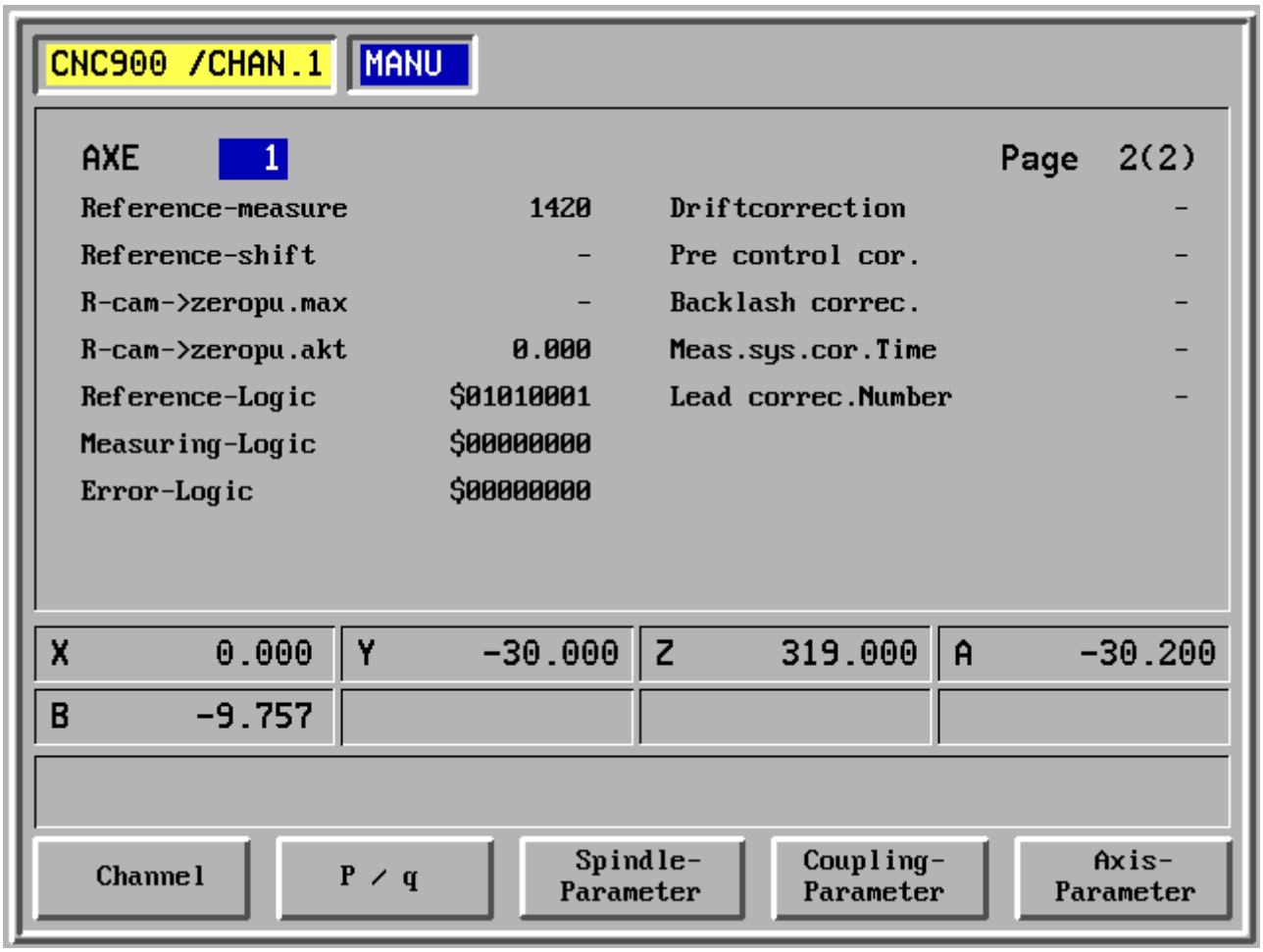
F3 Spindle parameter

F4 Coupling parameter

F5 Axis parameter

### 2.5.3 Parameter (continued)

Inputing axis data is possible in this menue. Page 2




F1 Channel

F2 P/q Switching between channel (P) and system parameters (q)

F3 Spindle parameter

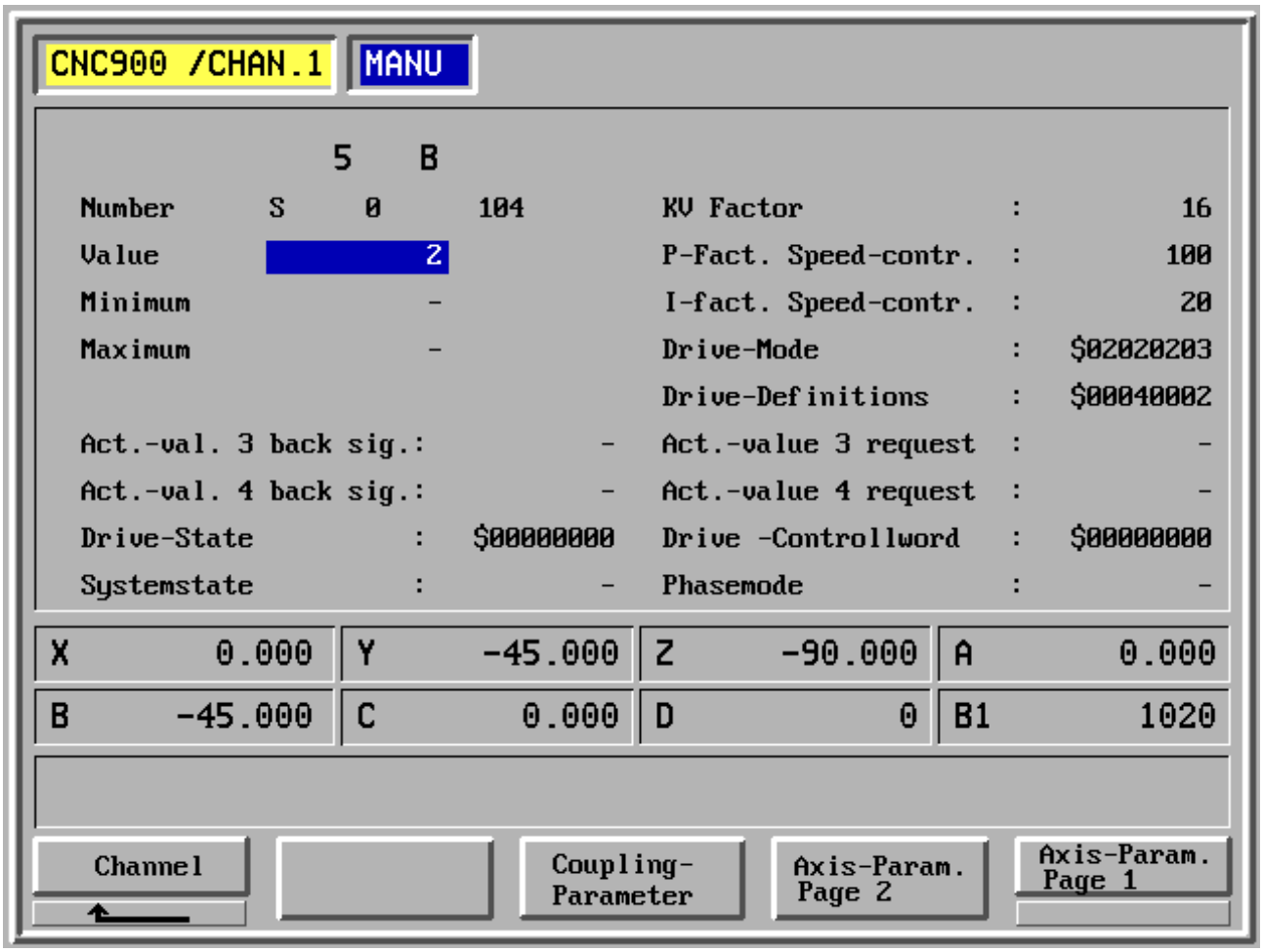
F4 Coupling parameter

F5 Axis parameter

## 2.5.3 Parameter (continued)

### Drive parameter

This menu permits the Input of the drive data.




F1 Channel

F2 -

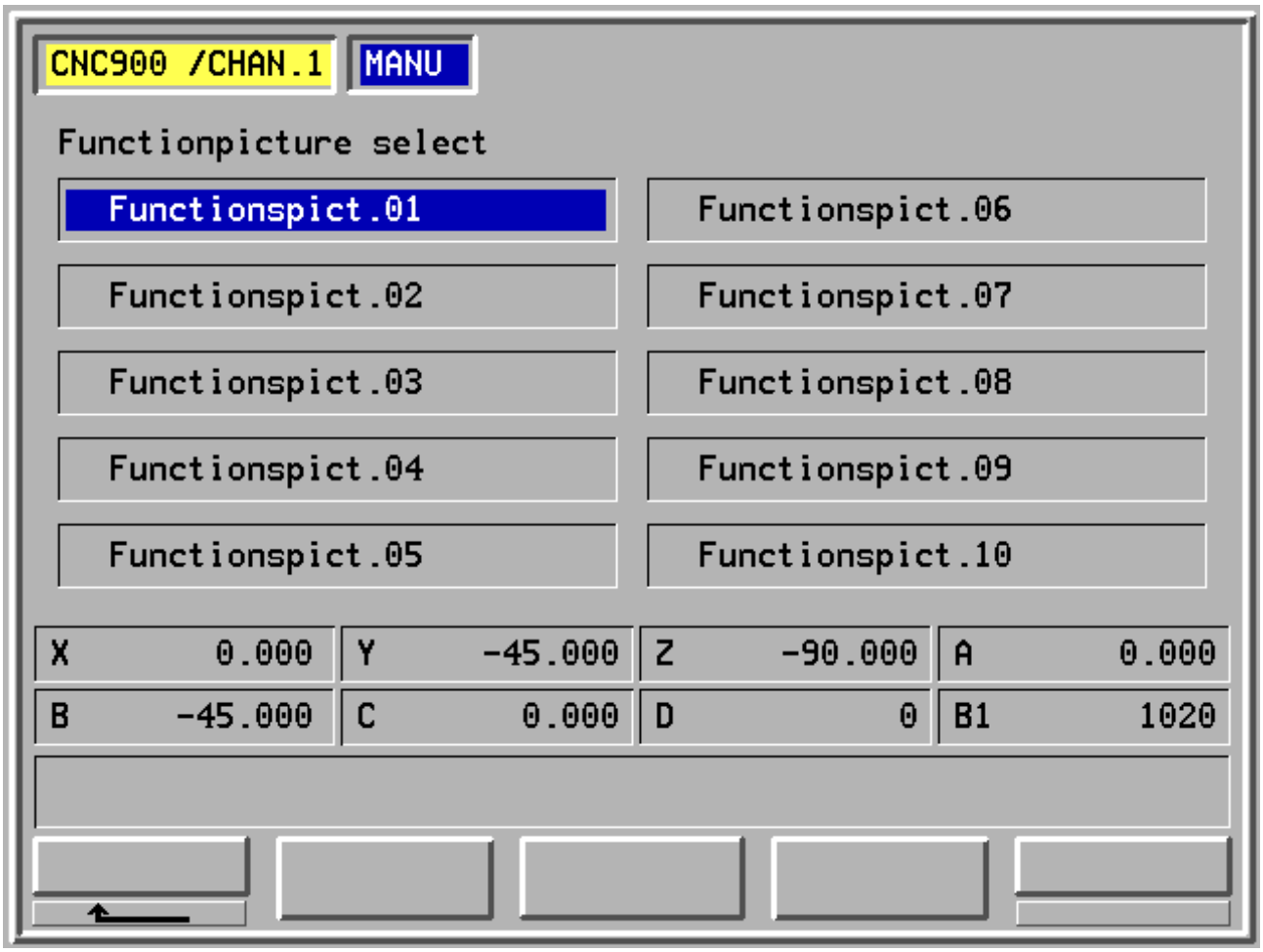
F3 Drive parameter

F4 Axis parameter page 2

F5 Axis parameter page 1

### 2.5.4 Machine functions

The actual function picture appears.




F1 -

F2 -

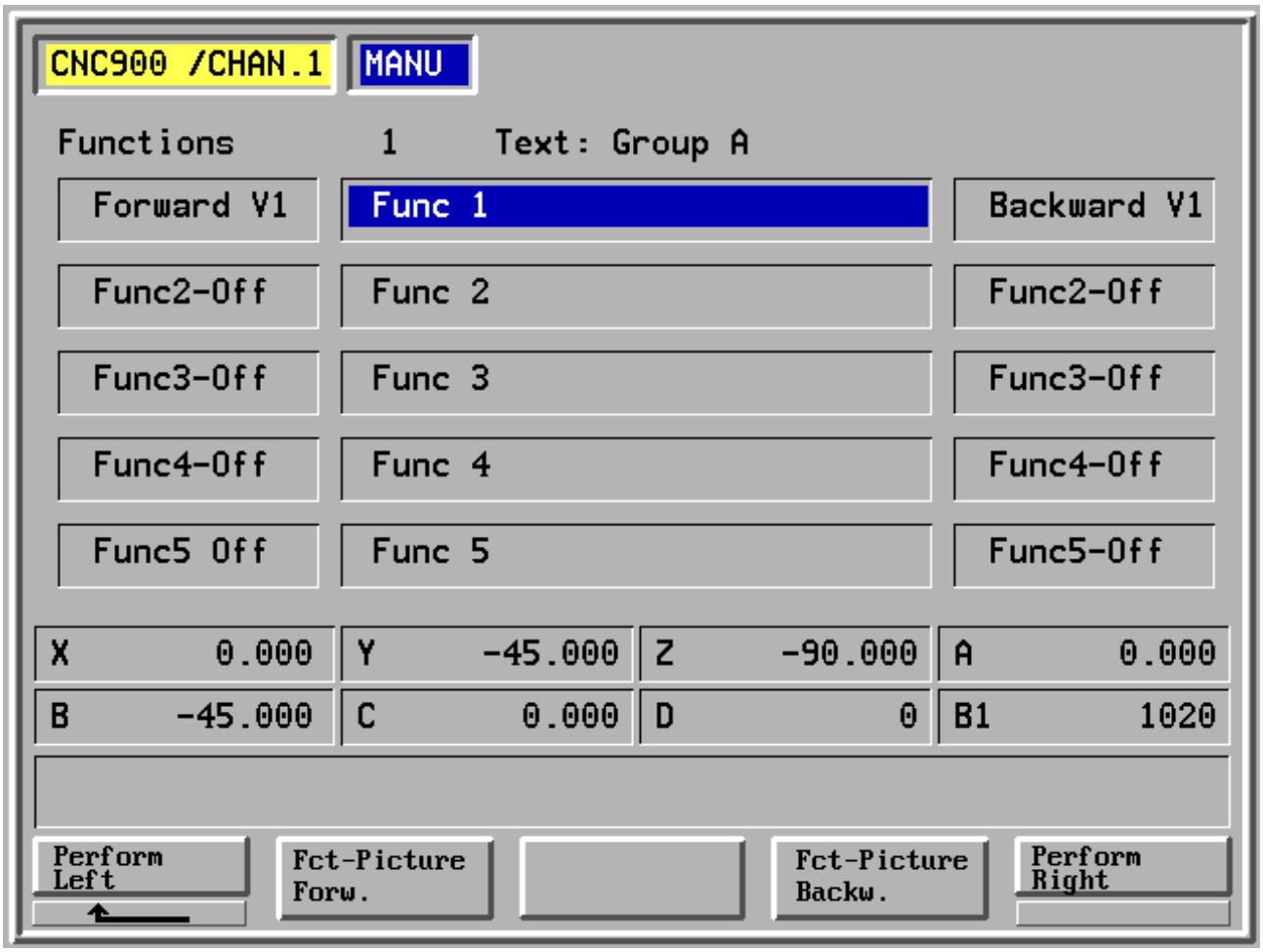
F3 -

F4 -

F5 -

## 2.5.4 Machine functions (continued)

The actual function picture appears.




F1 Performance left

F2 Function picture forward

F3 -

F4 Function picture backward

F5 Performance right

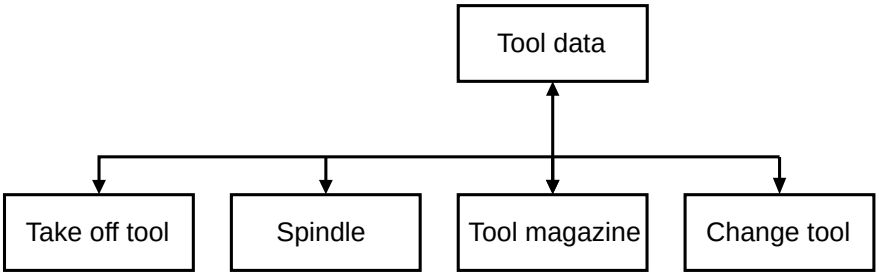
### 2.5.5 Tool data

The actual tool data can be input here.

The tool data menue consists of

- Lay down tool
- Spindle
- Magazine
- Tool change

Menue tree

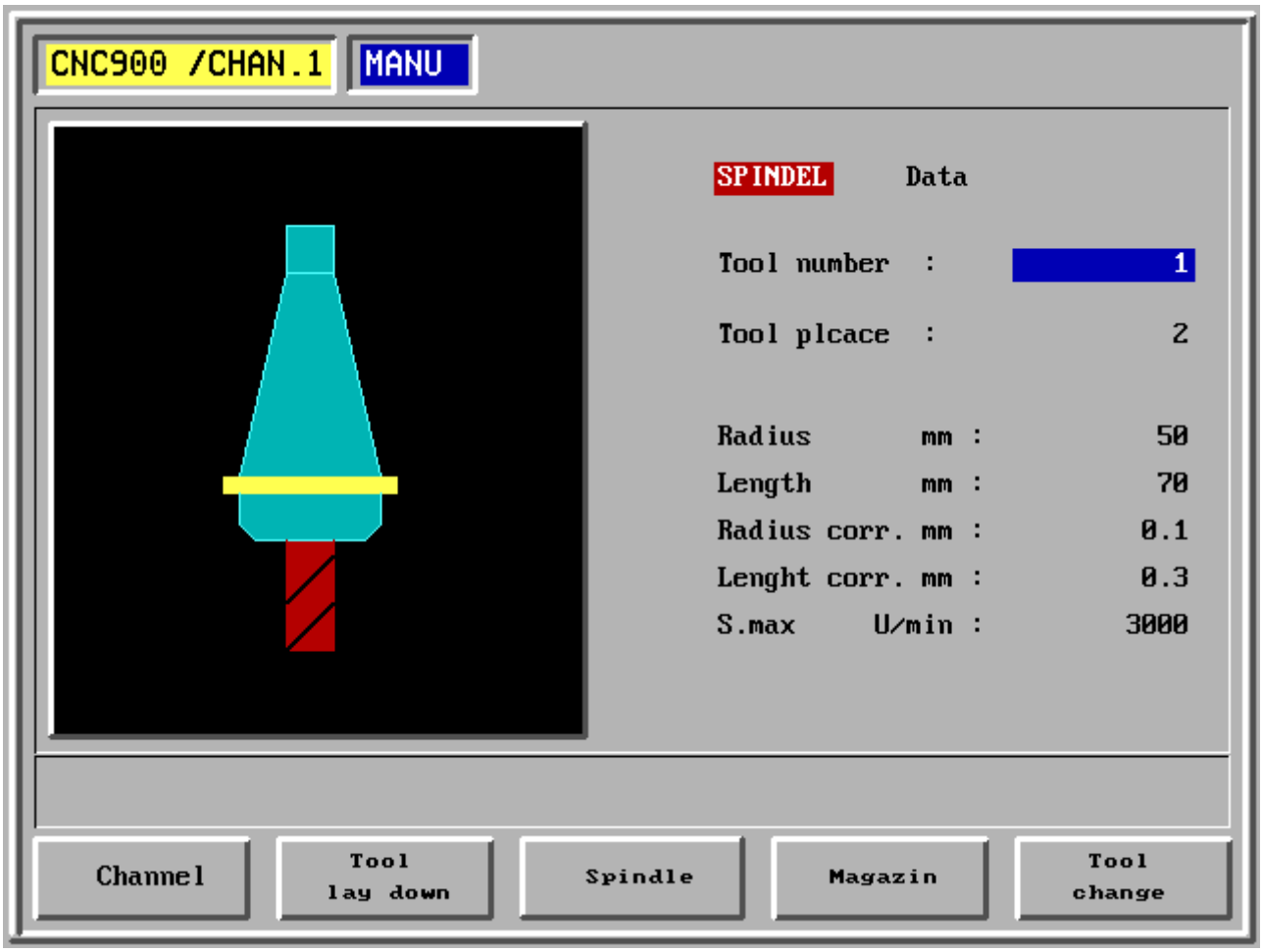



The tool dates (length, radius...) can be called up with 10-digit tool numbers in the program run.

Inputs are possible in manual mode via the operating panel or external data carriers without indicating a block number. If ‘delete store’ is input, the tool data are deleted during power on test.

## 2.5.5 Tool data

Tool in the spindle.




F1 Channel

F2 Lay down tool

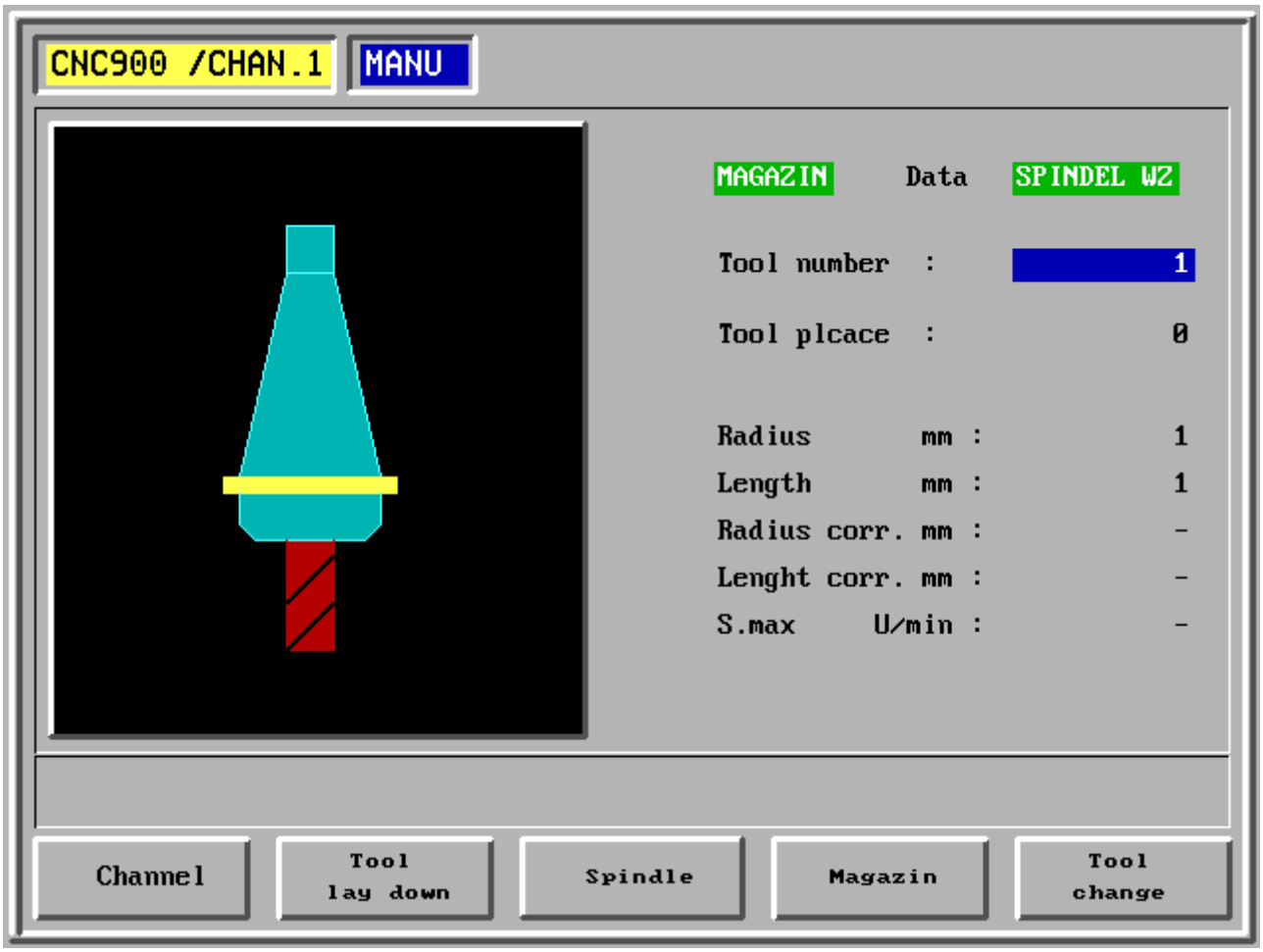
F3 Spindle

F4 Magazine

F5 Tool change

## 2.5.5 Tool data

Tool in the magazine.




F1 Channel

F2 Lay down tool

F3 Spindle

F4 Magazine

F5 Tool change

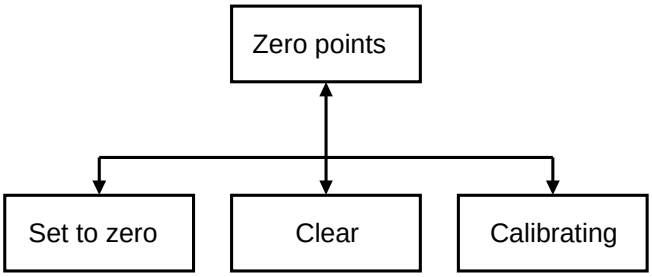
## 2.5.6 Zero points

The actual zero point data can be input here.

The zero point data menue consists of

- Set to zero
- Delete
- Calibrate

Menue tree



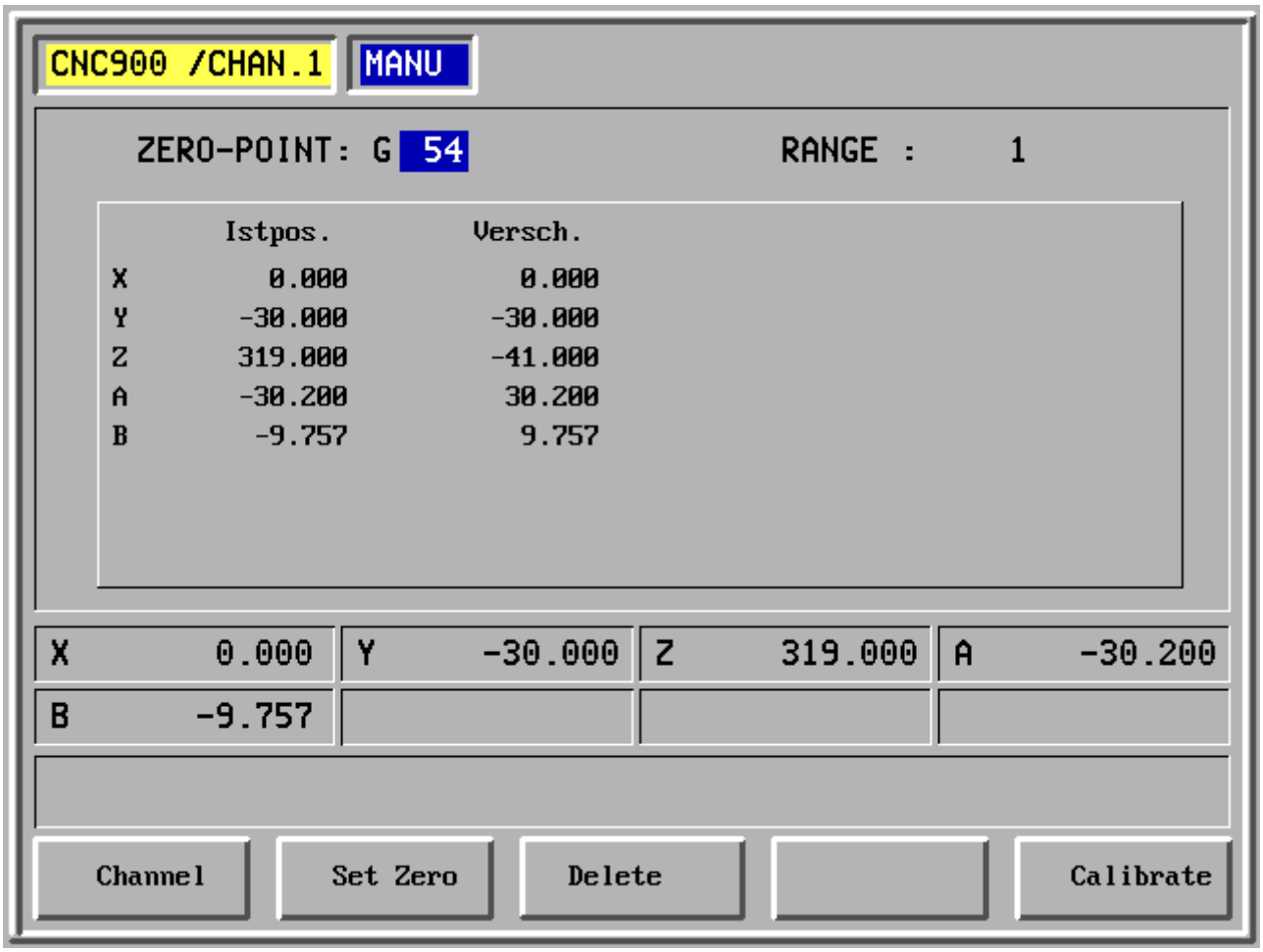

For each axis, a maximum of 6 zero points can be set with G54 to G59 and can be called up during program run.

Zero point shift is made ineffective with G53. The program then refers to the machine zero point.

Inputs are possible in manual mode via the operating panel or external data carriers without indicating a block number. When deleting the memory during power on test, the zero point data are alos deleted.
Zero point data can be loacated mathematically or they can be approached (edge scanner, clock gauge).

## 2.5.6 Zero points (continued)

The actual zero point is displayed. The values can be input and stored.




F1 Channel

F2 Set to zero

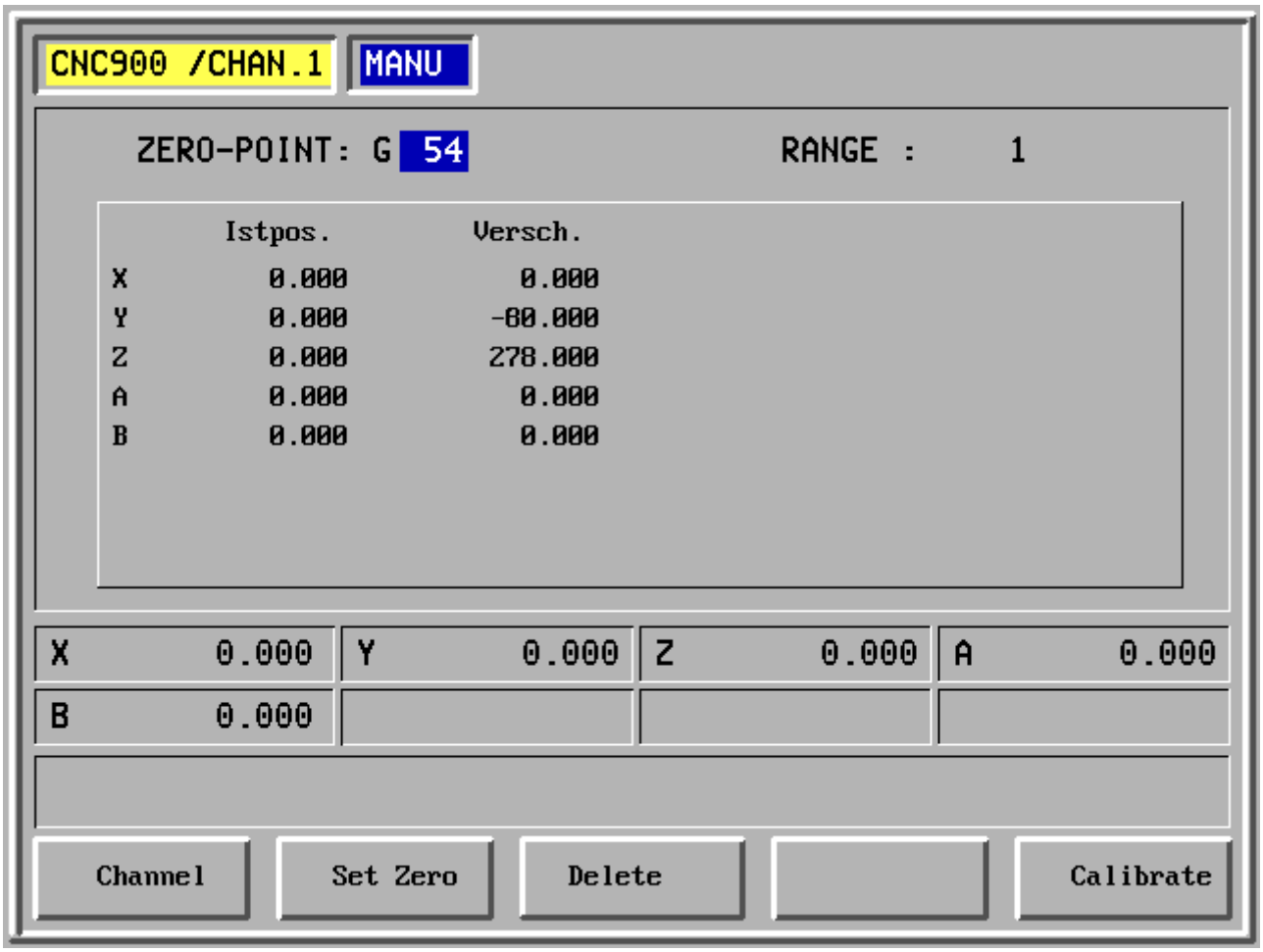
F3 Delete

F4 -

F5 Calibrate

## 2.5.6 Zero points (continued)

The actual values can be set to zero.




F1 Channel

F2 Set to zero

F3 Delete

F4 -

F5 Calibrate

## 2.6 Operating modes

The following operating modes can be set:
- MANUAL
- AUTOMATIC Sequential block
  Single block
  Positioning

### 2.6.1 Manual mode

Manual mode is switched on with key .

For traversing the axes, the axis name (X, Y, Z, ...) and travelling mode (continuously or step by step) and the feed rate have to be input first.

By pressing the keys (Manual+) or (Manual-) the selected axis is traversed in positive or negative direction.

The length of the actual tool is calculated when traversing the tool axis.

**Travelling mode**

During (continuously) travelling mode, the axis is moving as long until the manual key is pressed.
When traversing with fix length, the complete length is traversed by pressing a manual key once (the step width can be selected by pressing the key (step) again and again).
During this time, the keys for Manual+/-, axis name and travelling mode remain ineffective.

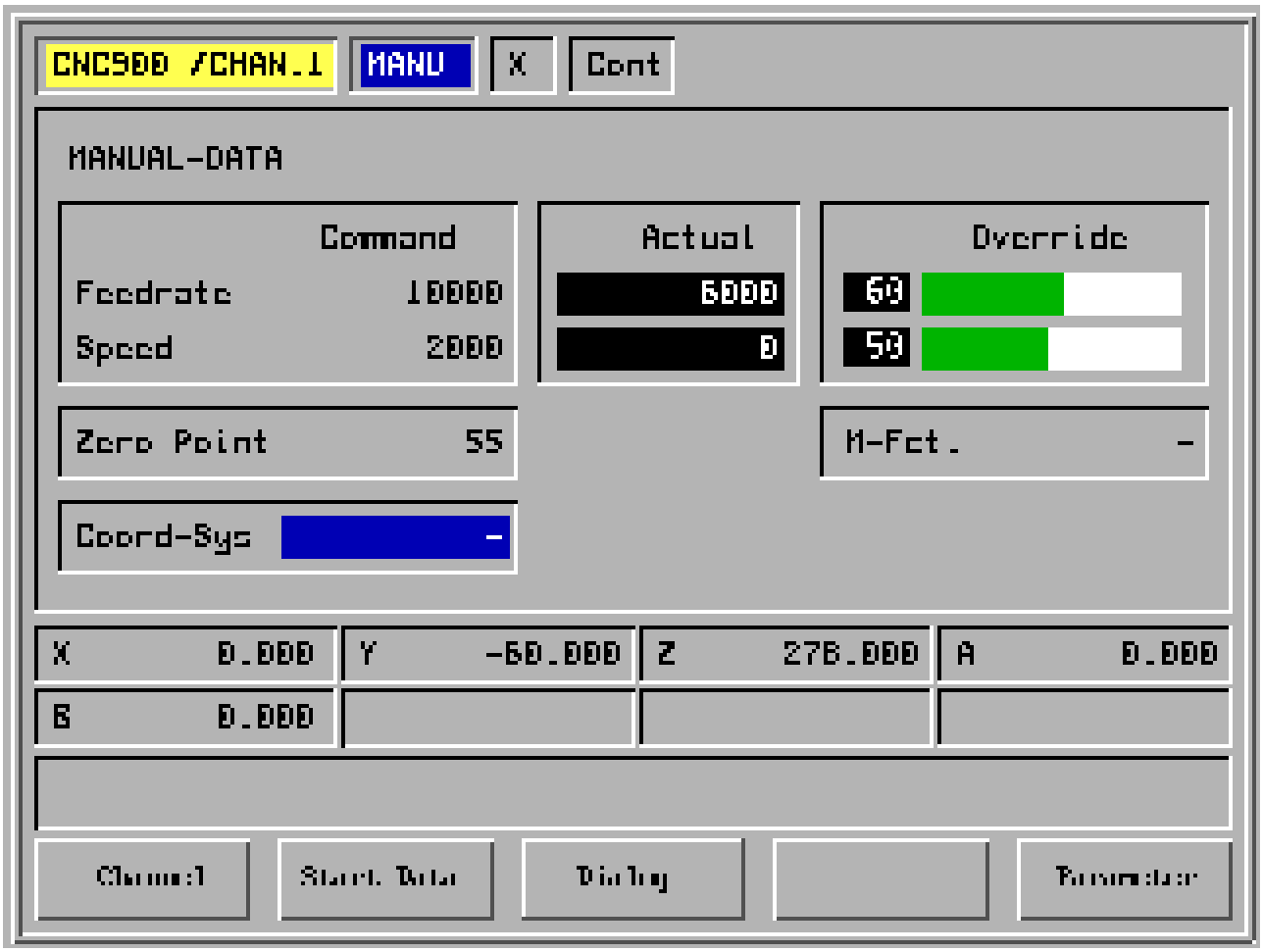
When pressing the key (Stop), the process can be interrupted. If a manual key is pressed again, the axis moves from the new position on with the selected length.

**Command = Actual**
Desired positions can be approached in the program and they can be overtaken into the command value display with key (Command=Actual) and can be written into the memory with (Input).

## 2.6.1 Manual mode (continued)

Traverse **continuously in manual mode**.

Switch on manual mode with key . Select continuously with key .




F1 Channel

F2 Start data

F3 Dialogue

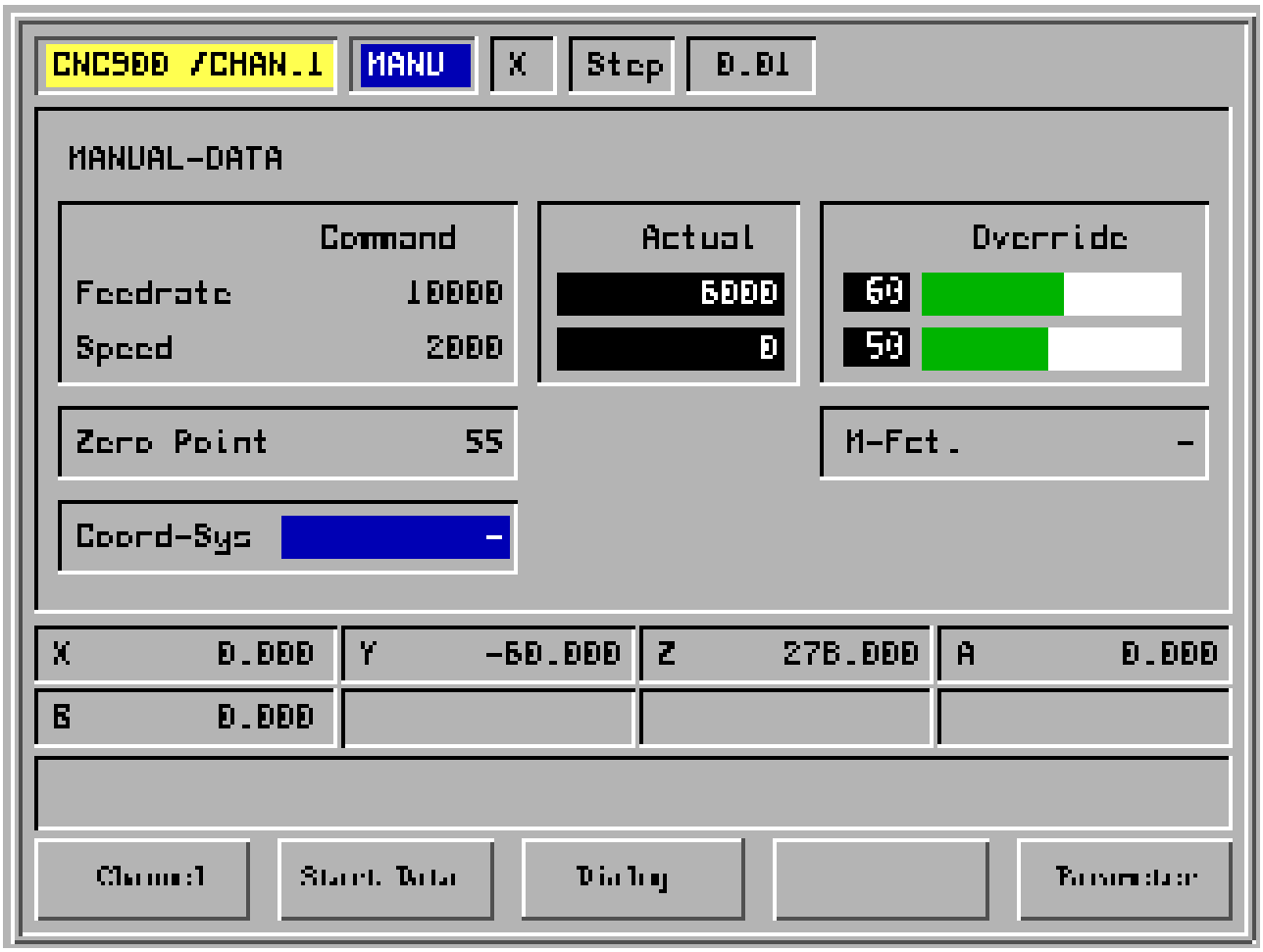
F4 -

F5 Parameter

## 2.6.1 Manual mode (continued)

Traverse **step by step in manual mode**.

Switch on manual mode with key . Select step-by-step with key .




F1 Channel

F2 Start data

F3 Dialogue

F4 -

F5 Parameter

## 2.6.2 Automatic mode

Automatic mode is switched on with the keys:

Automatic sequential block

Automatic single block

Positioning

### Start/Stop

The selected program is started with key (Start). It can be interrupted with key (Stop) and continued with key (Start) at any time.

The keys for machine functions are dependant of the PLC. The speed can be controlled with the override.

### Skip block

When making a program, the blocks which do have a slash placed in front of them, are skiped in automatic mode if the key / (skip block) is switched on.

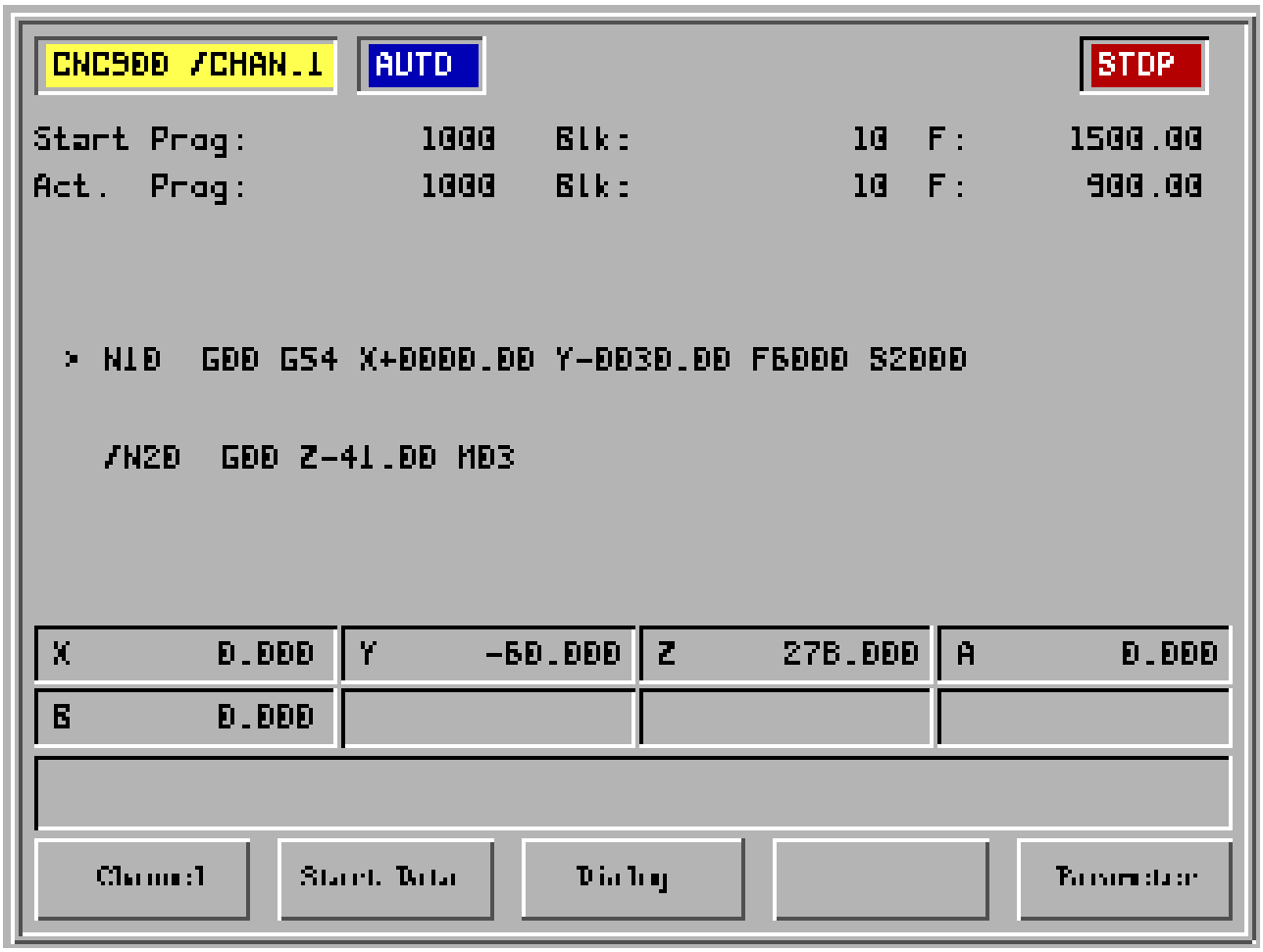
Switch on: Press key /
The key is only effective before program start.
The display of the operating mode is completed by the symbol '/'.

Switch off: Press key / again.

## 2.6.2 Automatic mode (continued)

In **automatic sequential block**, all blocks of a program are worked one after the other.

Switch on sequential block with key .




F1 Channel

F2 Start data

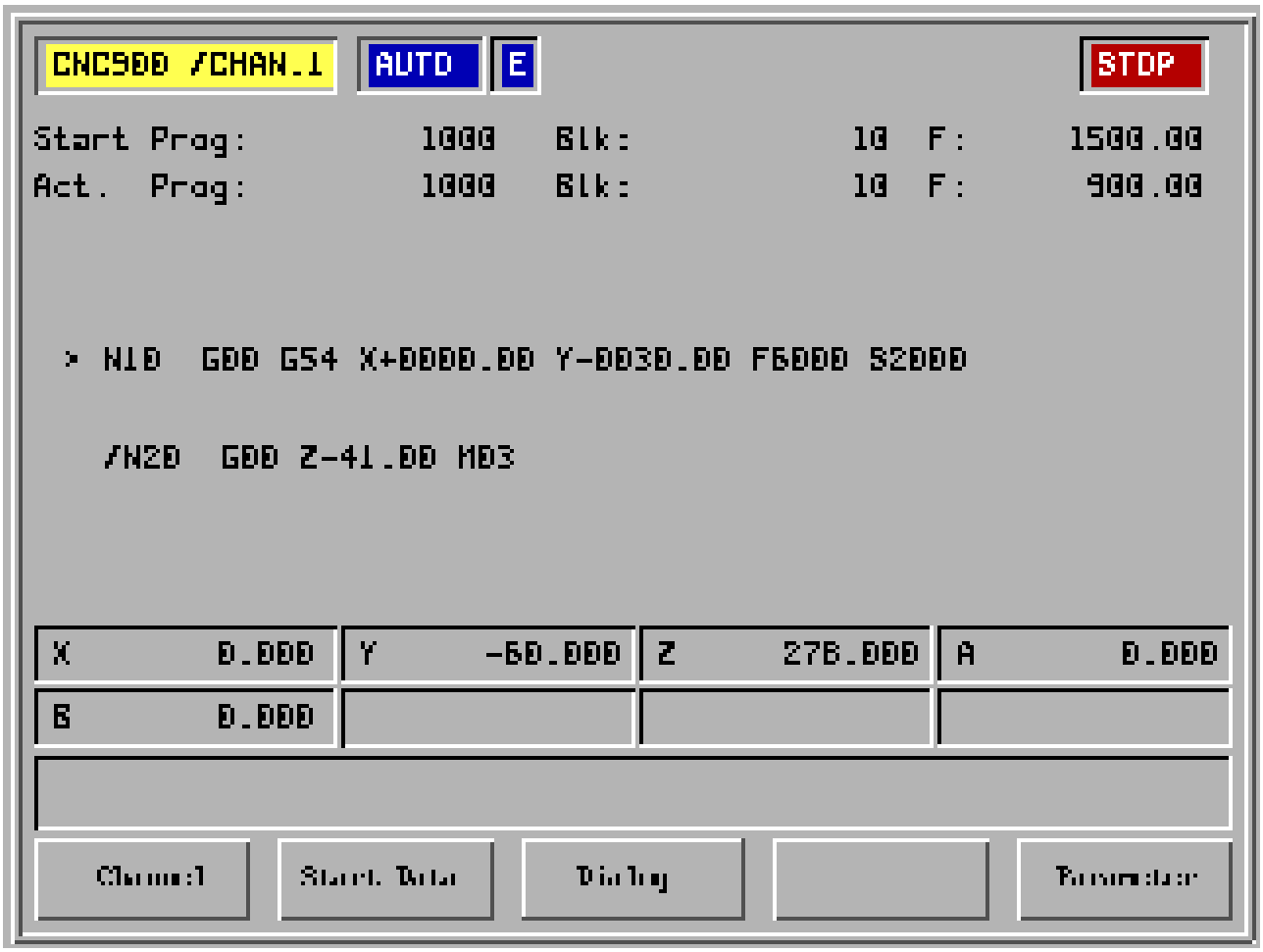
F3 Dialogue

F4 -

F5 Parameter

## 2.6.2 Automatic mode (continued)

In automatic single block, only one block is worked after the start. Start the next block with key . Switch on automatic single block with key .




F1 Channel

F2 Start data

F3 Dialogue

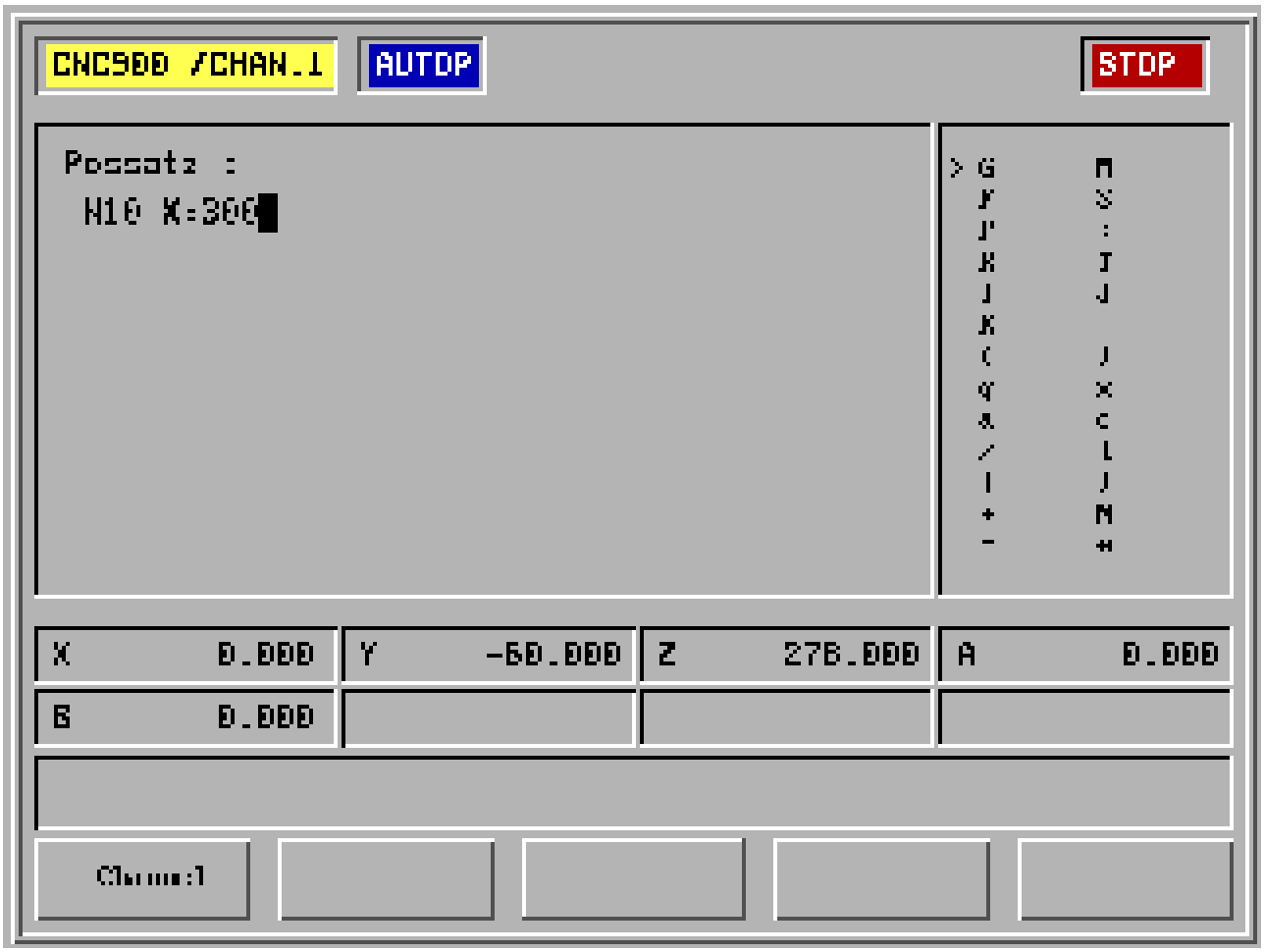
F4 -

F5 Parameter

## 2.6.2 Automatic mode (continued)

With positioning, a complete NC block or parts of it can be input via the numerical keys and worked without storing.

Switch on positioning with key ⊣.




F1 Channel

F2 -

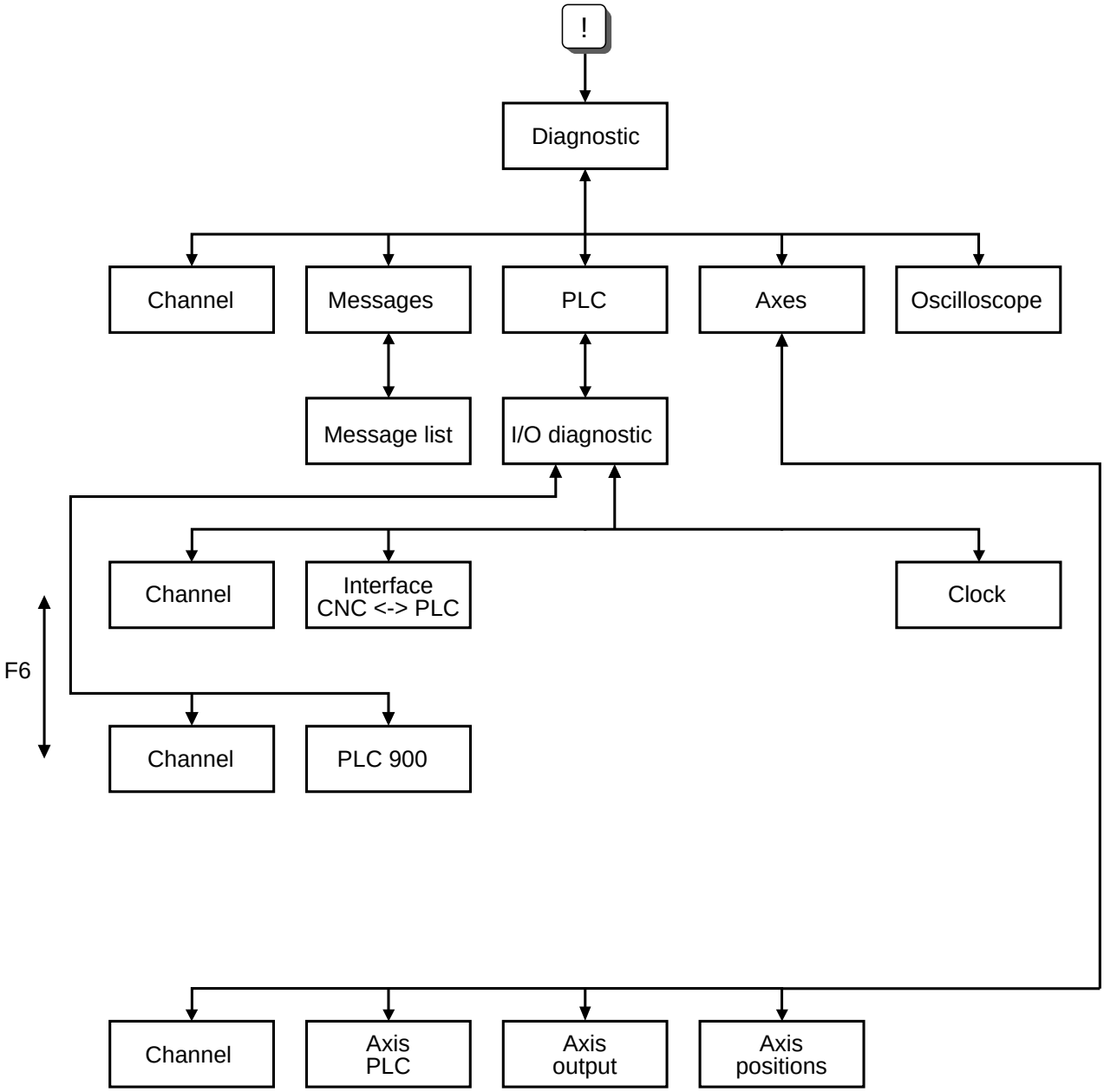
F3 -

F4 -

F5 -

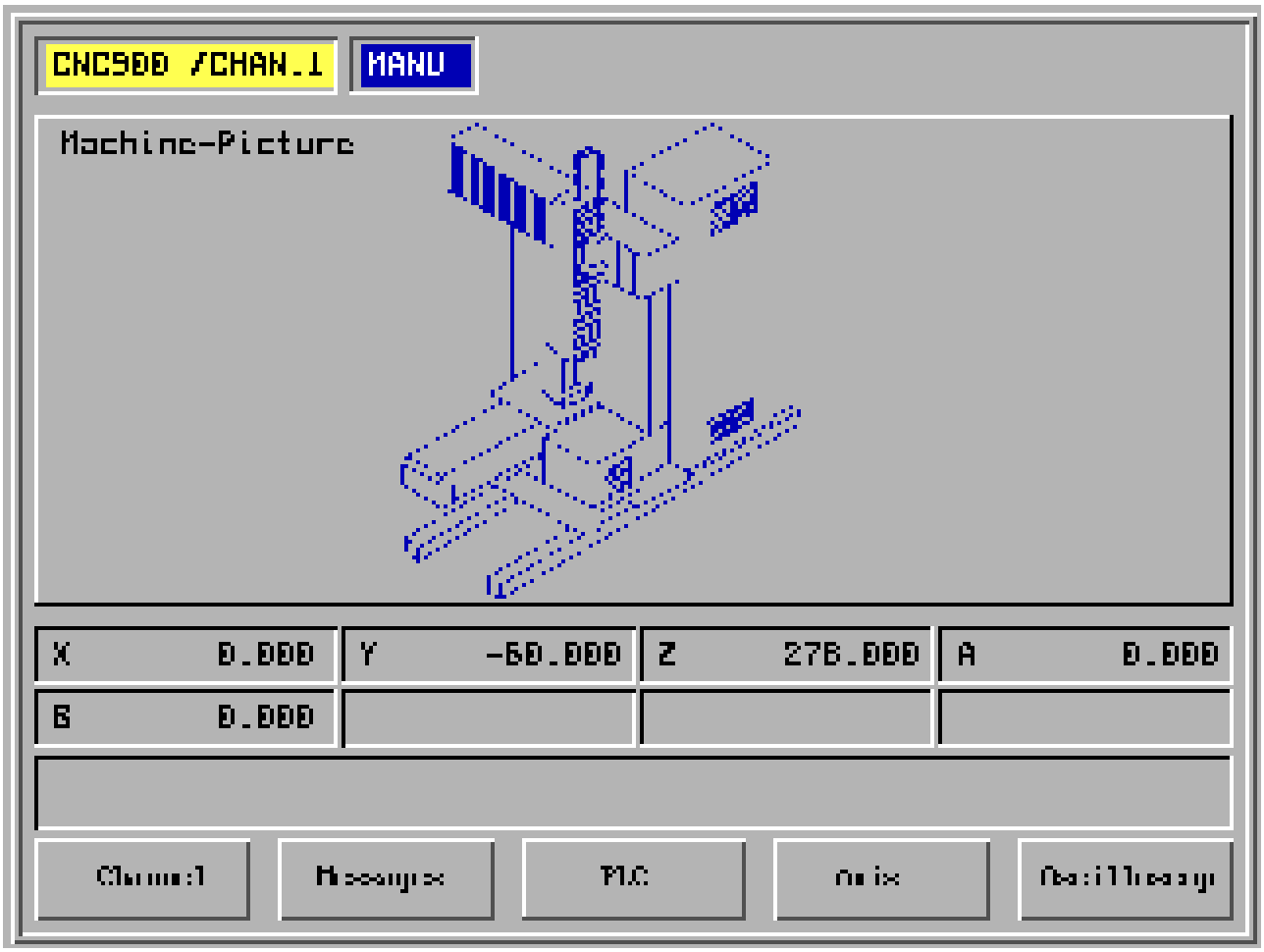
## 2.7 Diagnostic

Menue tree



## 2.7 Diagnostic

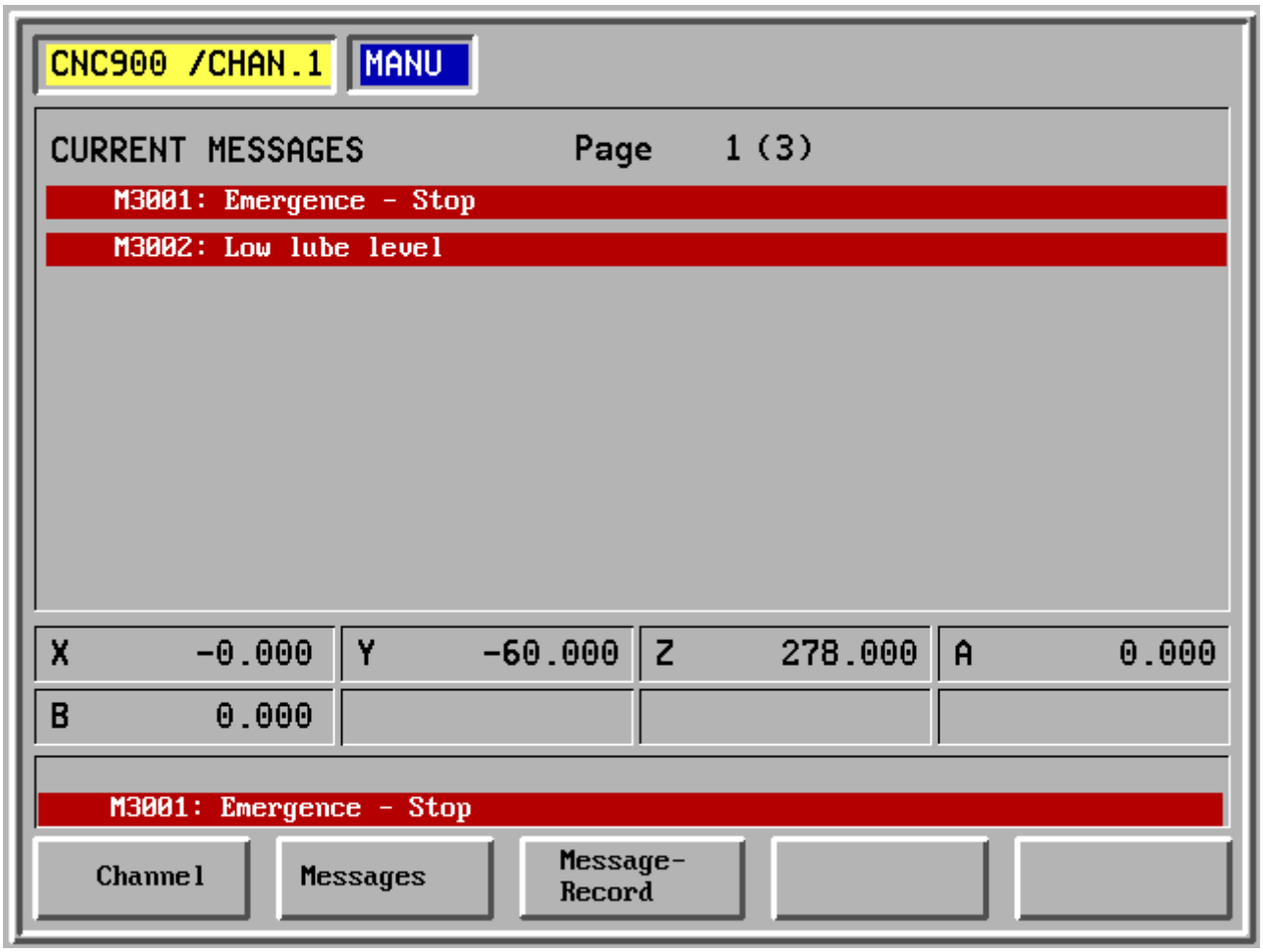
Diagnostic is switched on with the key [!]. The machine picture appears, e.g.




| | | |
|---|---|---|
| F1 | Channel | |
| F2 | Messages | Display messages |
| F3 | PLC | PLC diagnostic |
| F4 | Axes | Axis drive diagnostic |
| F5 | Oscilloscope | |

## 2.7.1 Messages

### Current messages




F1 Channel

F2 Messages

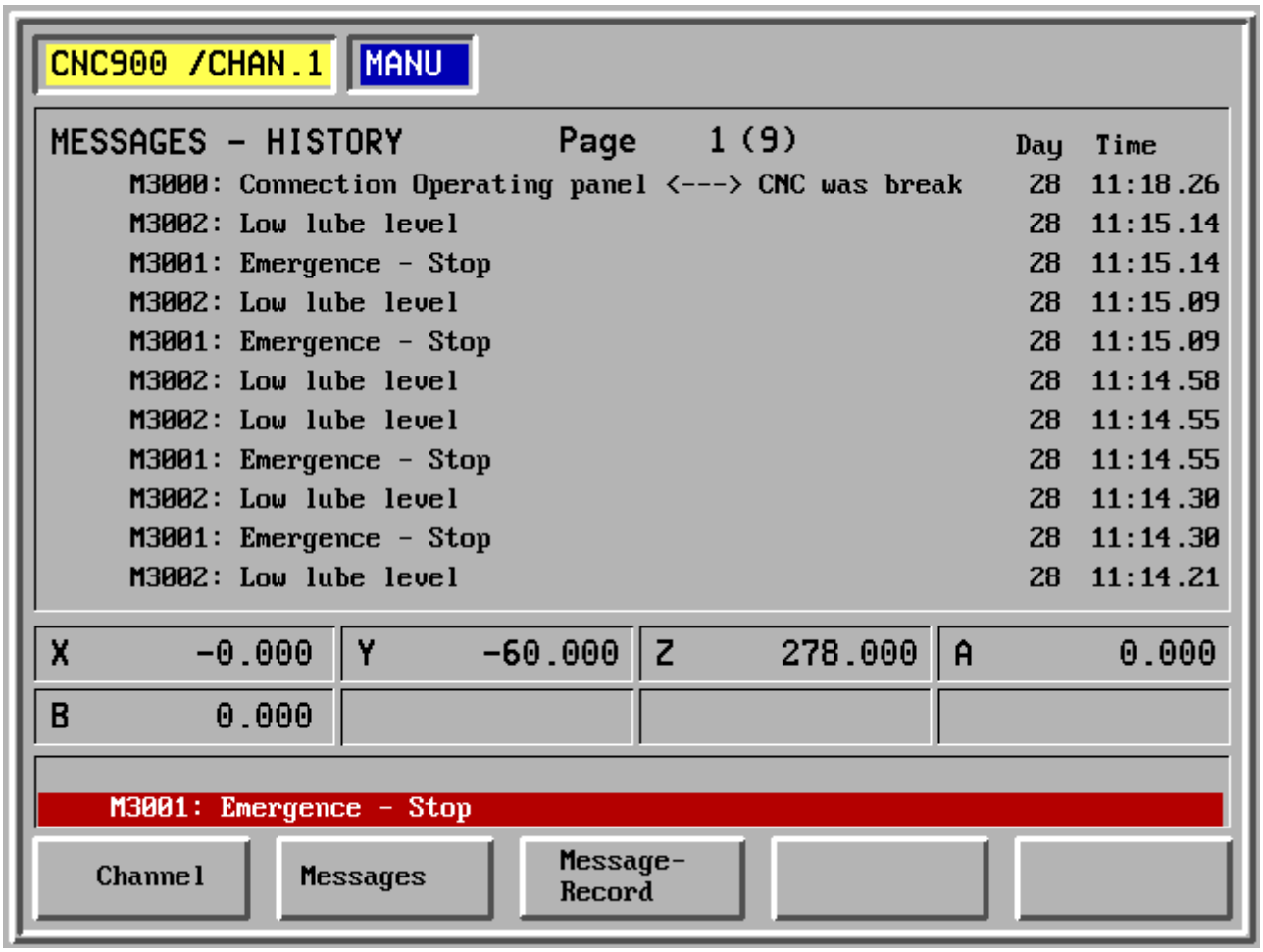
F3 Message record Display of previous messages

F4 -

F5 -

## 2.7.1 Messages

### Current messages




F1 Channel

F2 Messages

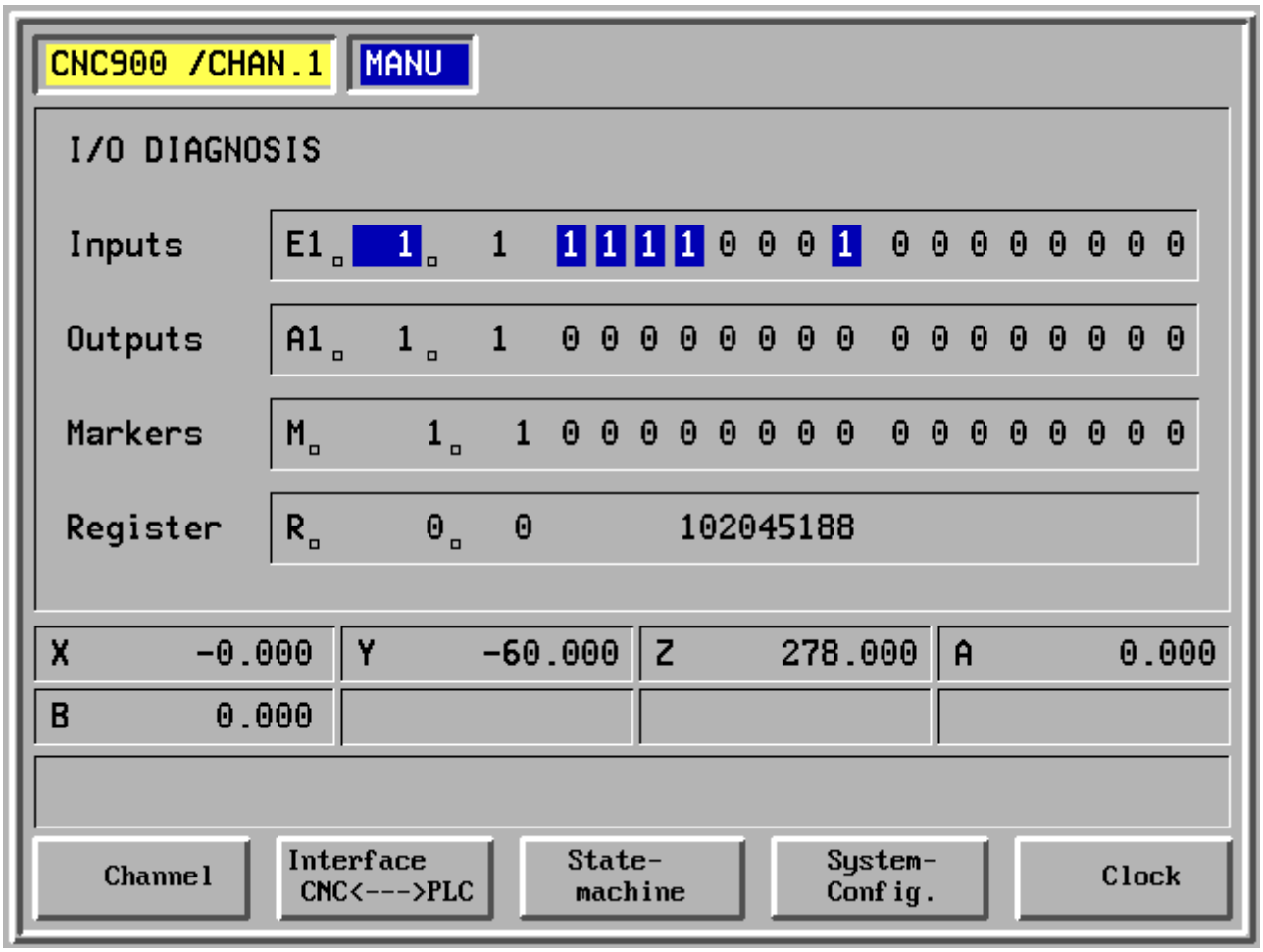
F3 Message record Display of previous messages

F4 -

F5 -

## 2.7.2 PLC

### I/O diagnostic




F1 Channel

F2 Interface CNC <—> PLC

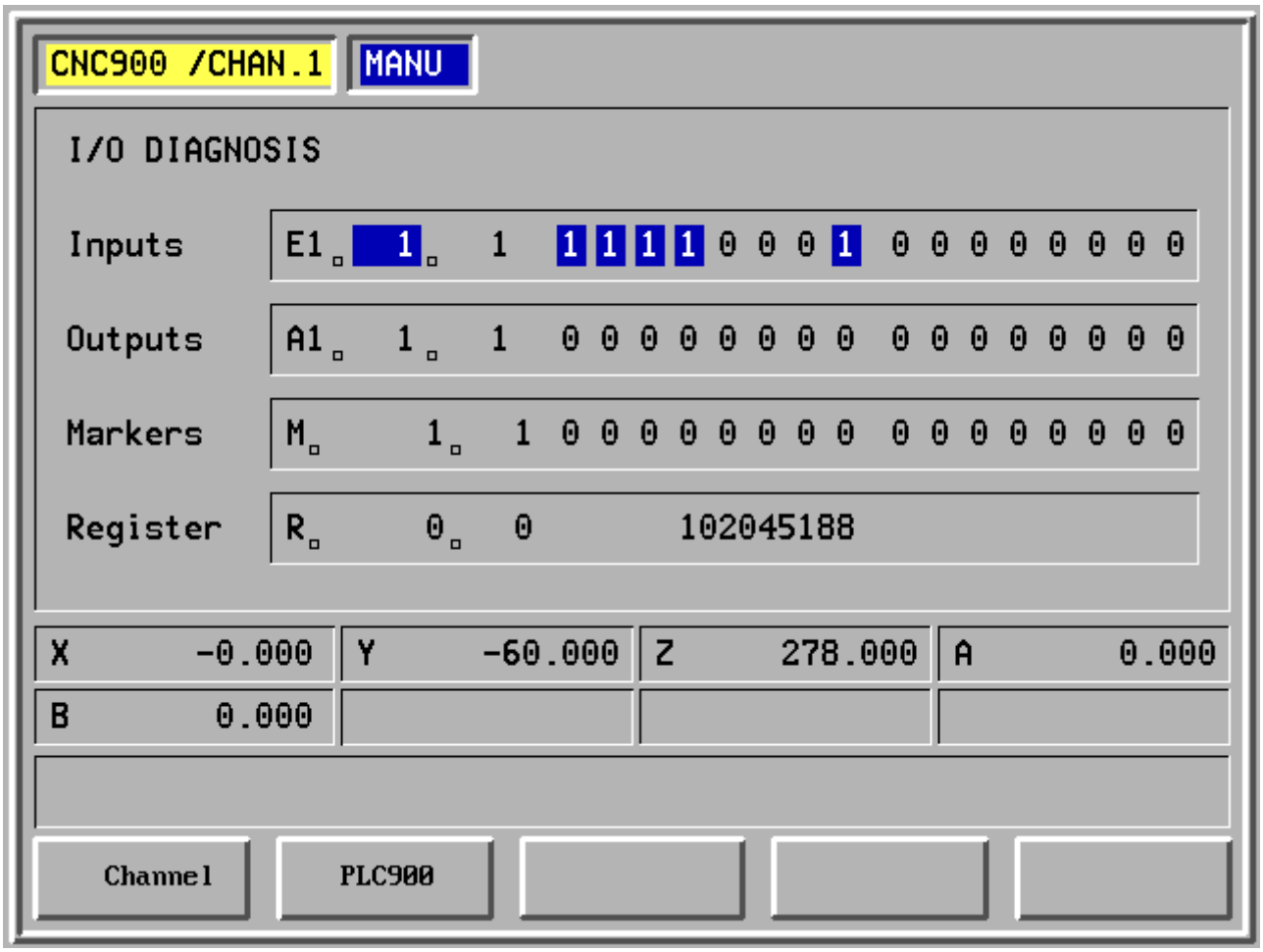
F3 State machine

F4 System configuration

F5 Clock

## 2.7.2 PLC (continued)

### I/O diagnostic




F1 Channel

F2 PLC 900

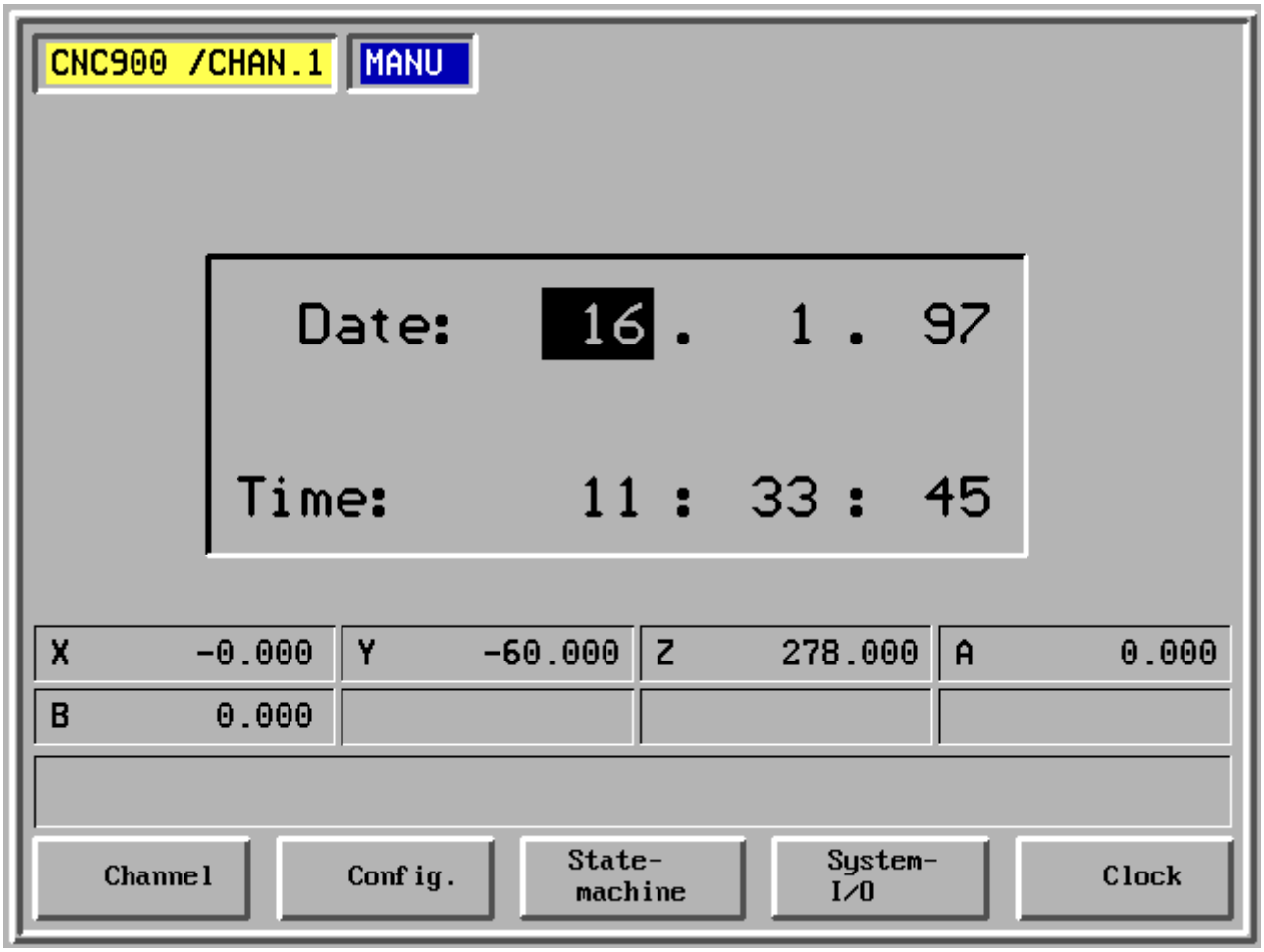
F3 -

F4 -

F5 -

## 2.7.2 PLC (continued)

### Clock




F1 Channel

F2 I/O

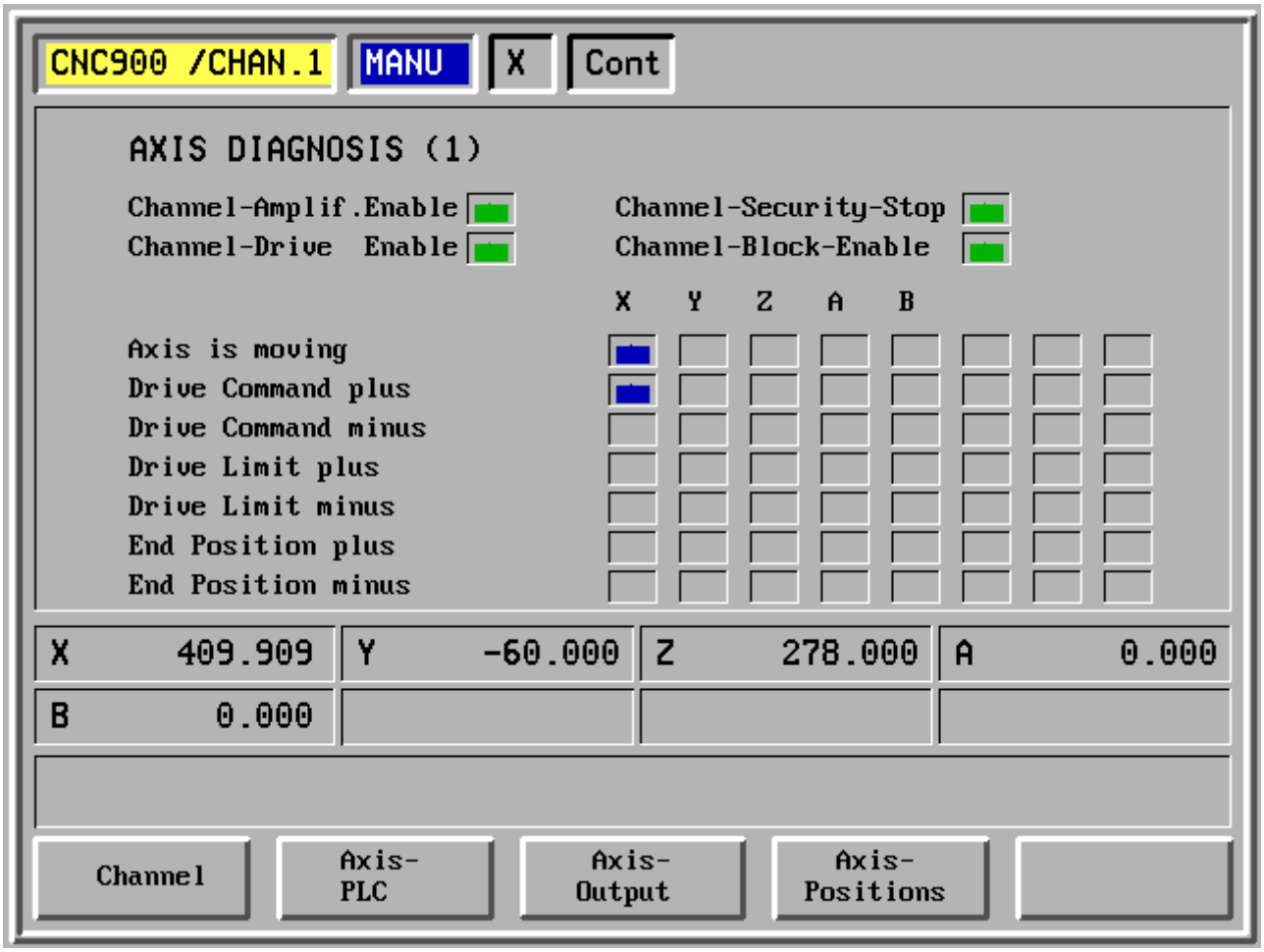
F3 State machine

F4 System configuration

F5 Clock

## 2.7.3 Axes

### Axis diagnostic 1




F1 Channel

F2 Axis PLC

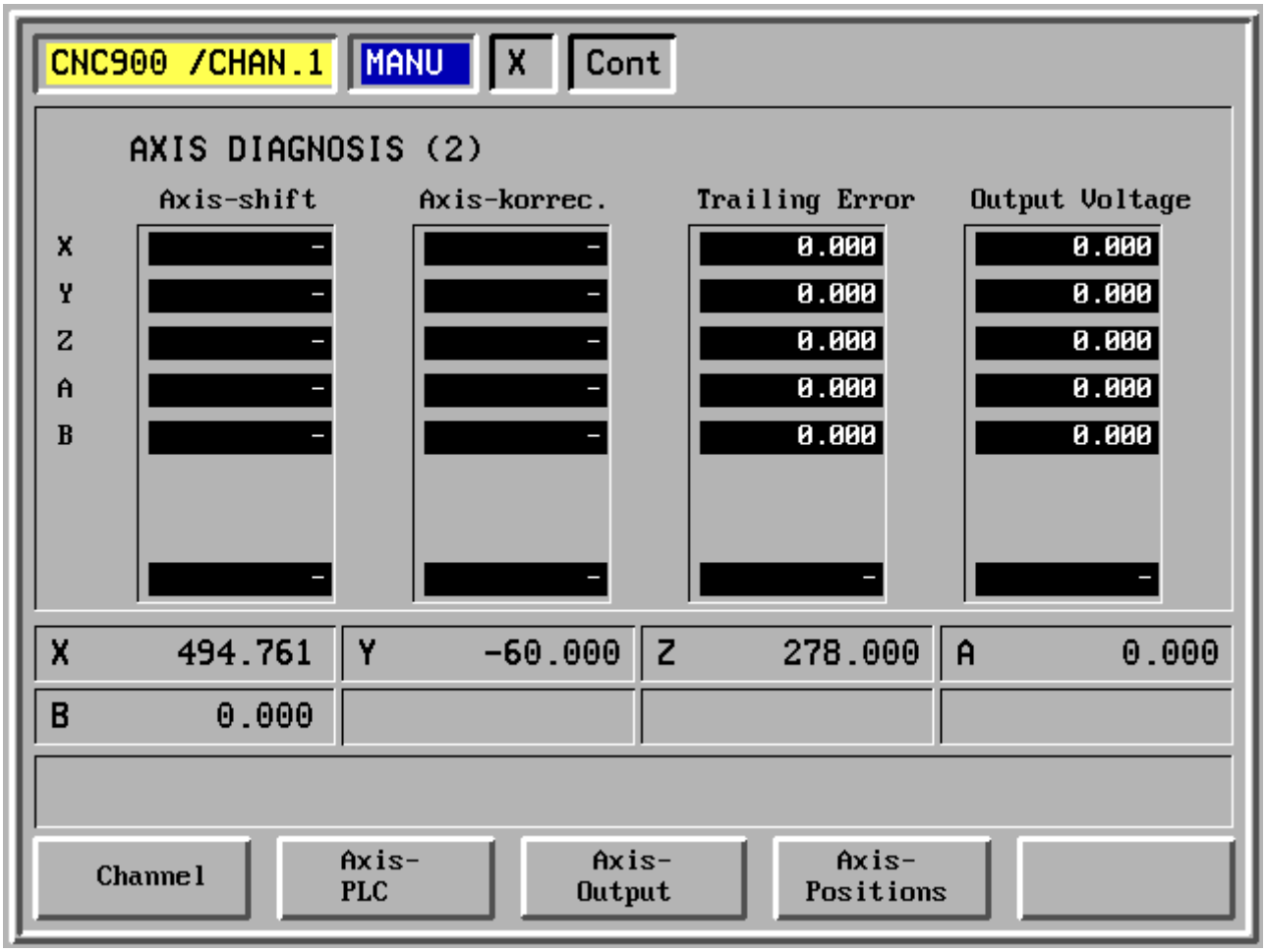
F3 Axis output

F4 Axis positions

F5 -

## 2.7.3 Axes (continued)

### Axis diagnostic 2




F1 Channel

F2 Axis PLC

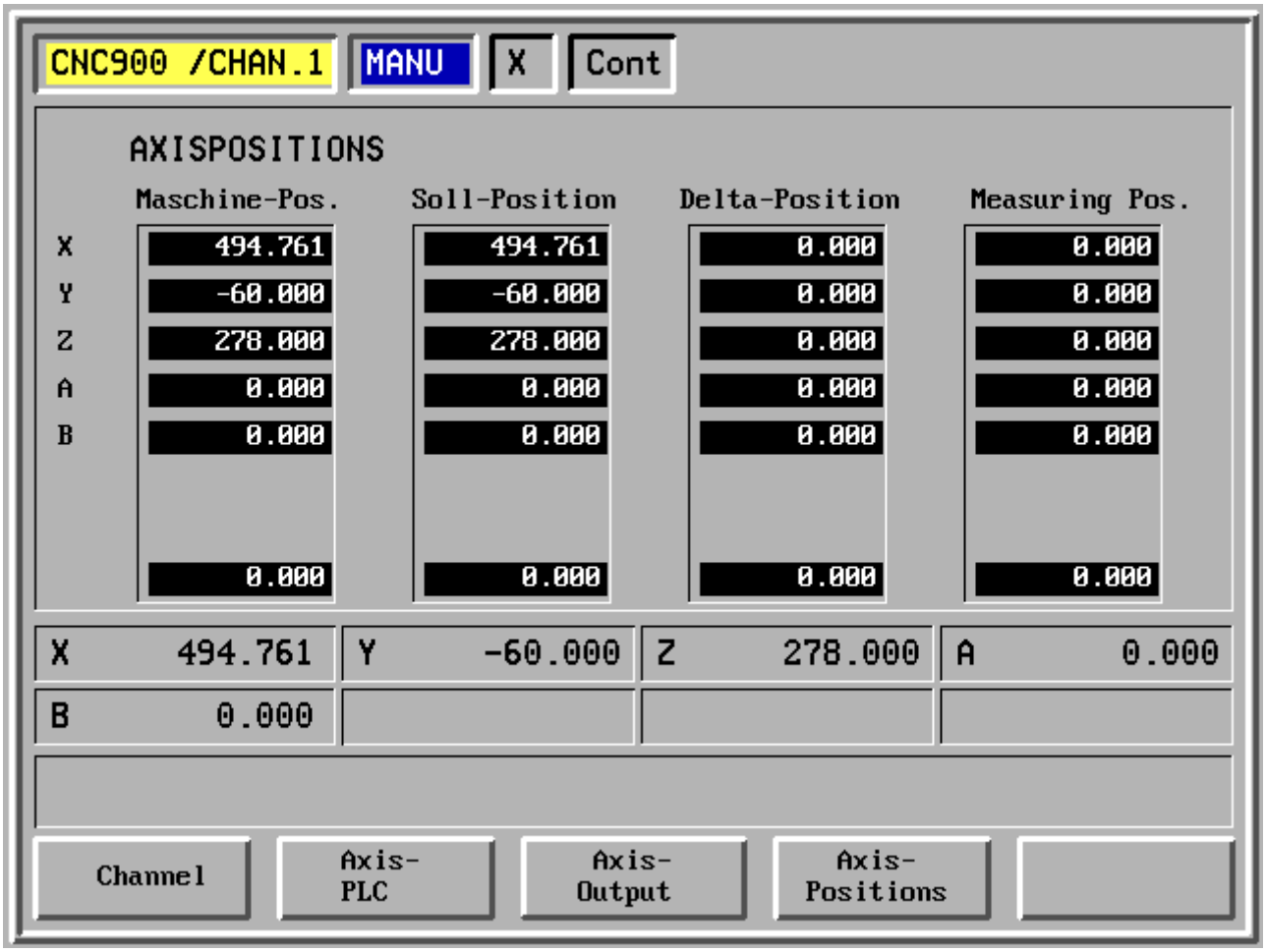
F3 Axis output

F4 Axis positions

F5 -

## 2.7.3 Axes (continued)

### Axis positions




F1 Channel

F2 Axis PLC

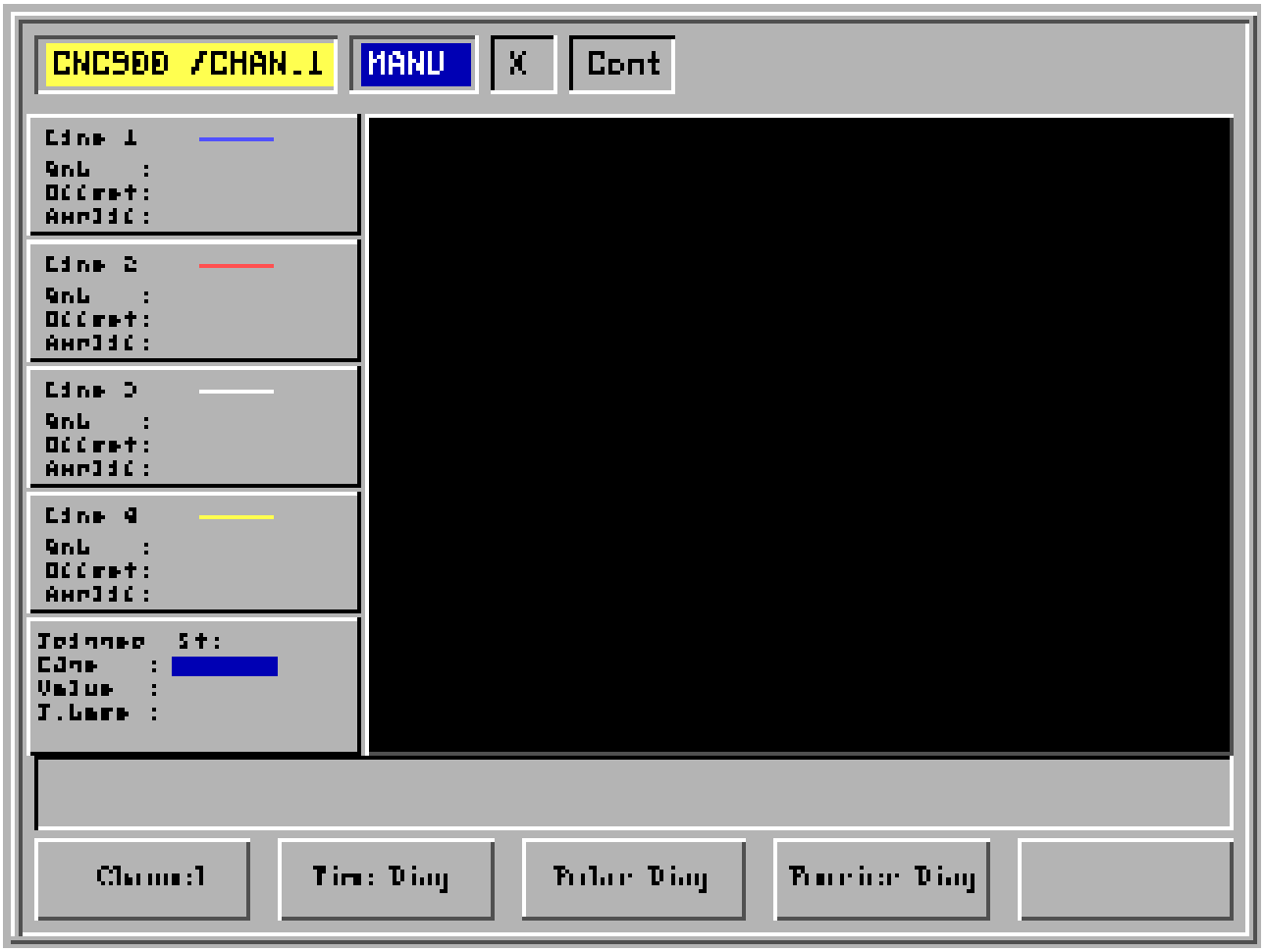
F3 Axis output

F4 Axis positions

F5 -

## 2.7.4 Oscilloscope

Four-channel oscilloscope with time-, polar- and Fourier diagnostic for evaluating the mechanical settings and for recognising defective mechanical parts.




F1 Channel

F2 Start time diagnostic

F3 Start polar diagnostic

F4 Start Fourier diagnostic

F5 -

## 2.7.4 Oscilloscope (continued)

**Qnr** Parameter number (connection)

| Number | Meaning | |
|---|---|---|
| q2150 | Command position | [mm, degree] |
| q2152 | Actual position | [mm, degree] |
| q2160 | Lag distance | [mm, degree] |
| q2161 | Coupling correction | [mm, degree] |
| q2168 | Actual difference (corresponds to speed) | [mm, degree] |
| q2169 | Output voltage of positioning control | [V] |

**Offset** Vertical offset

**Amplif** Amplification, vertical resolution, units per division

**Trigger St** Trigger line number

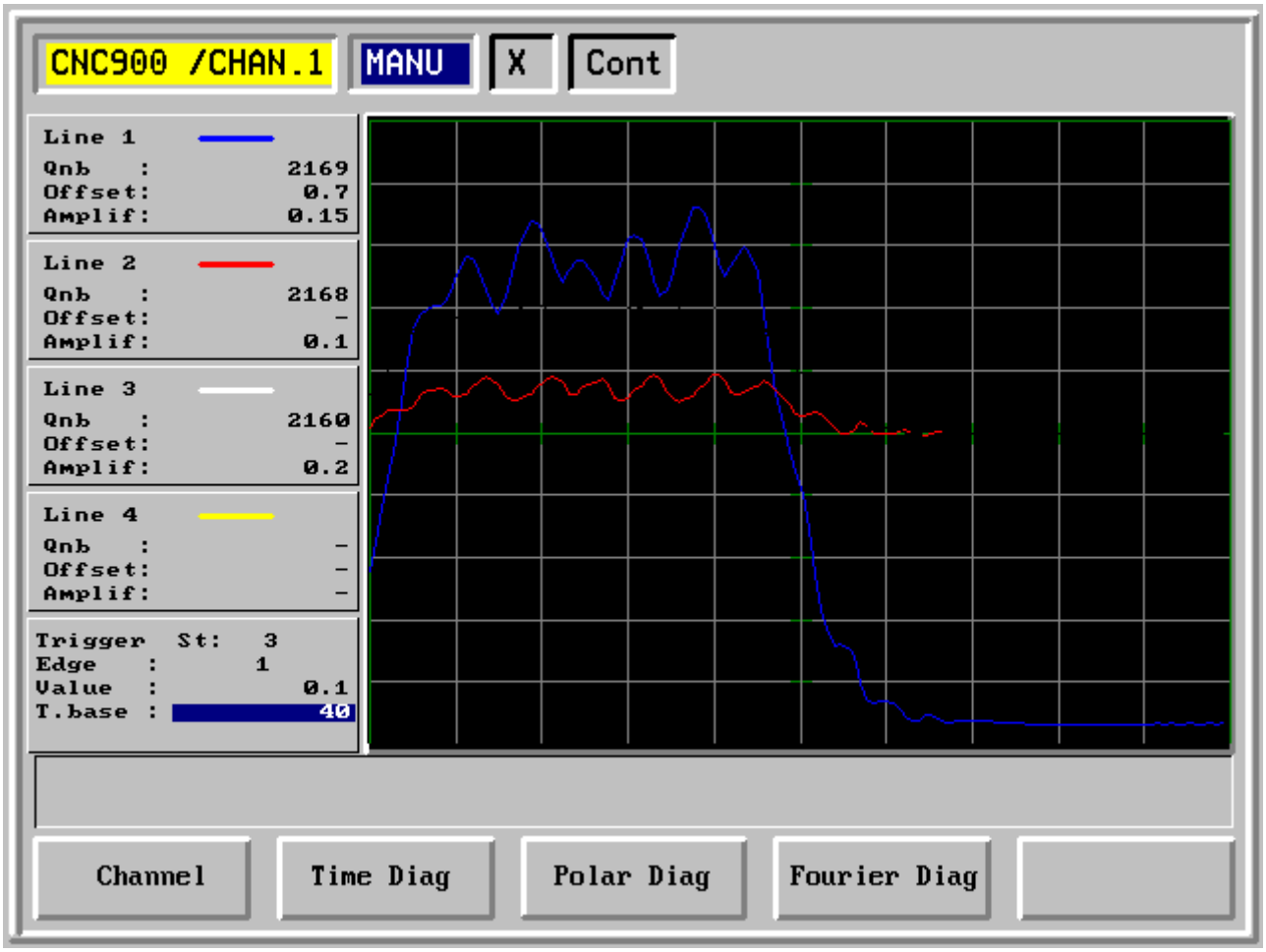
**Edge**
1 trigger at rising edge
-1 trigger at declining edge
0 trigger immediately

**Value** Value at which it is triggered.

**TB/Freq** Time basis / frequency, horizontal resolution, units per division [ms, Hz]

## 2.7.4 Oscilloscope (continued)

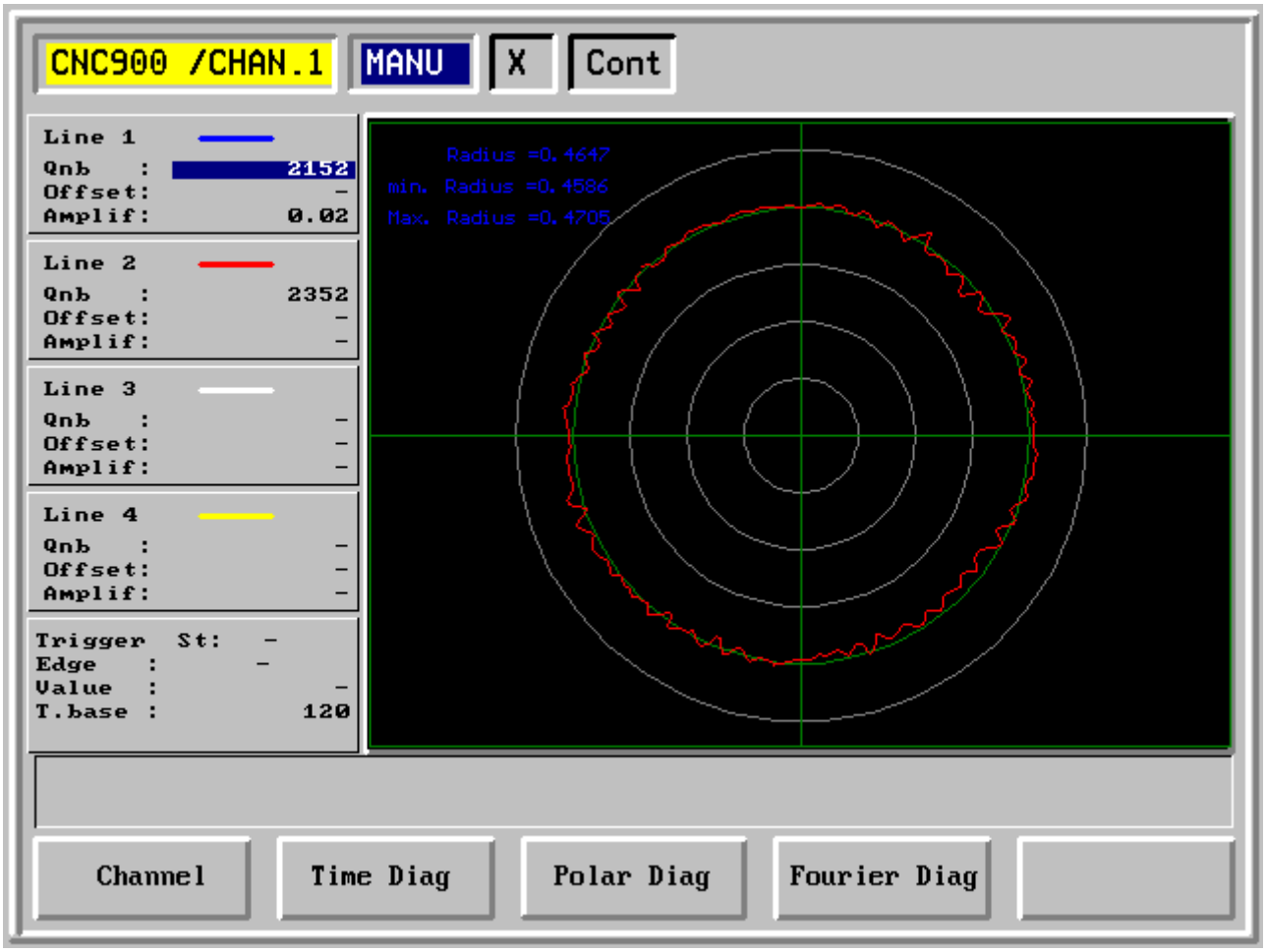
**Example: Three-channel time diagnostic**




| | | | |
|---|---|---|---|
| Line 1 | Qnr | 2169 | output voltage of positioning control in V |
| | Offset | 0,7 | vertical offset |
| | Amplif. | 0,15 | units per division |
| Line 2 | Qnr | | actual difference in mm/degree |
| | Amplif. | 0,1 | units per division |
| Line 3 | Qnr | 2160 | lag distance in mm/degree |
| | Amplif. | 0,2 | units per division |
| | | | |
| Trigger | Line number | 3 | |
| Edge | | 1 | trigger at rising edge |
| Value | | 0,1 | trigger at this value |
| Time basis / Frequency | | 40 | units per division |

## 2.7.4 Oscilloscope (continued)

**Example: polar diagnostic, circle test**

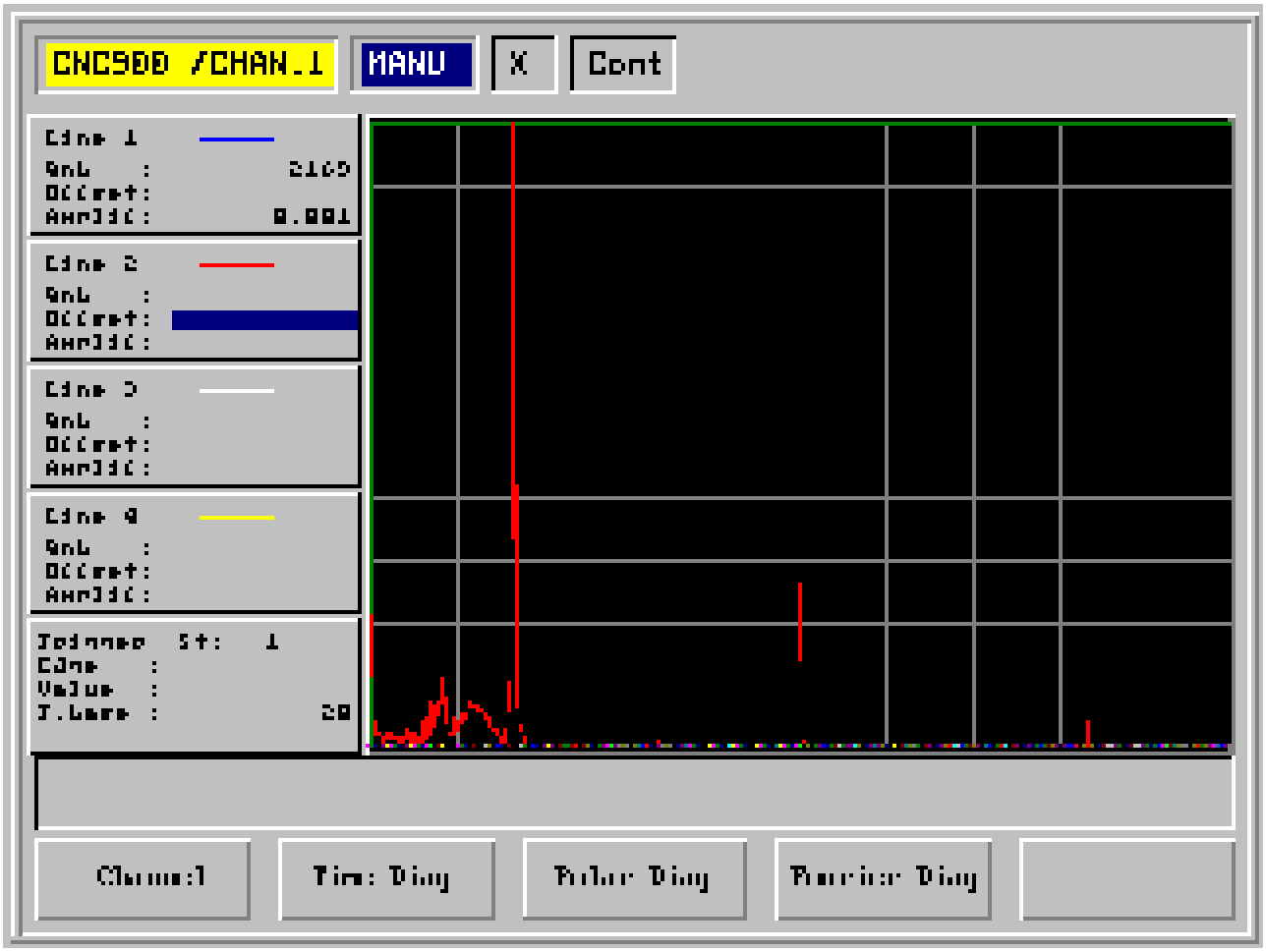



| | | | |
|---|---|---|---|
| Line 1 | Qnr | 2152 | actual position 1st axis in mm/degree |
| | Amplification | 0,02 | units per division |
| Line 2 | Qnr | 2352 | actual position 2nd axis in mm/degree |
| Time basis / Frequency | | 120 | units per division<br>chose time/frequency basis so that<br>at least one full circle is run. |

## 2.7.4 Oscilloscope (continued)

**Example: Fourier diagnostic, frequency spectrum**

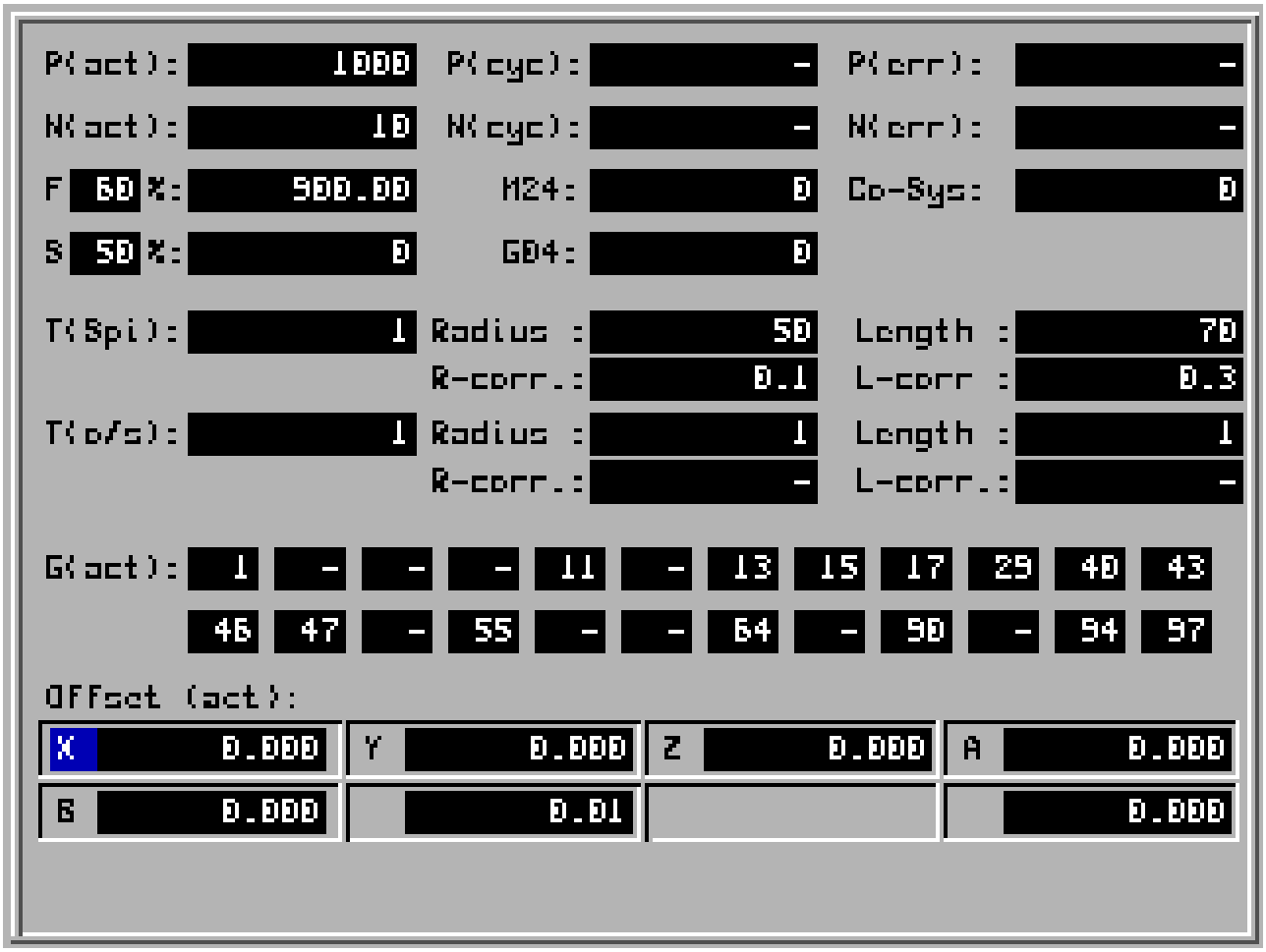
Frequency spectrum with oscillations at 33Hz and harmonics at 99Hz and 165HZ




| | | | |
|---|---|---|---|
| Line 1 | Qnr | 2169 | output voltage of positioning control in V |
| | Amplification | 0,01 | units per division vertically |
| Trigger | Line number | 1 | |
| Time basis / frequency | | 20 | units per division horizontally in Hz |

### 2.7.5 Additional informations

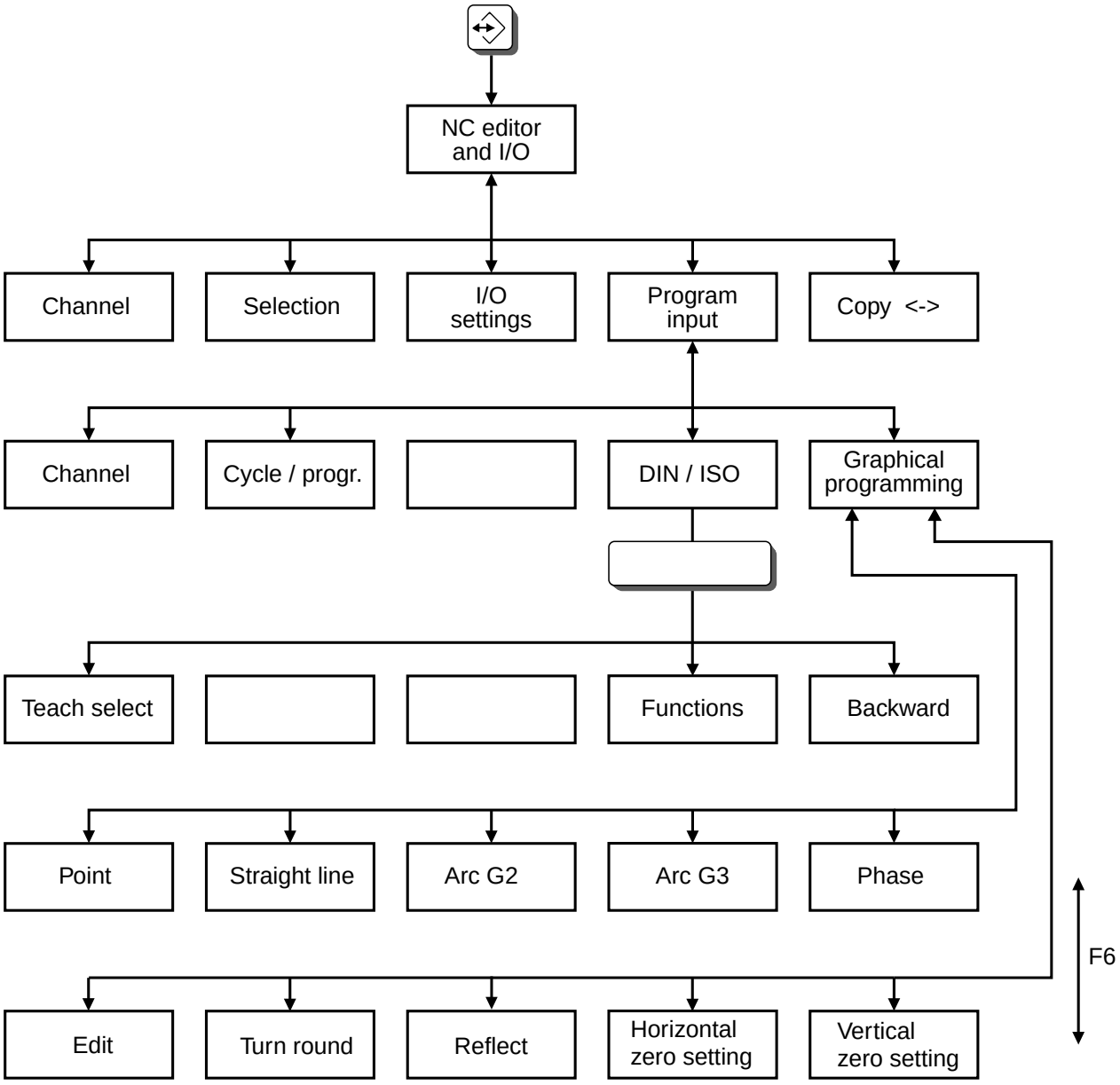
Additional online informations can be called up during operating with the key ?.



## 2.8 NC editor and I/O

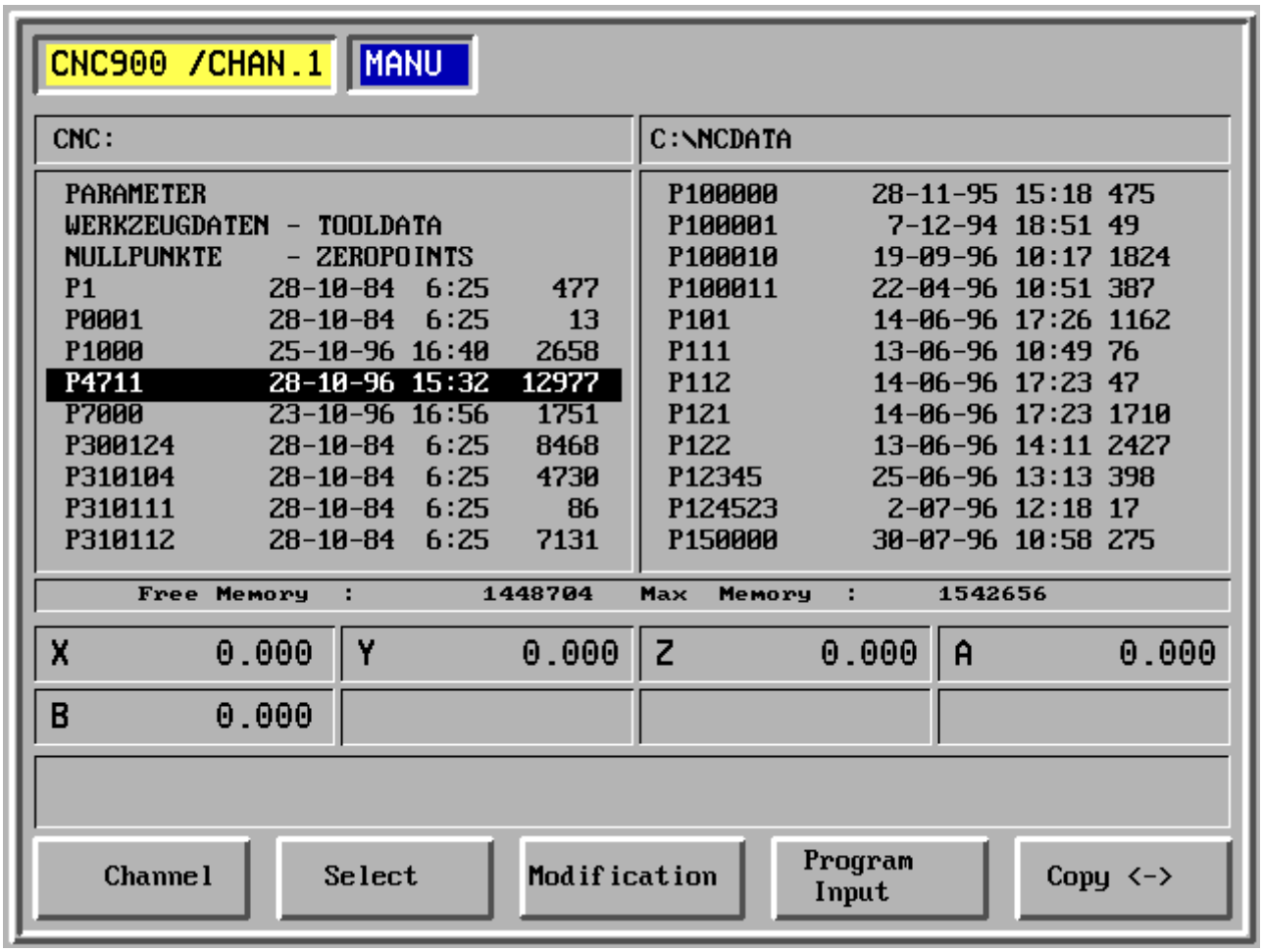
Writing, changing and storing NC programs;
Storing parameter, tool data and zero points.

Menue tree



## 2.8 NC editor and I/O (continued)

When pressing the key the menue for NC programming and I/O appears.




F1 Channel

F2 Selection

F3 I/O settings

F4 Program input

F5 Copy <->

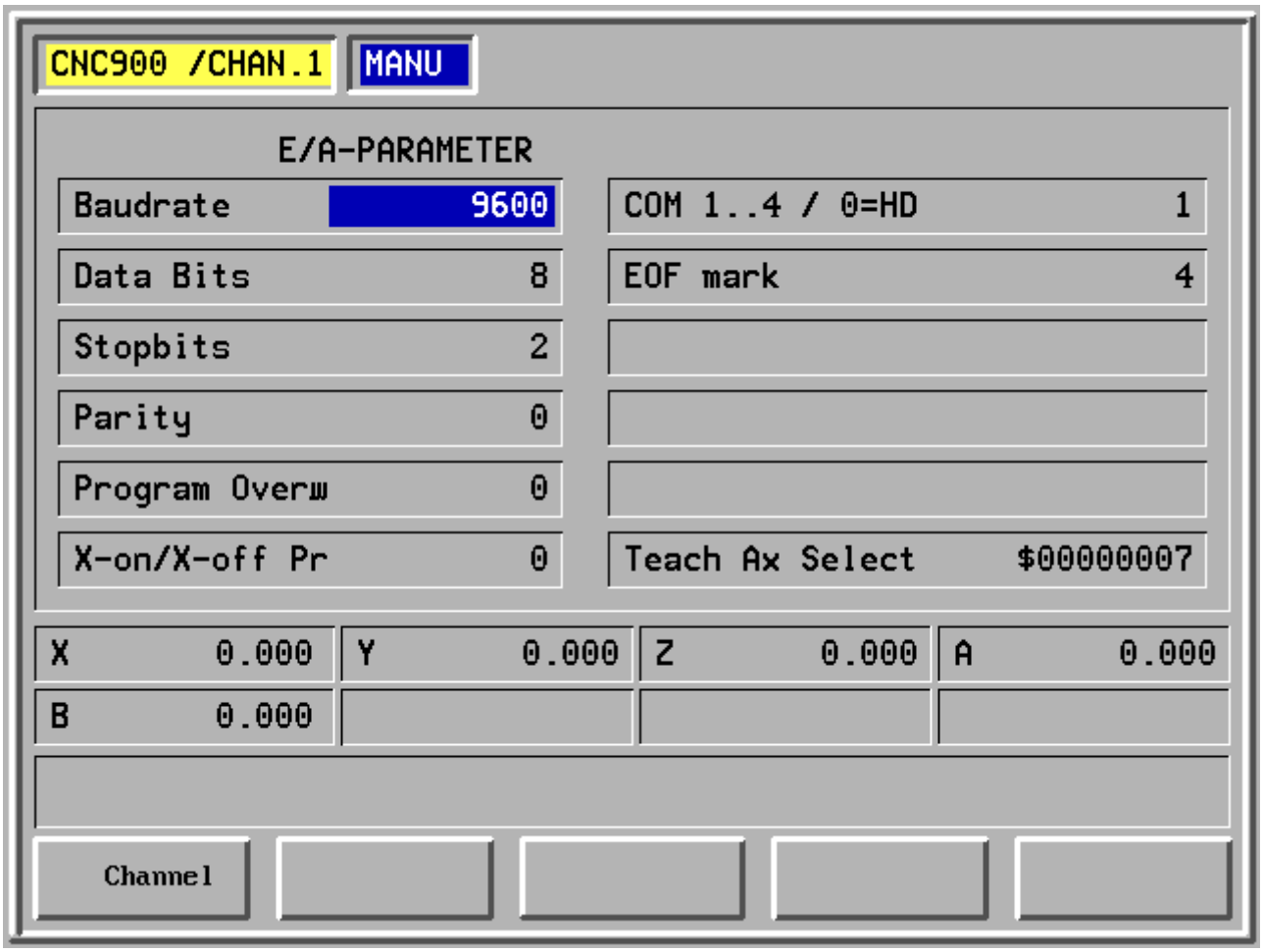
## 2.8.1 Selection

### Selection of storing modes

| on the left side | on the right side |
|---|---|
| CNC: | CNC: |
| C:\NCDATA | C:\NCDATA |
| | A:\ |
| | Serial I/O |

## 2.8.2 I/O parameters

This menue can be used for inputing I/O parameters.




F1 Channel

F2-

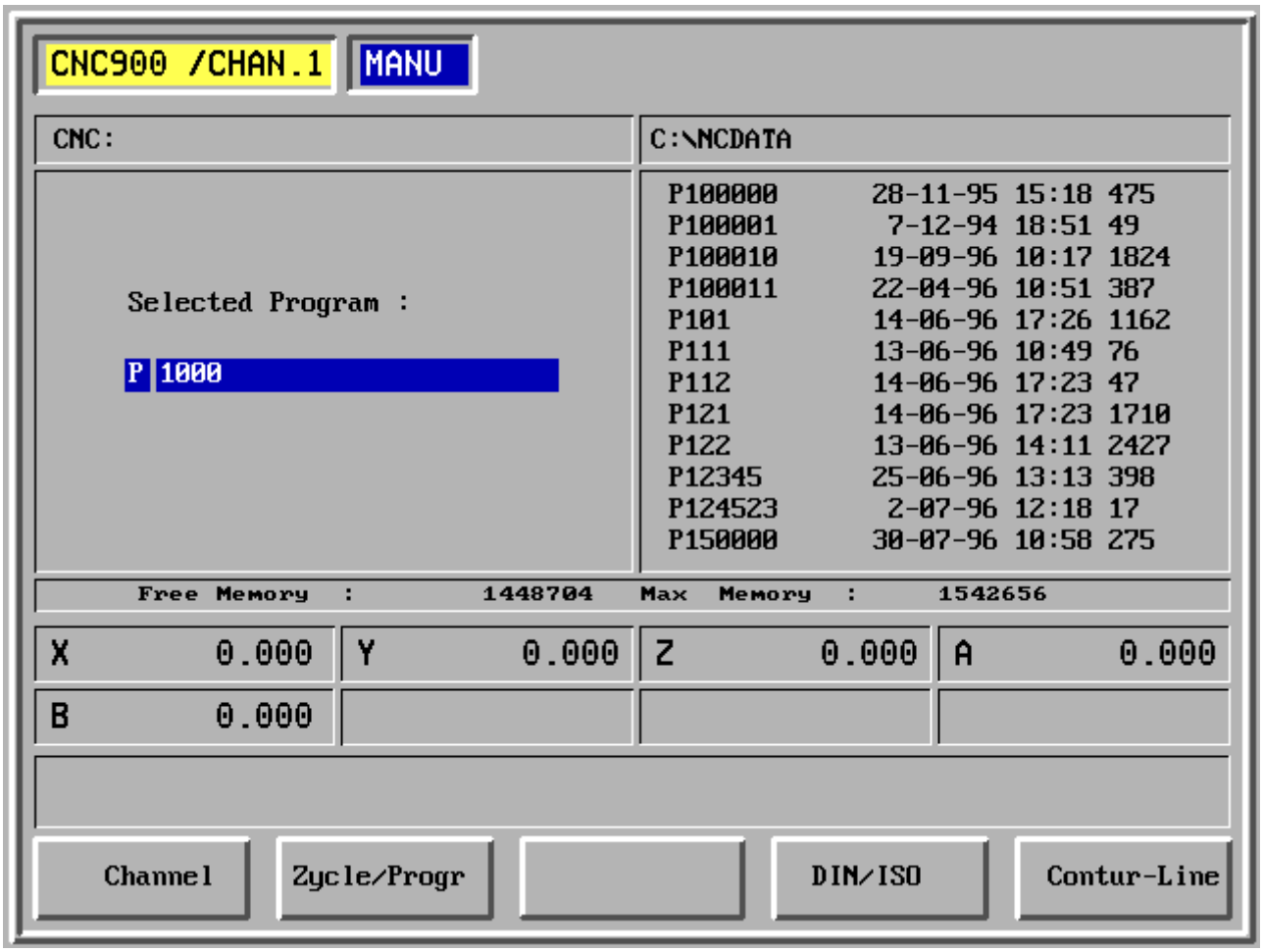
F3-

F4-

F5-

### 2.8.3 Program input

Program selection appears with pressing key F4 (in screen frame). With the cursor keys an existing program can be chosen or the number of a new program can be input with the numerical keyboard.




F1 Channel

F2 Cycle /program

F3 -

F4 Input a program according to DIN / ISO

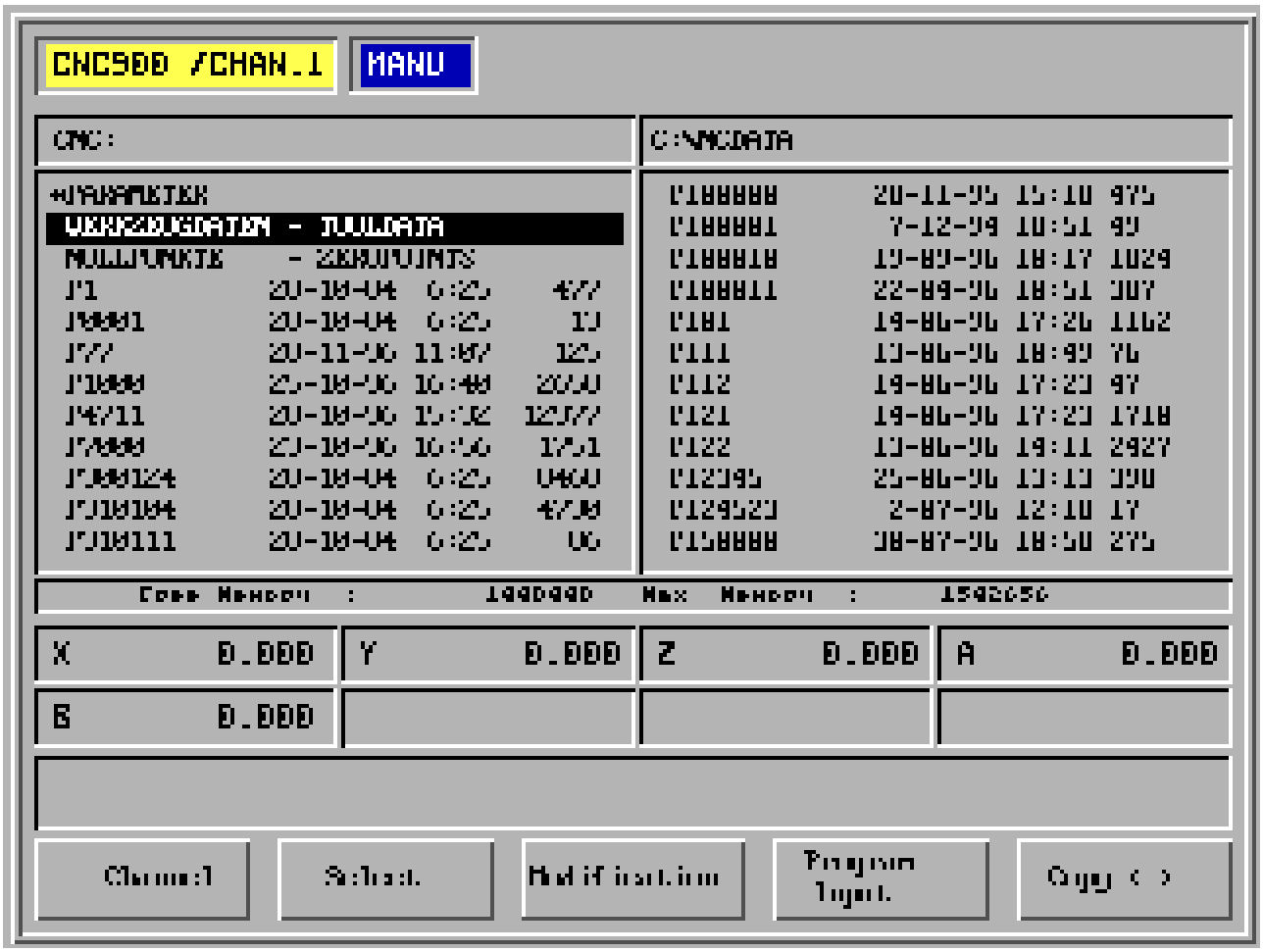
F5 Input a program with outline

## 2.8.3 Program input (continued)

| Program input | paragraph |
|---|---|
| according to DIN / ISO | 2.9 |
| also Teach in | 2.10 |
| with graphic support (outline path) | 2.11 |

## 2.8.4 Copying

Parameters, tool data, zero points and NC programs can be selected with the cursor keys for copying. The selected data are activated with the key and marked with an *.




F1 Channel

F2 Selection

F3 I/O settings

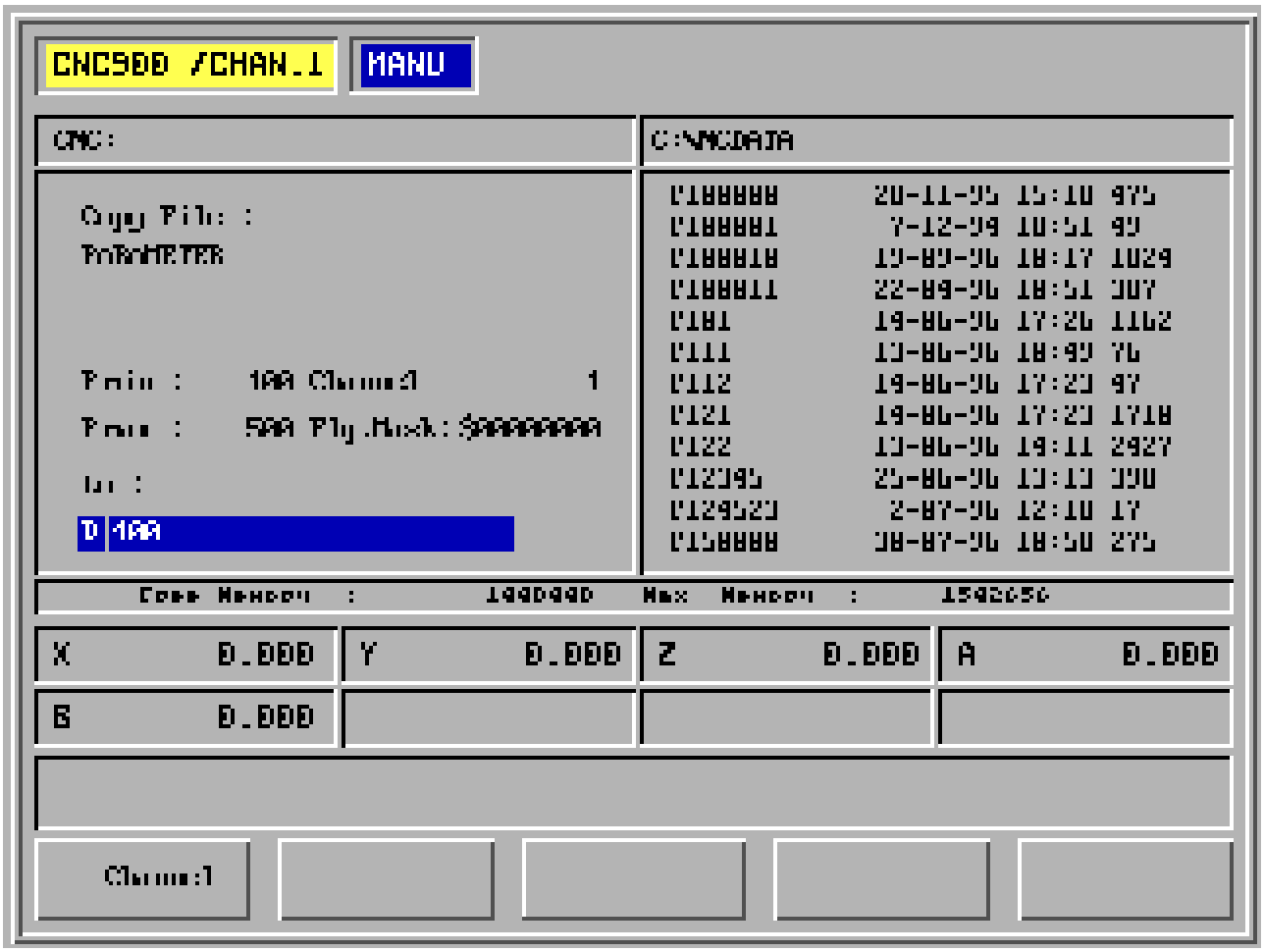
F4 Program input

F5 Copy <->

## 2.8.4 Copying (continued)

### Parameter

After selecting with the cursor keys and after activating with parameters can be copied with F5 from CNC: to C:\NCDATA or A:\ . Input Pmin and Pmax, identification letter D.




F1 Channel

F2 -

F3 -

F4 -

F5 -

## 2.8.4 Copying (continued)

**Parameter**

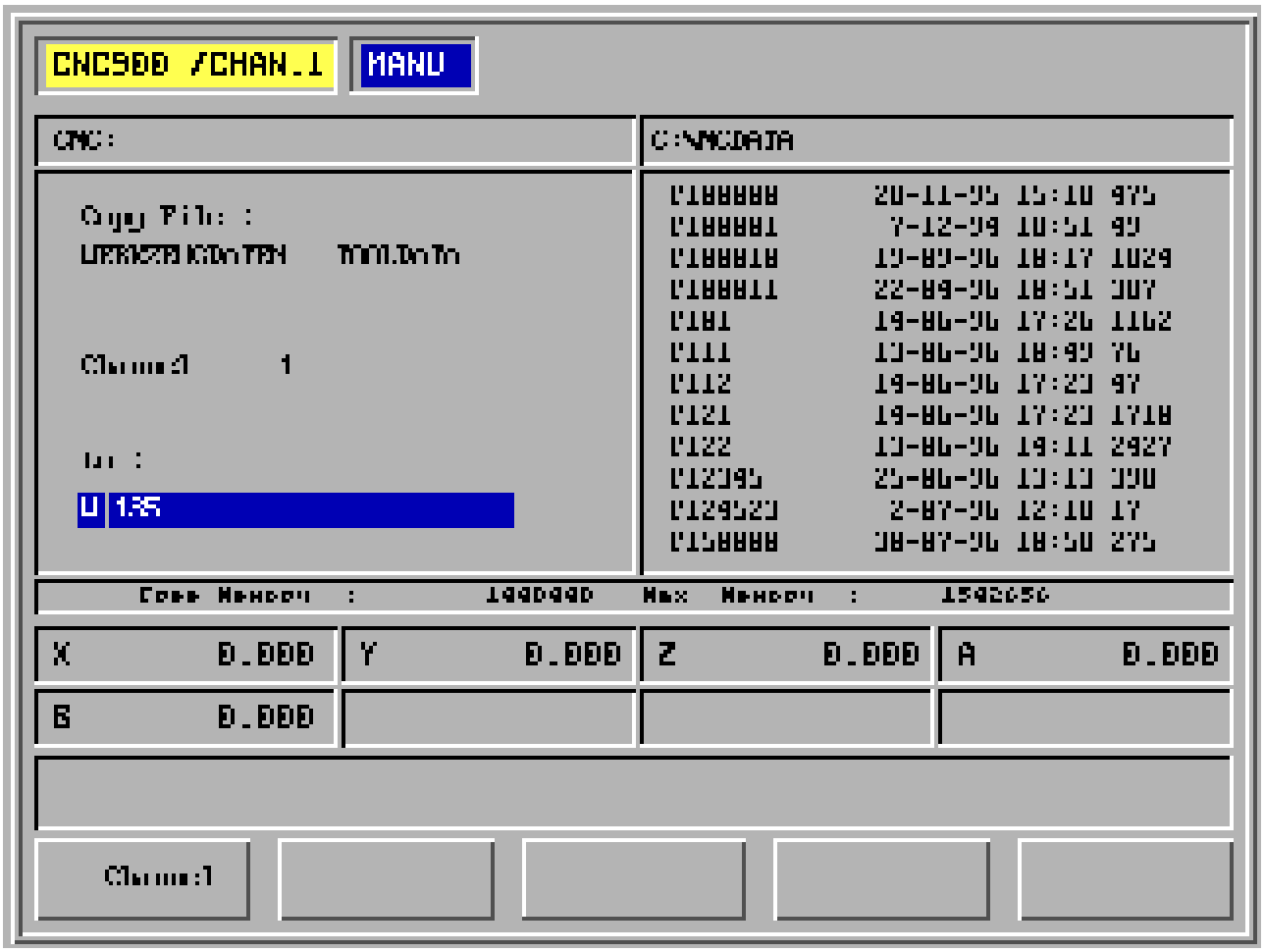
Meaning of the input fields

| | | |
|---|---|---|
| Pmin: | first parameter of output | |
| Pmax: | last parameter of output | |
| Channel | 0 | Output of q-parameters |
| | 1 to 8 | Output of P-parameters of the corresponding channel |
| Flag mask | Status flag mask | |
| | 0 | Output of all parameters according to Pmin - Pmax |
| | <>0 | Output of parameters in the range of Pmin - Pmax, at which the bits are set in the parameter status according to the flag mask.<br>Herewith an output of all parameters in which the EEPROM bit is set, is possible. |
| to: | DOS file name | |

## 2.8.4 Copying (continued)

### Tool data

After selecting with the cursor keys and after activating with tool data can be copied with F5 from CNC: to C:\NCDATA or A:\ . Identification letter W.




F1 Channel

F2 -

F3 -

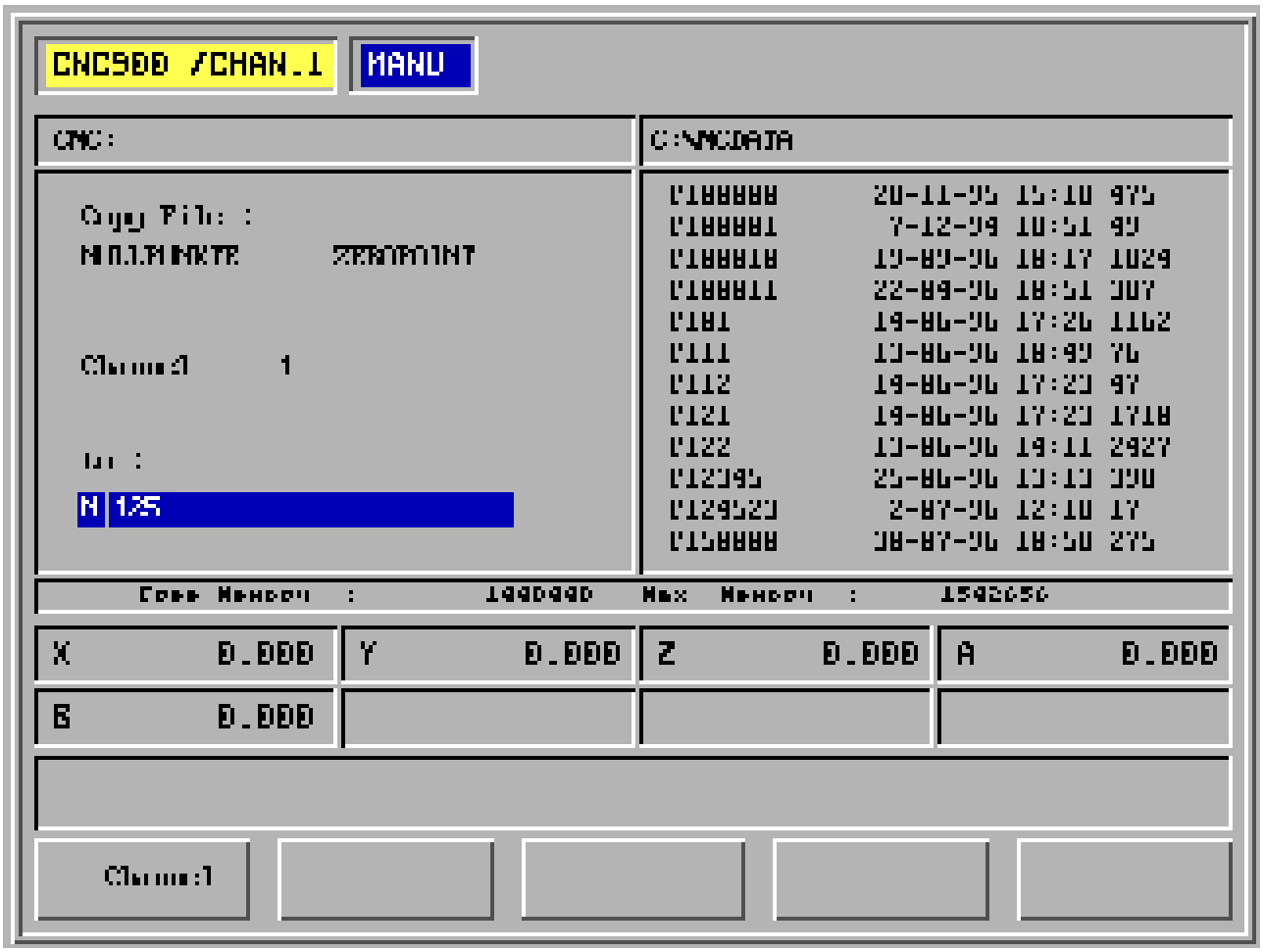
F4 -

F5 -

## 2.8.4 Copying (continued)

### Zero points

After selecting with the cursor keys and after activating with zero points can be copied with F5 from CNC: to C:\NCDATA or A:\ . Identification letter N.




F1 Channel

F2 -

F3 -

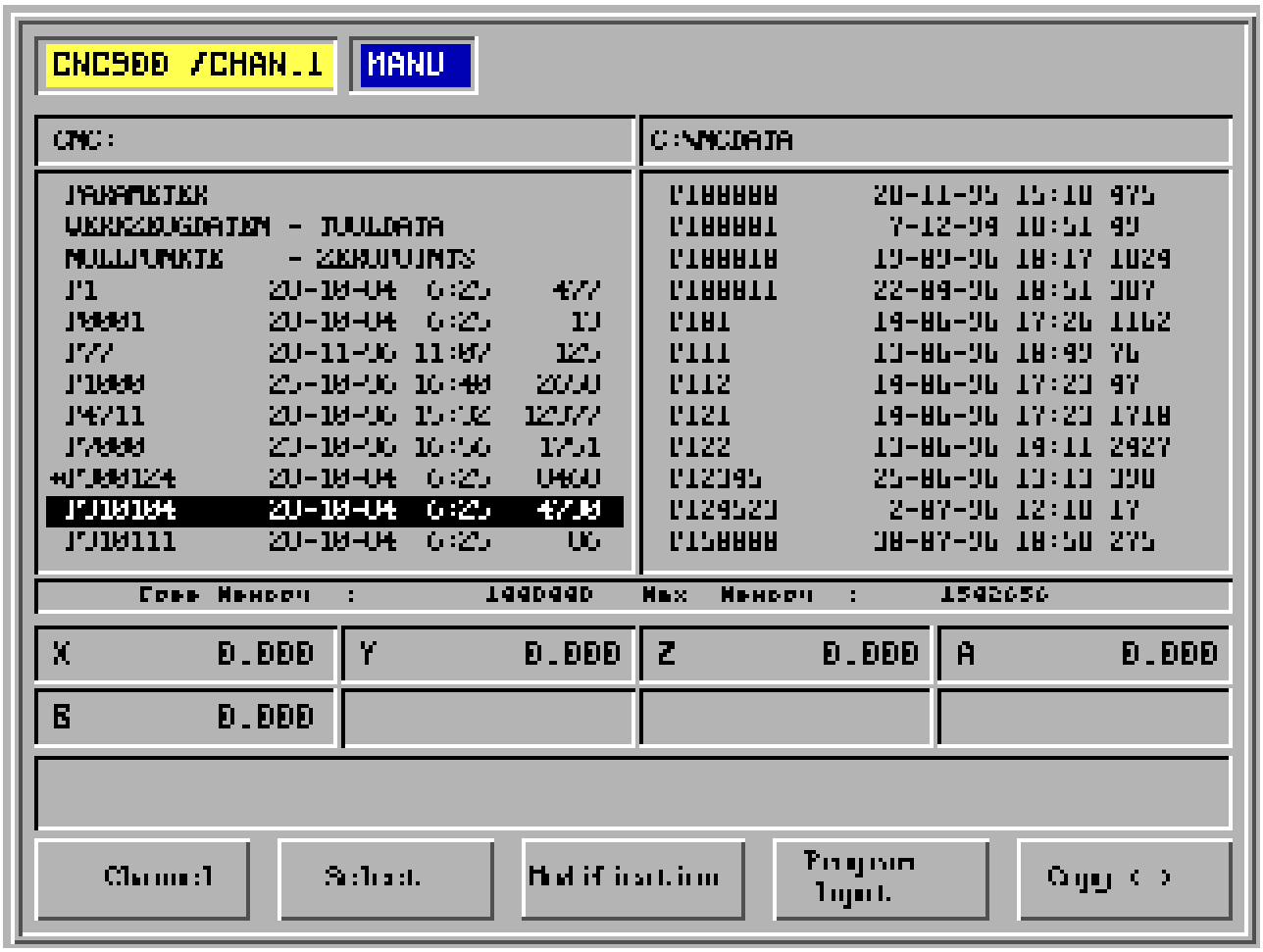
F4 -

F5 -

## 2.8.4 Copying (continued)

### NC programs

After selecting with the cursor keys and after activating with , the selected NC program is marked with *.




F1 Channel

F2 Selection

F3 I/O settings

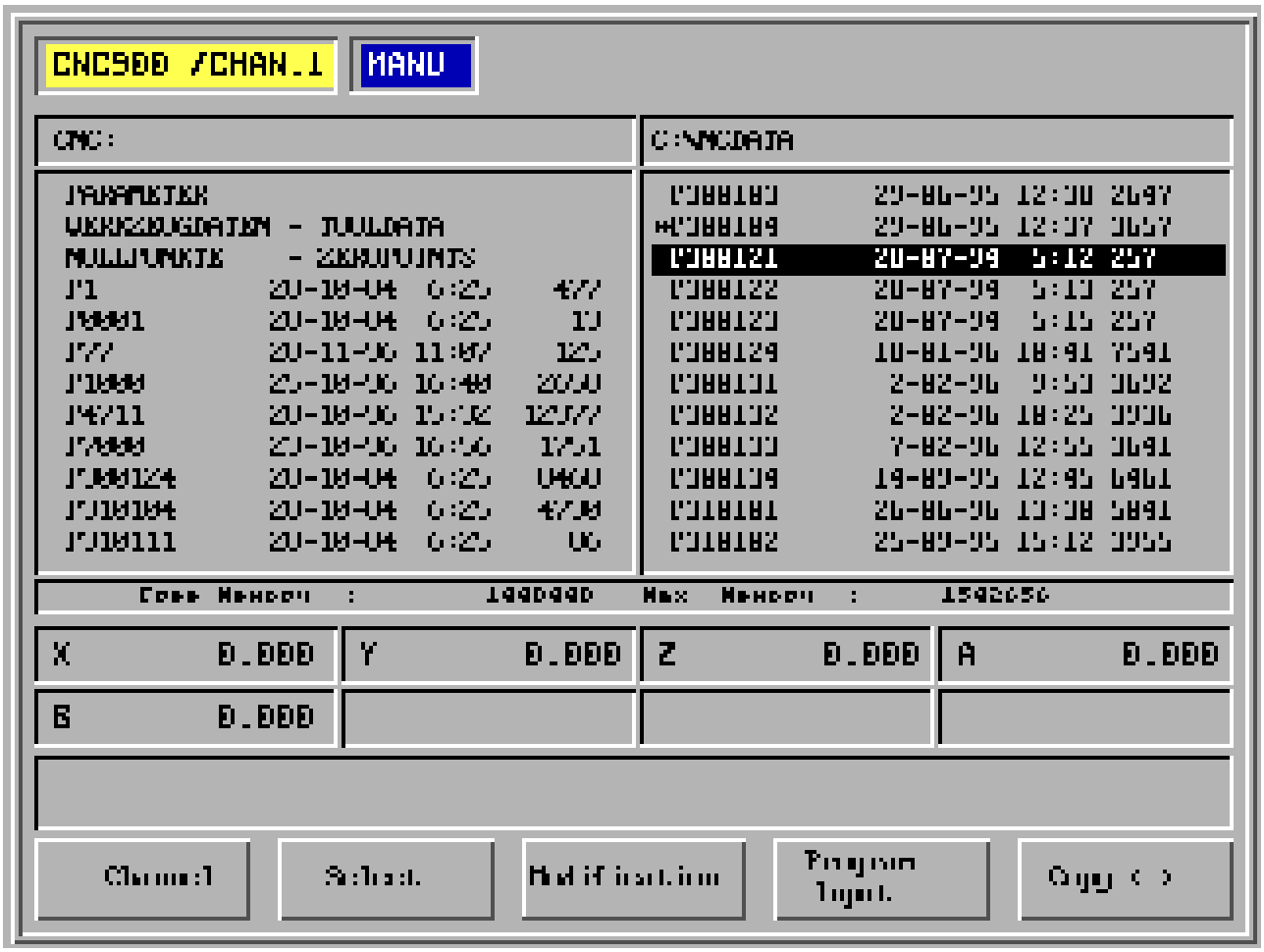
F4 Program input

F5 Copy <->

## 2.8.4 Copying (continued)

### NC programs

After selecting with the cursor keys and after activating with tool daNC programs can be copied with F5 from CNC: to C:\NCDATA or A:\ . Identification letter P.




F1 Channel

F2 Selection

F3 I/O settings

F4 Program input

F5 Copy <->

## 2.8.4 Copying (continued)

### NC programs

### All programs mark

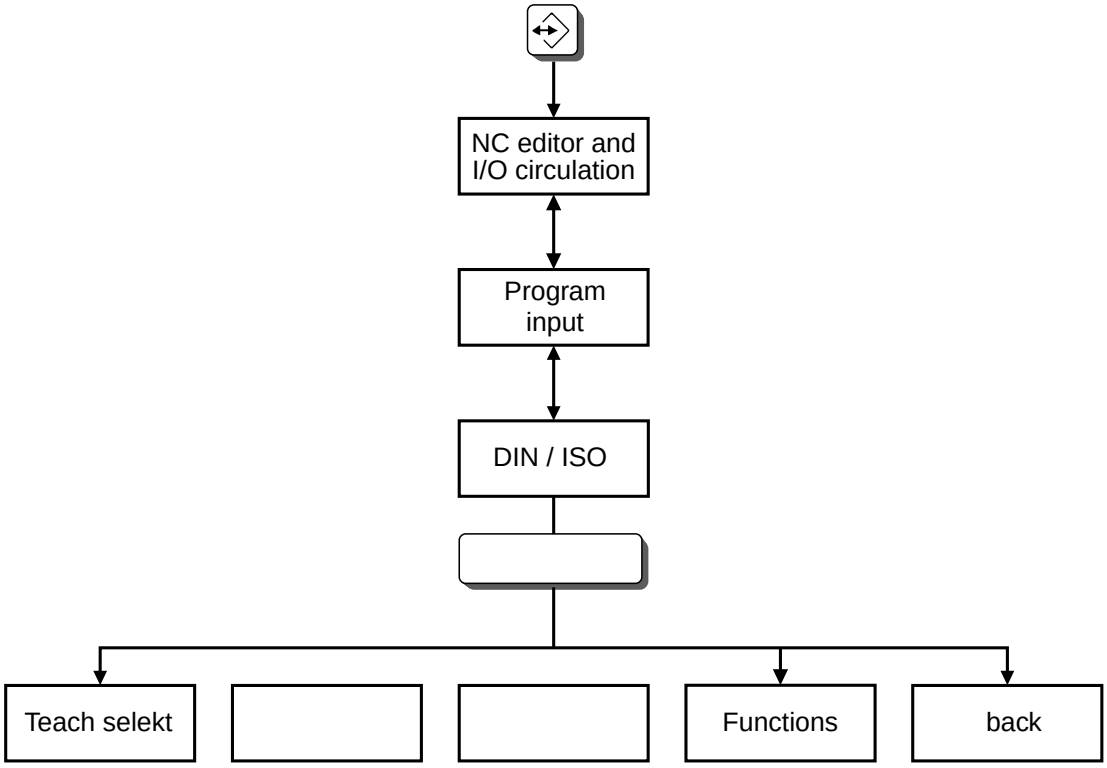
F6 and inserting branch press.

### All programs off NC memory copy
(store total NC memory in a file)

Programs mark and Funktionstate F5 (copy) press.

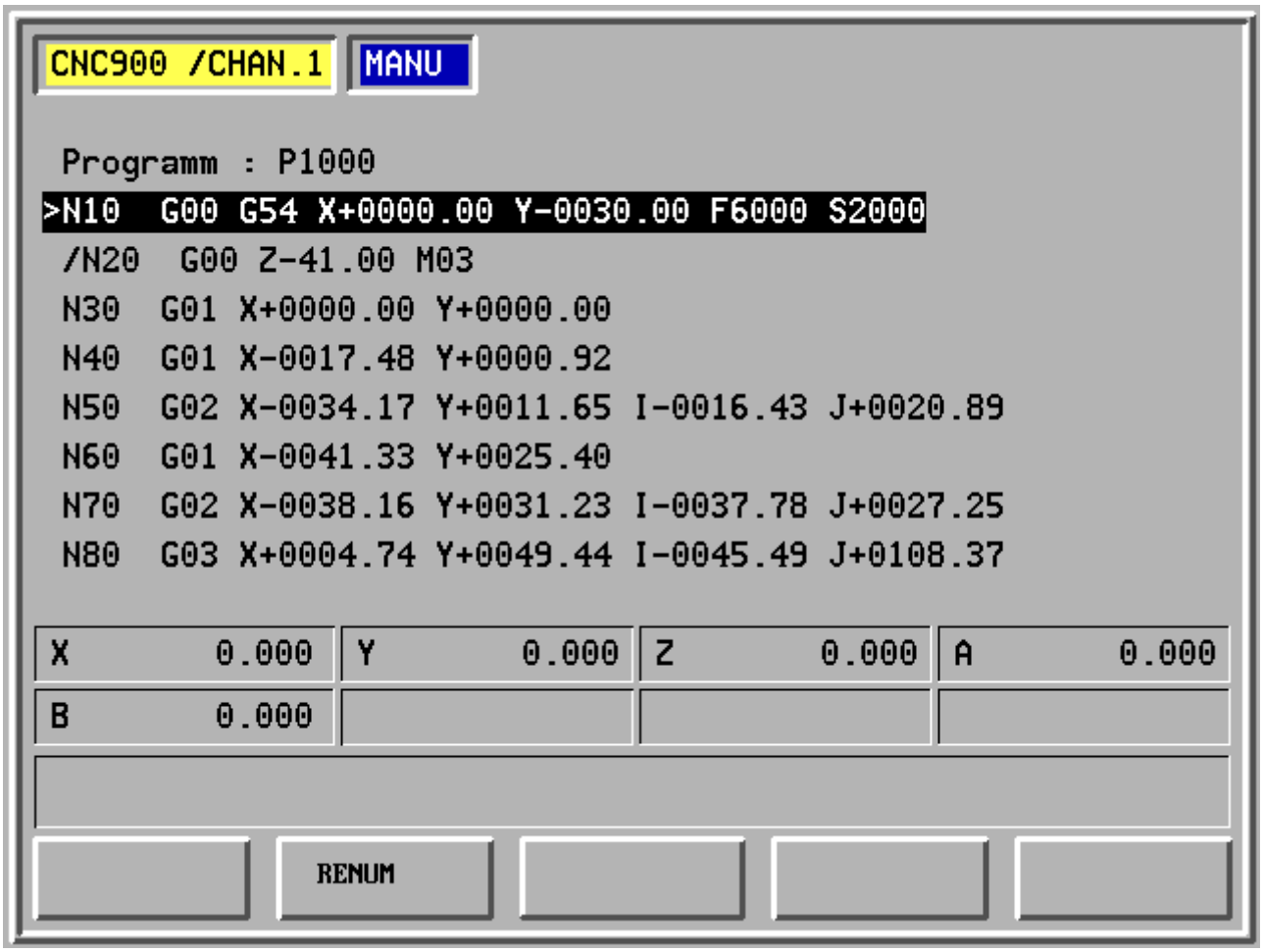
## 2.9 Input a program according to DIN / ISO

Menue tree



## 2.9 Input a program according to DIN / ISO (continued)

After inputing the program number and after pressing the key DIN / ISO the program appears with the first blocks in the display, if a program is existing with the indicated number. If not, only the program number and >N10 appears.




F1 -

F2 -

F3 -

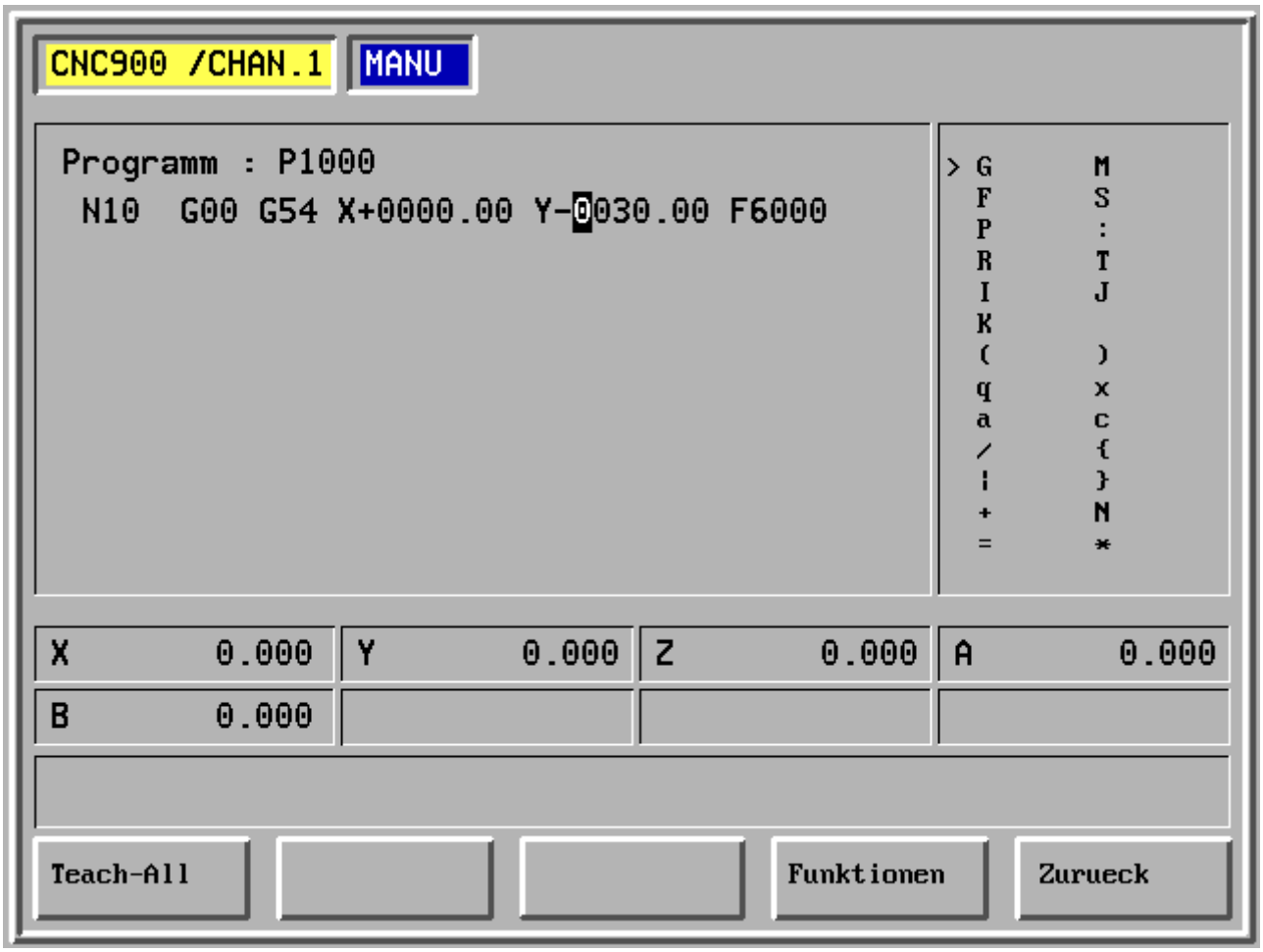
f4 -

F5 -

## 2.9 Input a program according to DIN / ISO (continued)

### Changing or inputing blocks

When pressing [↵] the selected block and the function appear.




F1 Teach-Select

F2 -

F3 -

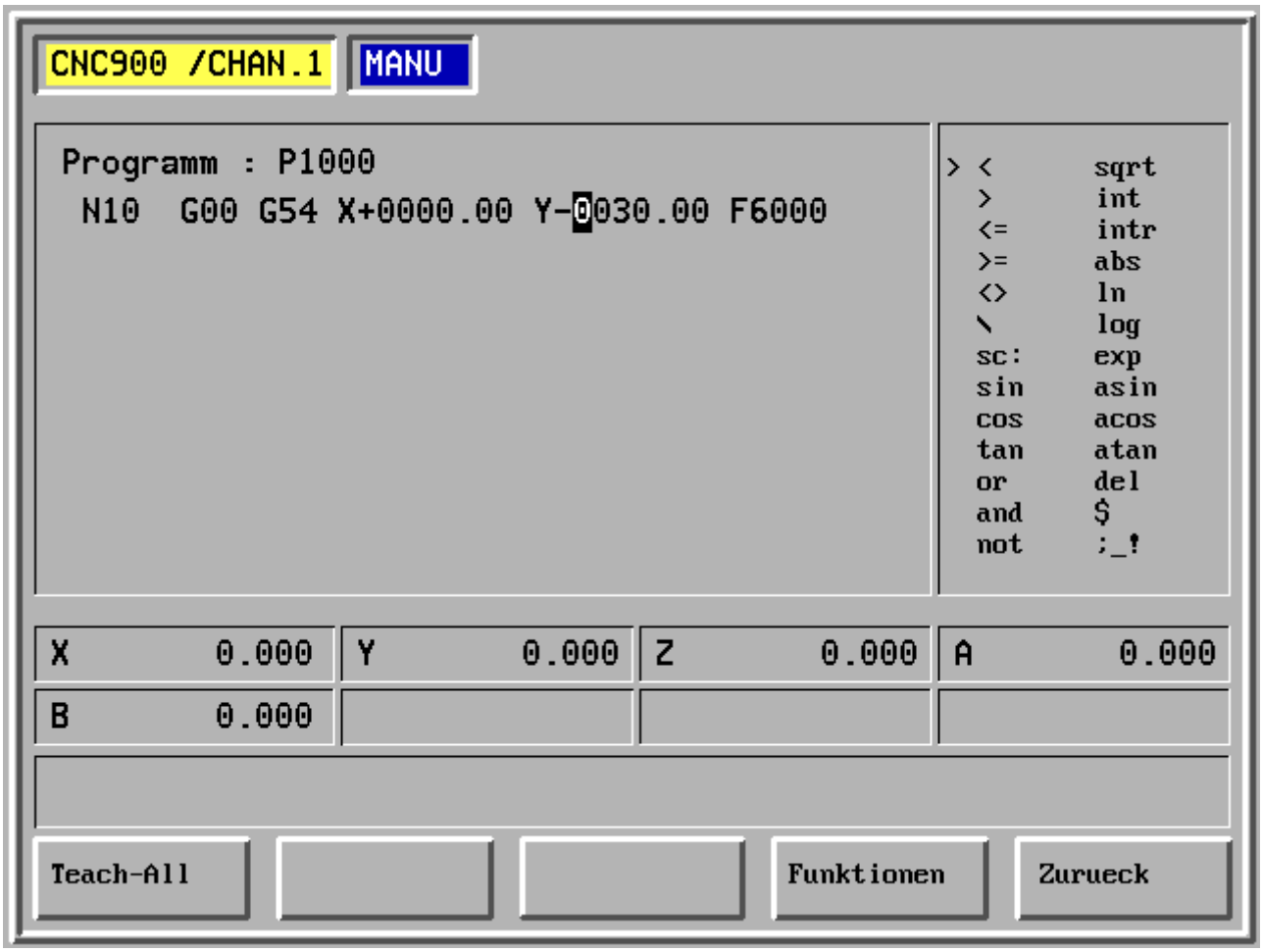
F4 Functions Switching on further programming functions

F5 Back

## 2.9 Input a program according to DIN / ISO (continued)

### Functions

When pressing the functions are activated. Selection with cursor keys.




F1 Teach-Select

F2 -

F3 -

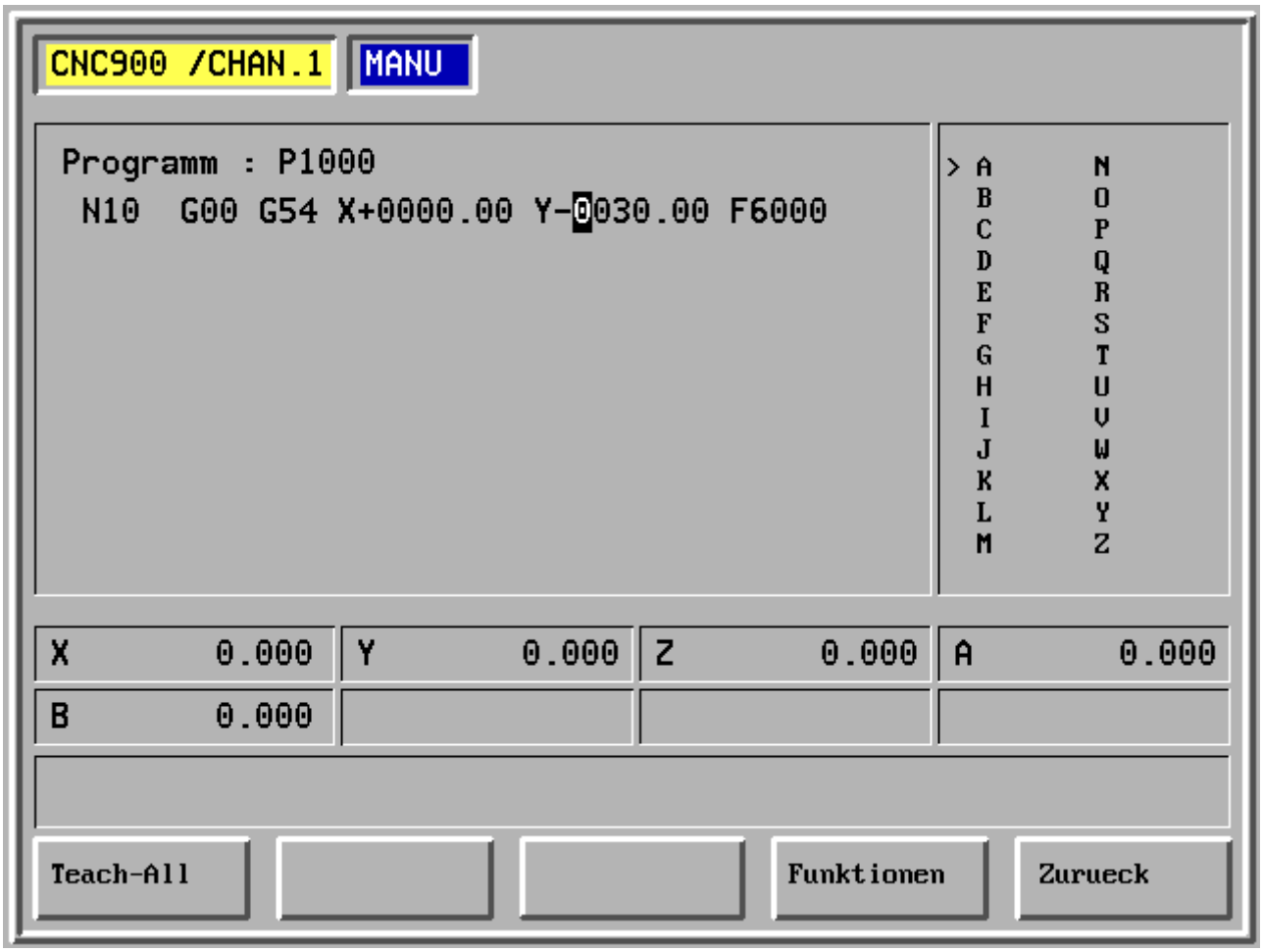
F4 Functions Switching on further programming functions

F5 Back

## 2.9 Input a program according to DIN / ISO (continued)

### Functions

When pressing XXX another function siede appears.




F1 Teach-Select

F2 -

F3 -

F4 Functions Switching on further programming functions

F5 Back

## 2.10 Preparing a NC program in Teach mode

### 2.10.1 Setting zero points

The parameter P11804 (tool carrier - length) must be loaded with the right values and the tool dimension must be active.

Drive axes in the desired zero point position.

Call up function „**Command=Actual**“ and store with **‘Enter’**.
Herewith the current actual values of the axes are transmitted to the zero point memory.

In this way different zero pointes can be set.

If these zero point shifts should be active in manual operation mode, the parameter P8758 has to be loaded with the desired value (G54 to G59).

In automatic mode, the call up is made with the functions G54...G59.

Remark:
The zero point shifts are only effective in the tool coordinate system (G48) or in the workpiece coordinate system (G49).

## 2.10.2 Enter a program with “Teaching”

It is advisable, to mark the workpiece with all known or determining „Teach-points“.
This facilitates later a fast discovering of the individual NC blocks, to insert in the program certain data and/or functions.

A further help would be, if the stored „Teach-points” would be written in a list with the corresponding block number, e.g. Point 5 = block no. 80.

The stored zero point shift, on which the NC program refers, can be activated with parameter P382.

Select mode of operation „Positioning“.
Approach zero point position with a positioning block,
e..g. N10 G0 G55 X0 Y0 Z0 A0 B15

The mode of coordinate, in which the command / actual data were stored (P8751), must be inserted in the block over the corresponding G - function (G48, G49).

Select manual operation mode:
Enter and store program number and the corresponding functions and technological data in the designated NC blocks,
e.g. N10 T1 M16
N20 G55 G49 FOR. .. S .... X ... .... Y.. ... .. Z.. ... ..

With „continuous drive“ or „step drive“ the desired position is approached with all axes.
If all axes are in their anticipated position, the position is stored with the function ‘Command=Actual’ and ‘Enter and transmitted to the indicated block.
e.g. N30 X ... .... Y.. ... .. Z.. ... .. A.. ... .. C.. ... ..

The next Teach - points are started and stored likewise.

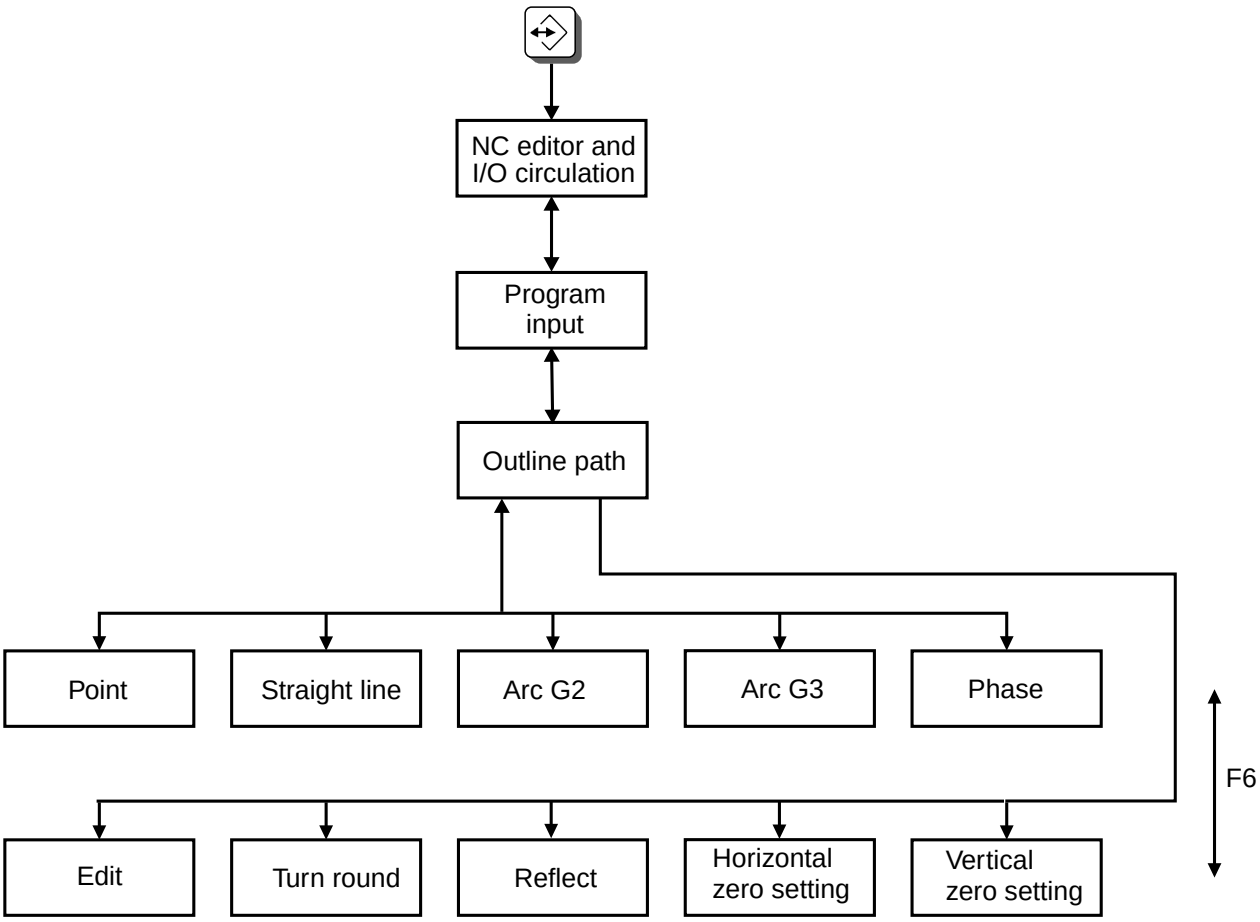
Subsequently the program is optimizeed by inserting feedrate, number of revolutions etc.

After reviewing the program and after a test run, the program is finished.

## 2.11 Program input with graphic support (outline path)

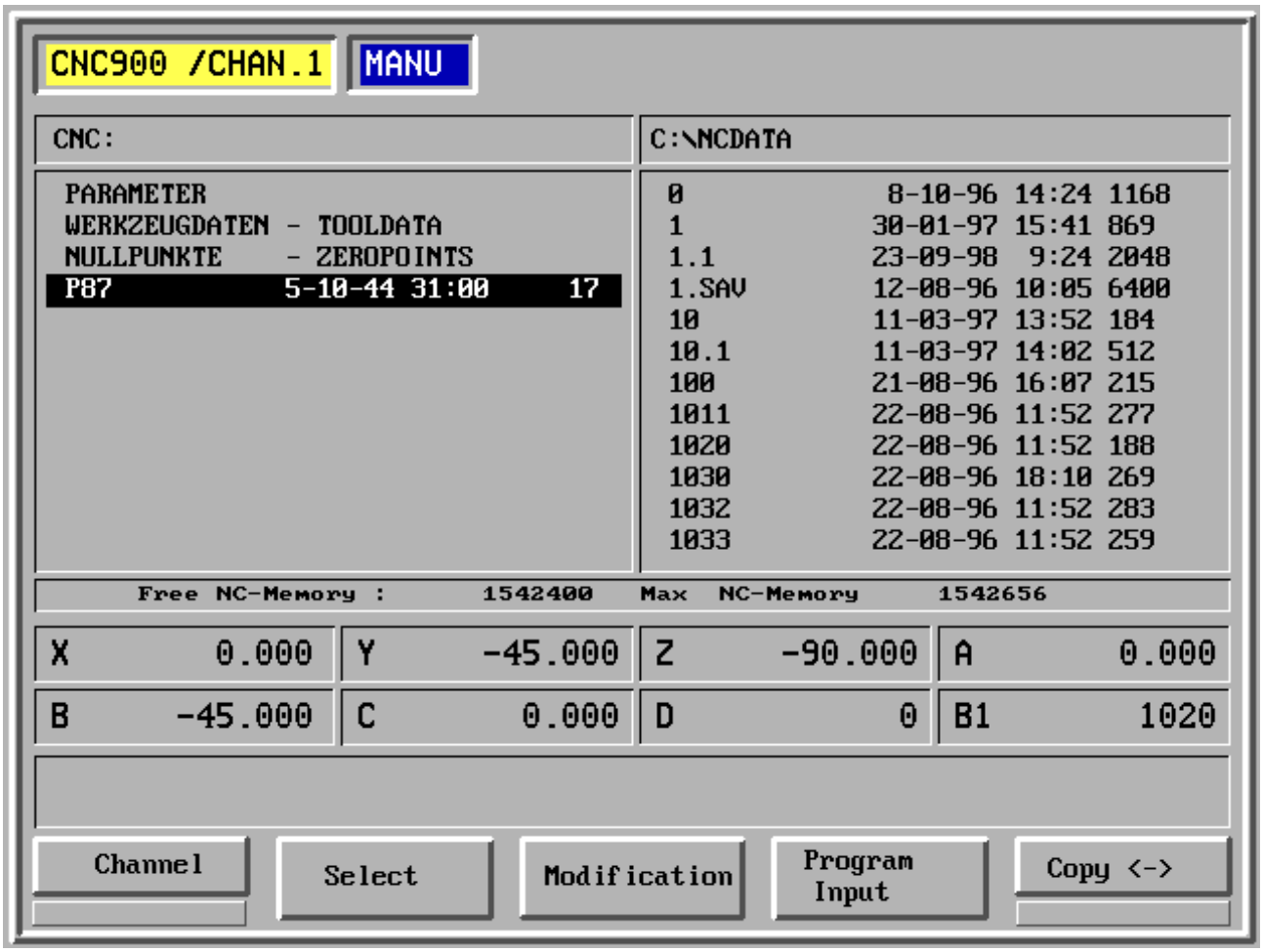
### 2.11.1 General

**Menue tree**



## 2.11.1 General (continued)

With pushing from key the menu for NC programming seems.




F1 Channel

F2 Selection

F3 Adjustments

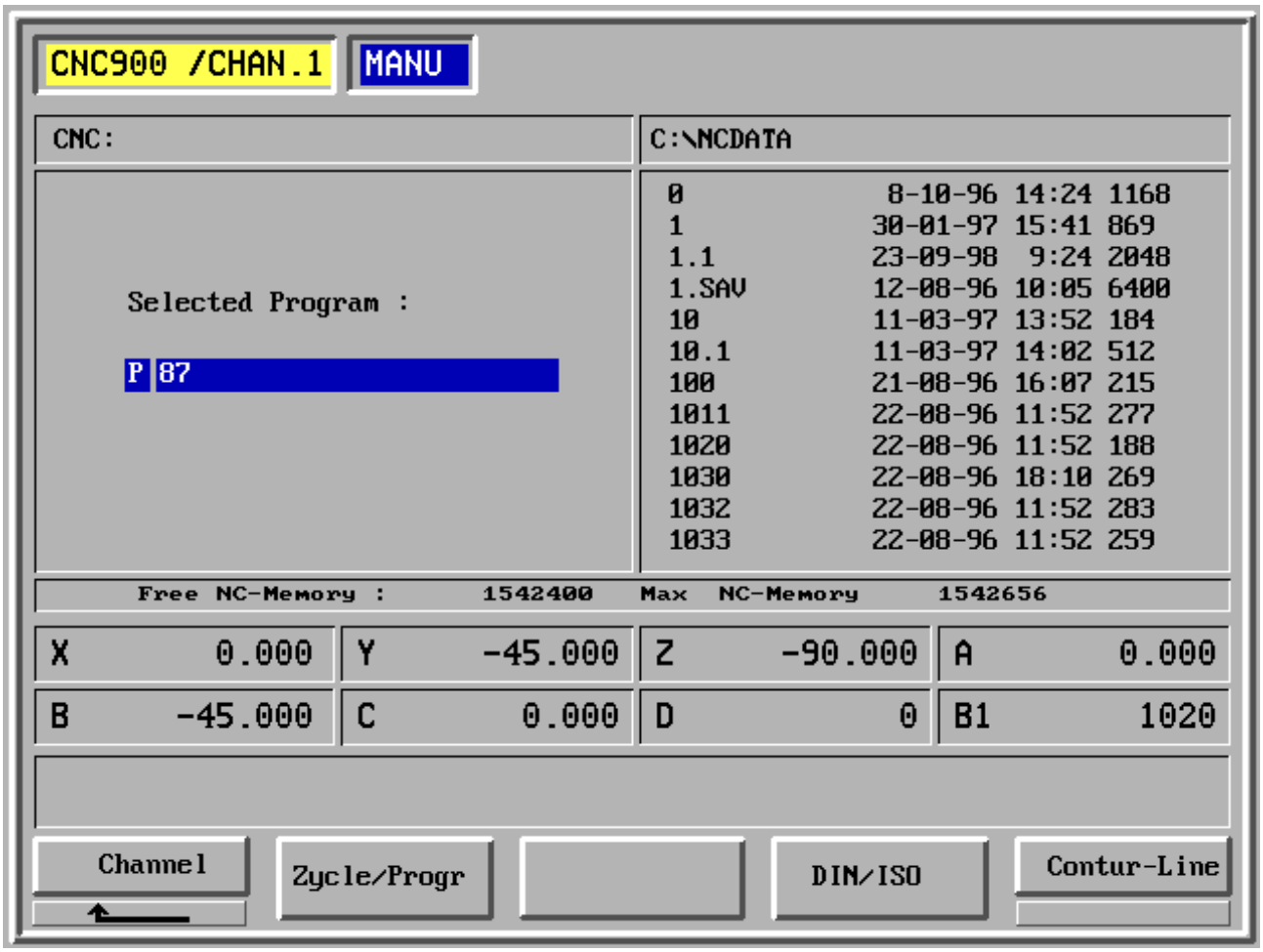
F4 Program input

F5 Copy <->

## 2.11.1 General (continued)

### Program input

With pushing of key F4 (within the display frame) seems the program selection. The paragraph of a new program can be input with the numerical keyboard.




F1 Channel

F2 Cycle/program

F3 -

F4 Program input according to DIN / ISO

F5 Program input with outline path

## 2.11.1 General (continued)

With the cursor keys an existing program can be chosen or the number of a new program can be input with the numerical keyboard. After pressing the key F5, the picture with the coordinates appears.

With the keys (page up) and (page down), the picture can be enlarged or reduced (zoom function) for a better view.

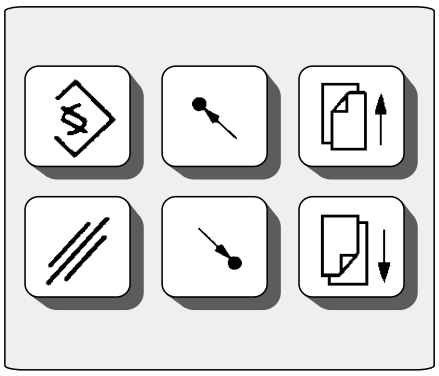
New outlines can be inserted continuously whereby a blue point is indicating the inserting place.

With the keys (Pos1) and (End) NC blocks can be moved forward and backward, they do then appear in red. Those moved NC blocks can be inserted or deleted with the keys (Change) or (Delete).

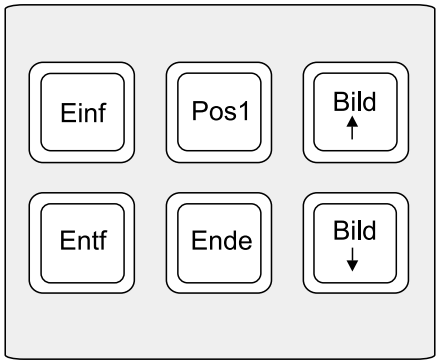
The block numbers are automatically numbered continuously (increased).

Max. 100 blocks can be programmed in a program with GPE.

Programming is finished and the program is stored with F7.



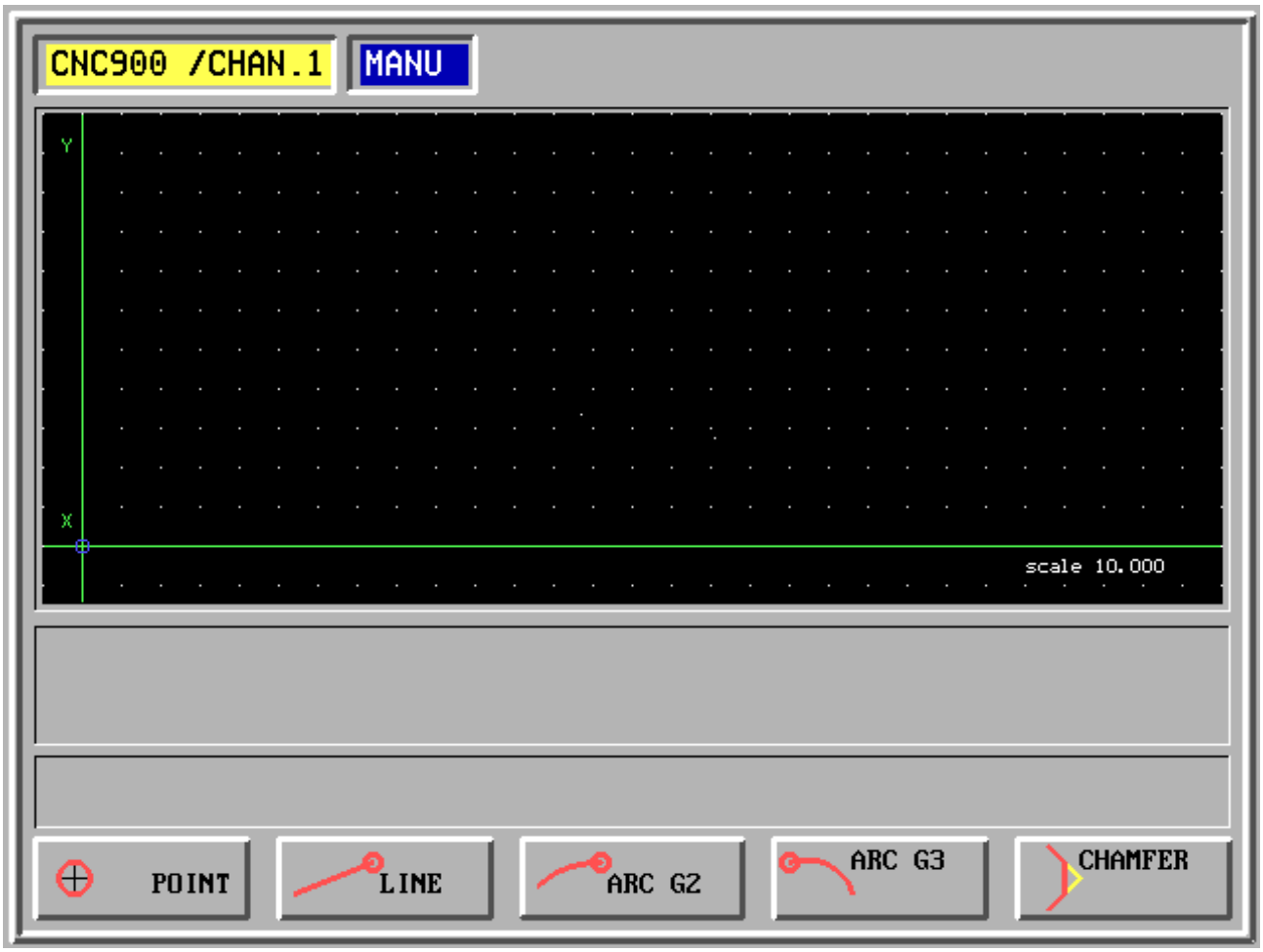
Key field operating panel




and suitable keys on the PC

## 2.11.1 General (continued)

**Basic menu 1 (switch with F6)**




F1 Insert point

F2 Insert straight line

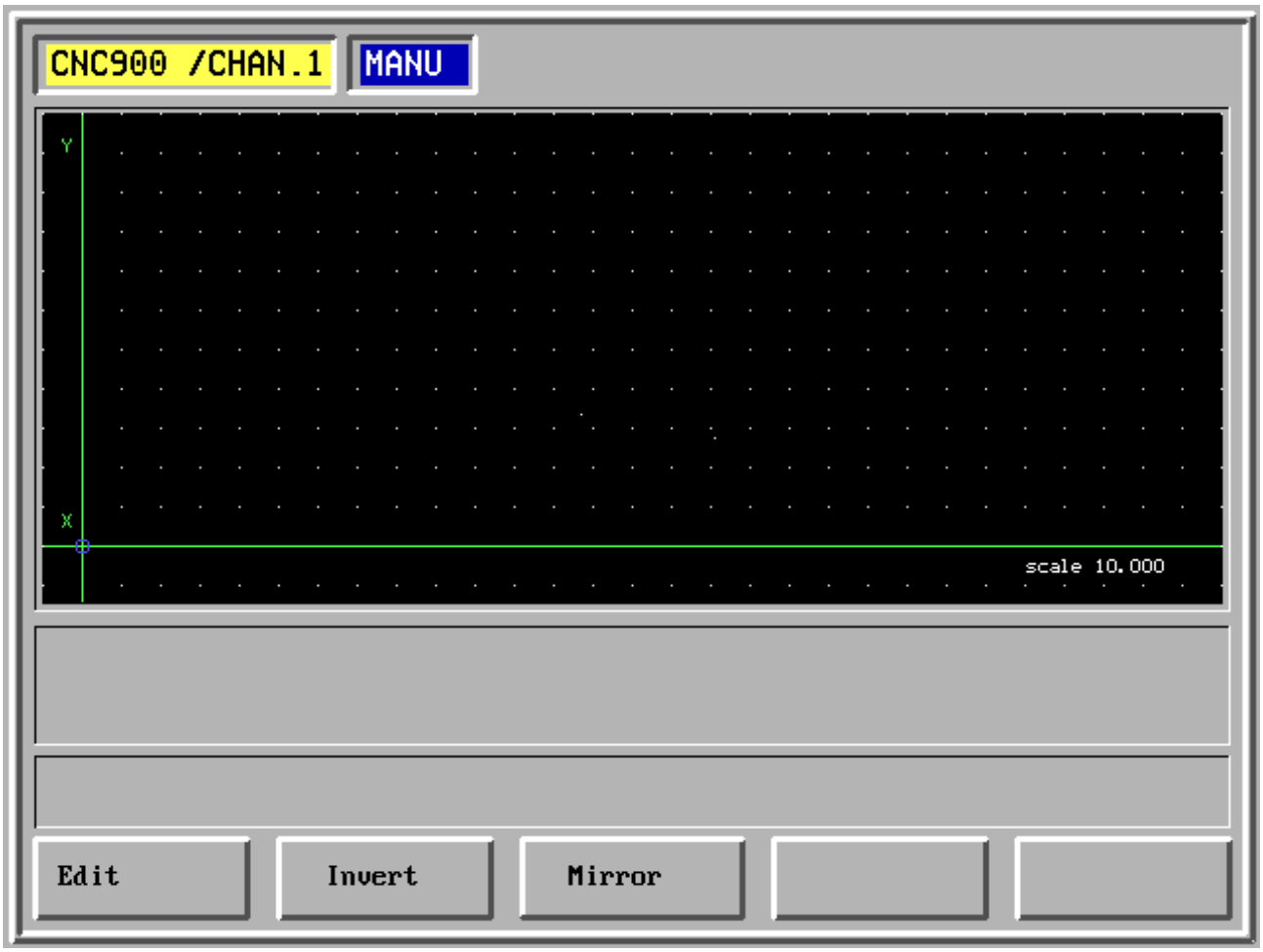
F3 Arc G2 (clockwise)

F4 Arc G3 (counter-clockwise)

F5 Insert phase and rounding

## 2.11.1 General (continued)

**Basic menu 2 (switch with F6)**




F1 Program edit with full function range (F, G, M etc.),
if a ASCII keyboard available actual

F2 Processing direction turn around

F5 Outline reflect

F4 Horizontal zero setting
F5 Vertically zero setting

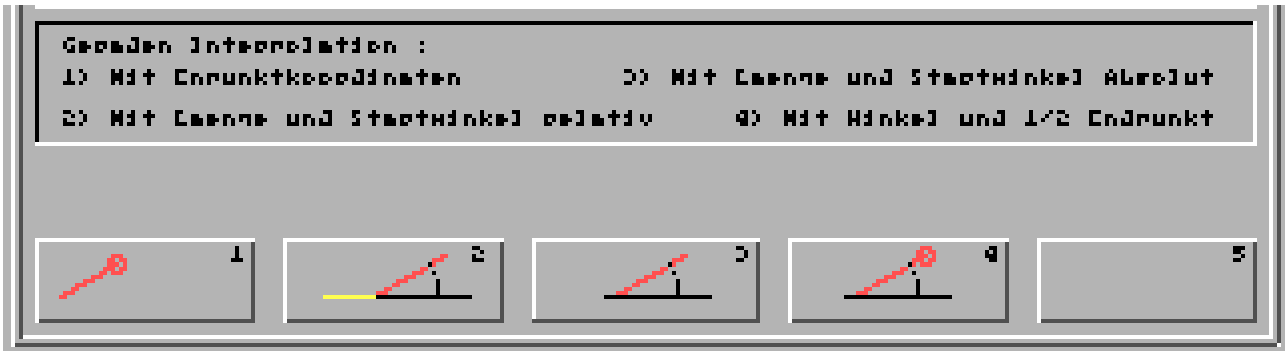
### 2.11.2 Inserting a point

With the numerical keyboard the coordinates of one point can be input and inserted with key .


The input point is started with rapid traverse (G00).

### 2.11.3 Insert a straight line

With the numerical keyboard the coordinates of a straight line can be input and inserted with key . One sets always at the blue point.




Selection of the different types of the straight line generation:

F1 Linear interpolation with Input of the terminator point coordinates

F2 Linear interpolation with Input of length and start angle relative

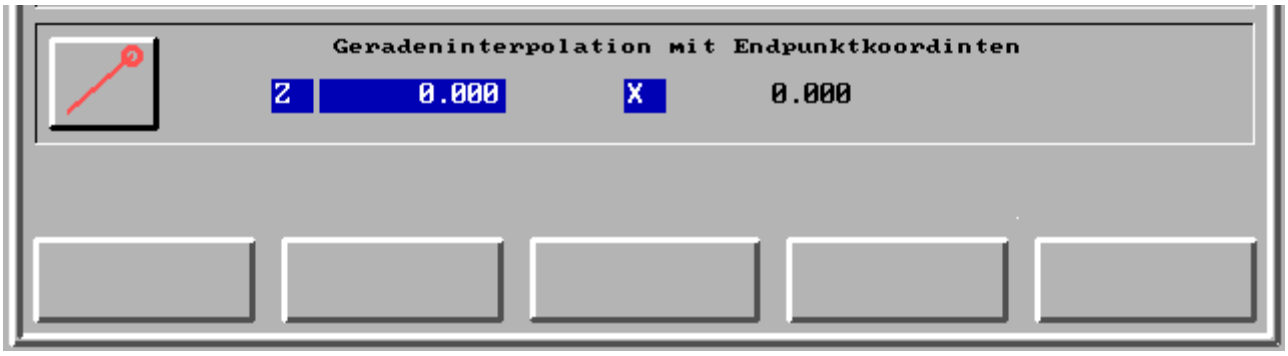
F3 Linear interpolation with Input of length and start angle absolutely

F4 Linear interpolation with Input of angle and 1/2 terminator point,
i.e. that only one of the coordinates must be input.
The coordinate input last is taken over.

## 2.11.3 Insert a straight line (continued)

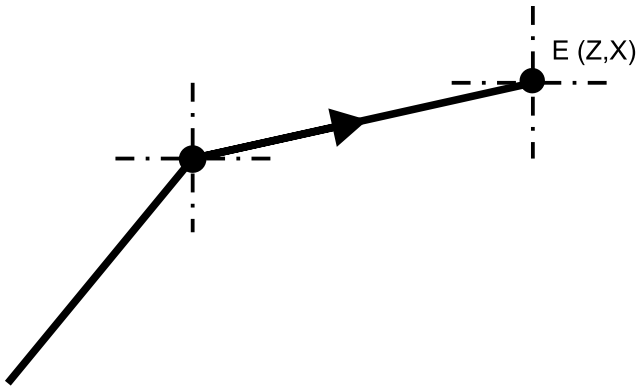
### linear interpolation with Input of the terminator point coordinates

The terminator point coordinates input from the start point to a linear (G1) is inserted.




Linear interpolation with the terminator point coordinates (E) Z and X

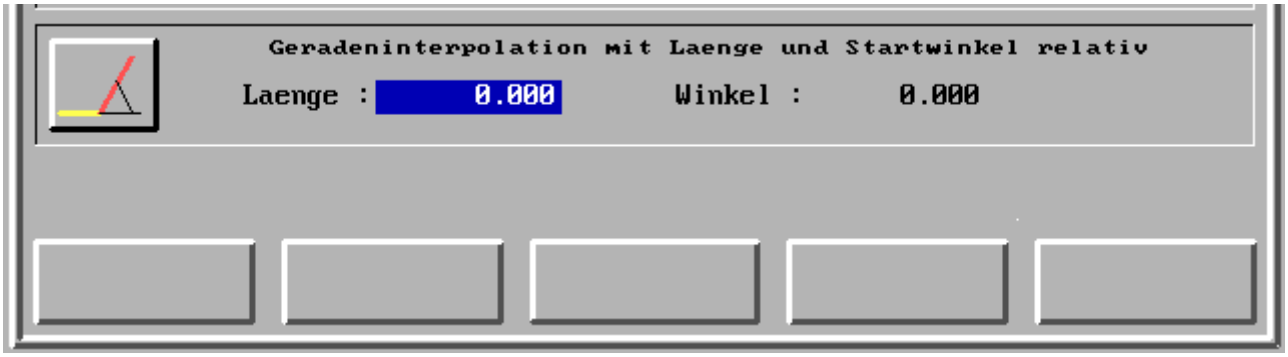
Example



## 2.11.3 Insert a straight line (continued)

**linear interpolation with Input of length and start angle relative**

A linear with length and start angle is relatively inserted by the start point.

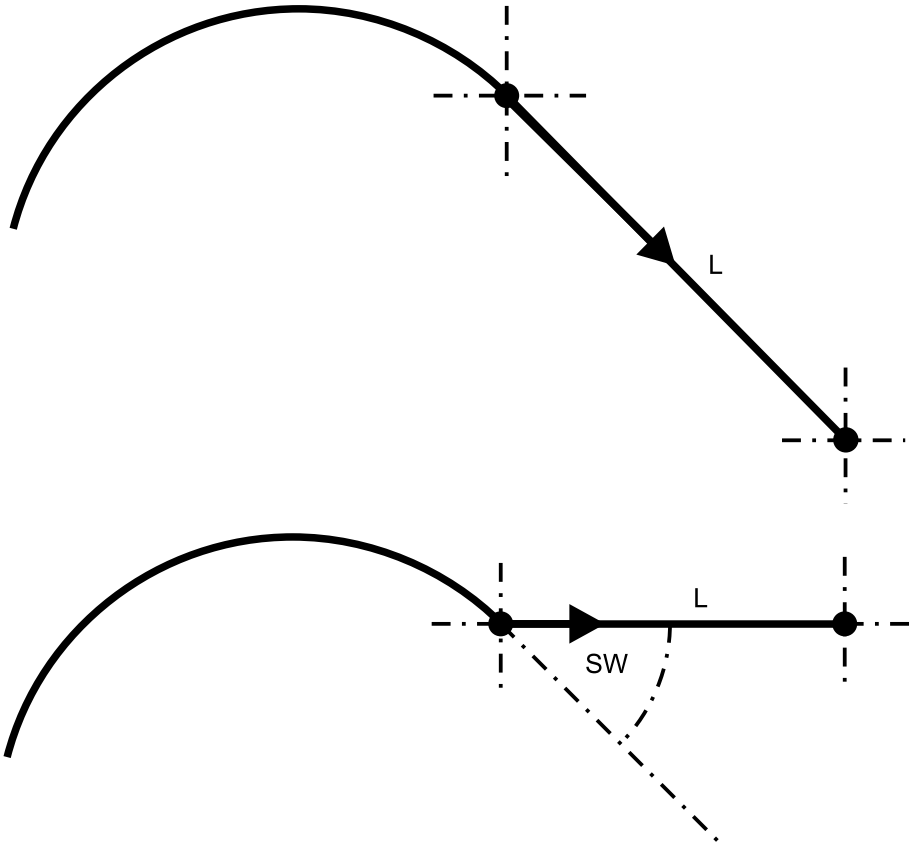



Linear interpolation
with length (l) and
Start angle (SW) relative
to the preceding block

Examples:

Angle relative 0°

i.e. tangential
to the preceding block




Angle relative 45°
to the preceding block

## 2.11.3 Insert a straight line (continued)

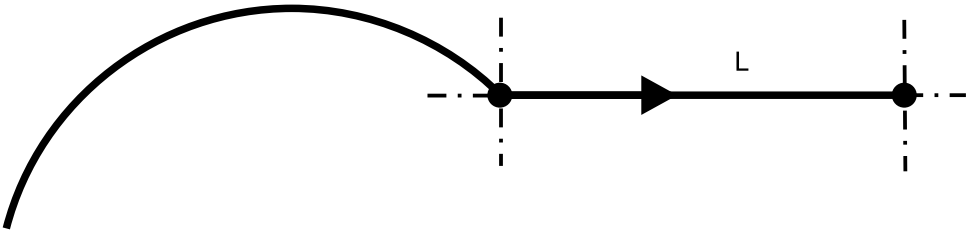
**linear interpolation with Input of length and start angle absolutely**

A linear with length and start angle is absolutely inserted by the start point.


Linear interpolation
with length (l) and final angle (EW) absolutely

Example:

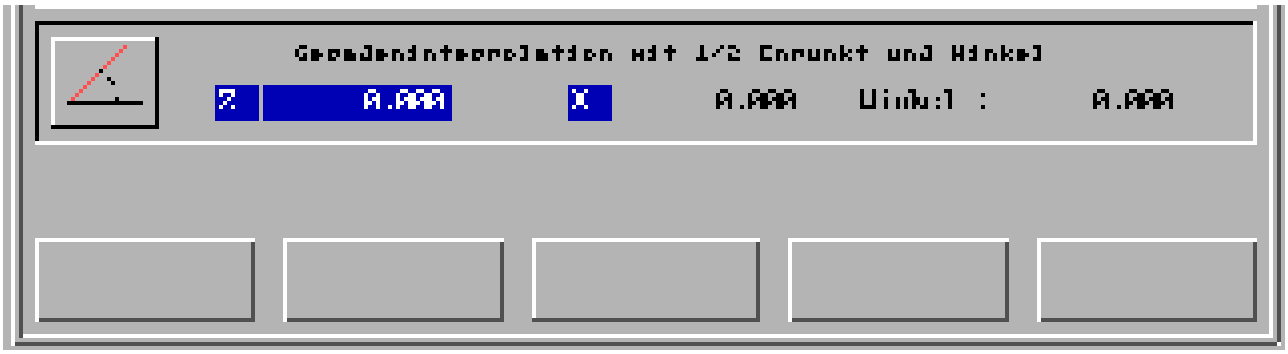
Angle absolutely 0°



## 2.11.3 Insert a straight line (continued)

**linear interpolation with Input of final angle absolutely and 1/2 terminator point**

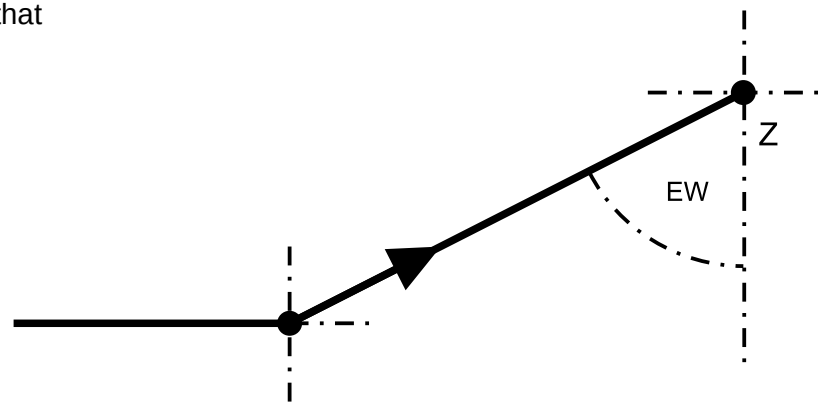
The terminator point coordinates with 1/2 terminator point and final angle, input from the start point to, absolutely a linear is inserted.



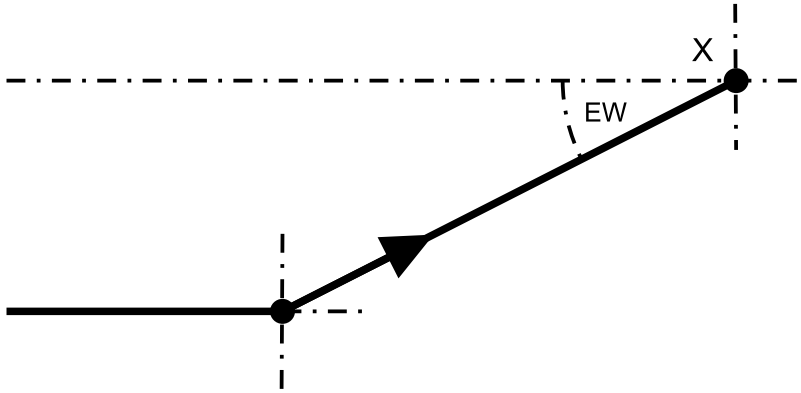

Linear interpolation
with 1/2 terminator point and final angle (EW) absolutely
The indicated angle actual of the final angles
the programmed straight lines with that
indicated direction in Z or X.

Examples:

Final angle absolutely 60° to Z




Final angle absolutely 30° to X



## 2.11.4 Inserting an arc

With the numerical keyboard the coordinates of an arc can be input and inserted with key .
One sets always at the blue point.


F1 Circular interpolation with terminator point coordinates and radius

F2 Circular interpolation with terminator point and centre point

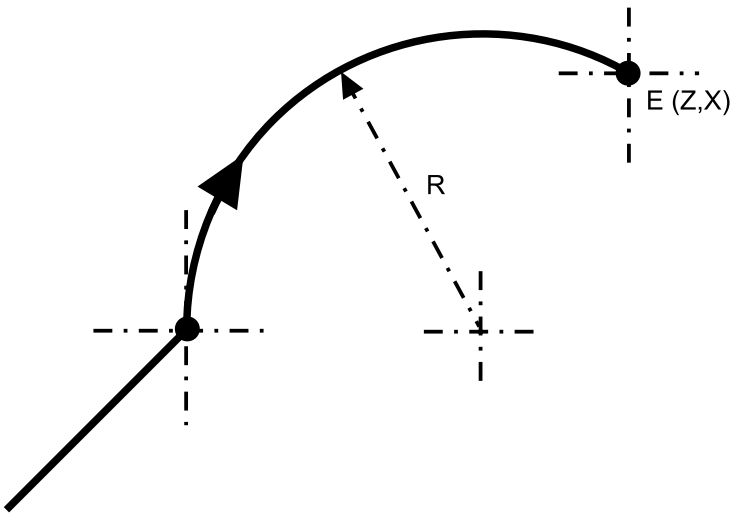
F3 Circular interpolation with radius and final angle

F4 Circular interpolation with radius and 1/2 terminator point
i.e. that only one of the coordinates must be input.
The coordinate input last is taken over.

## 2.11.4 Inserting an arc (continued)

### Circular interpolation with terminator point coordinates and radius

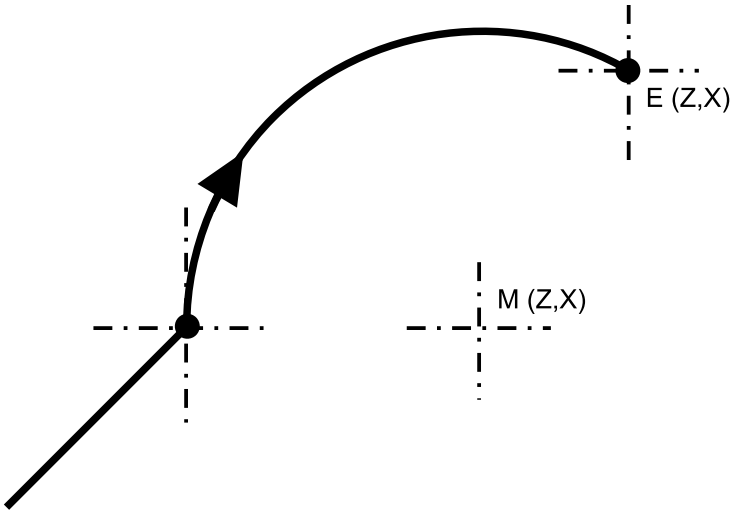

Circular interpolation in the clockwise direction
with terminator point coordinates (E) Z and X and radius (r)



## 2.11.4 Inserting an arc (continued)

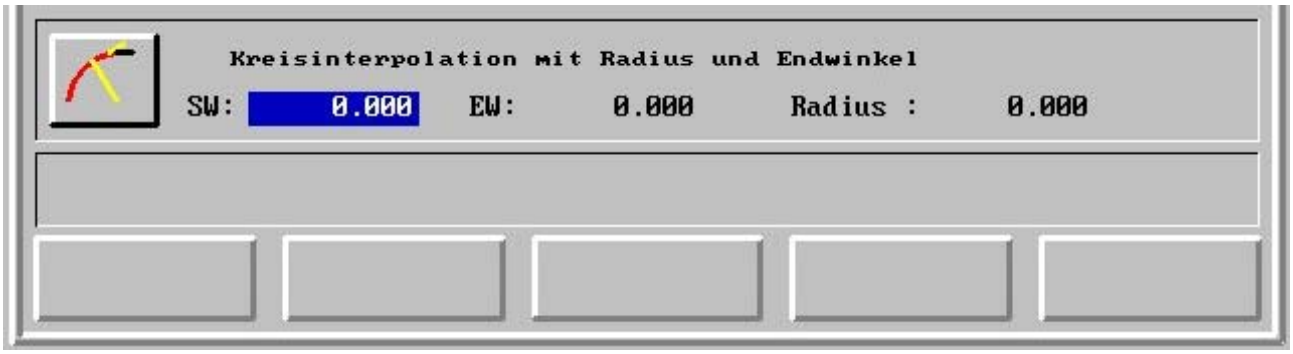
### Circular interpolation with terminator point and centre point


Circular interpolation in the clockwise direction
with terminator point coordinates (E) Z and X
and Mittelpunkkoordinaten (m) Z and X

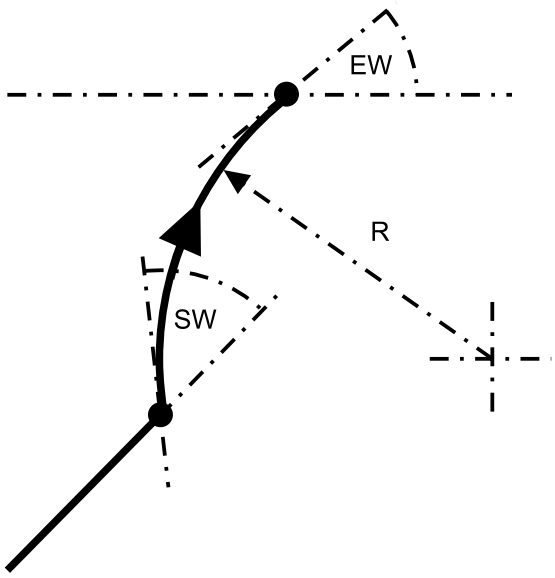


## 2.11.4 Inserting an arc (continued)

### Circular interpolation with radius and final angle

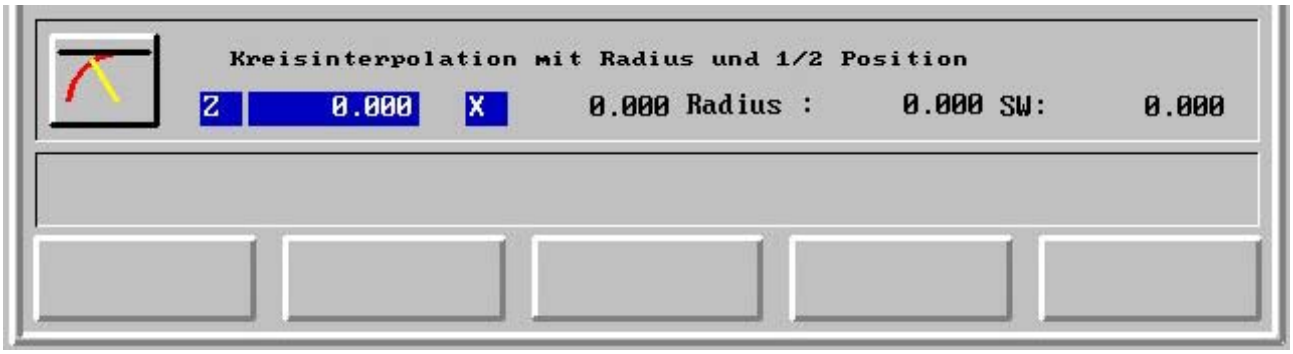



Circular interpolation in the clockwise direction
with radius (r) and start angle (SW) and final angle (EW)

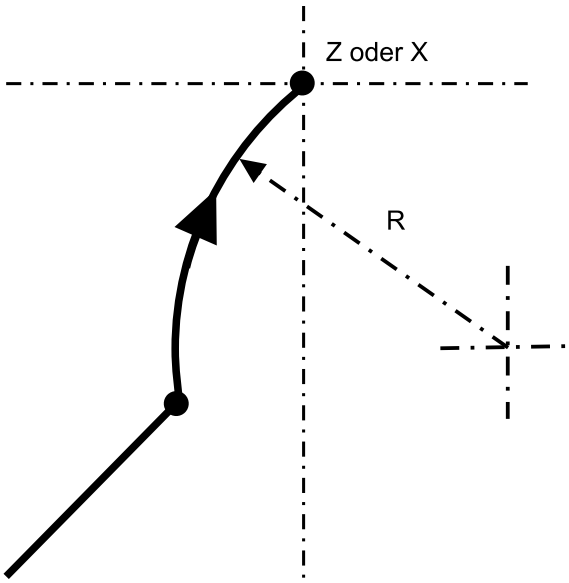


## 2.11.4 Inserting an arc (continued)

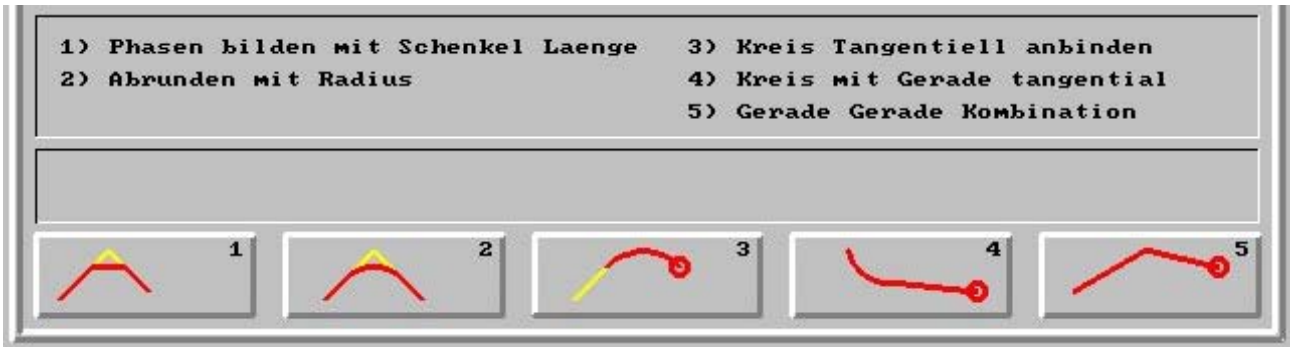
### Circular interpolation with radius and 1/2 terminator point




Circular interpolation in the clockwise direction
with radius (r) and 1/2 final position (Z or X)



## 2.11.5 Inserting a chamfers or roundness




| | |
|---|---|
| F1 | Chamfers form with leg length |
| F2 | Round off with radius |
| F3 | Circle tangential tie up |
| F4 | Circle with linear tangential |
| F5 | Combination linear with linear |

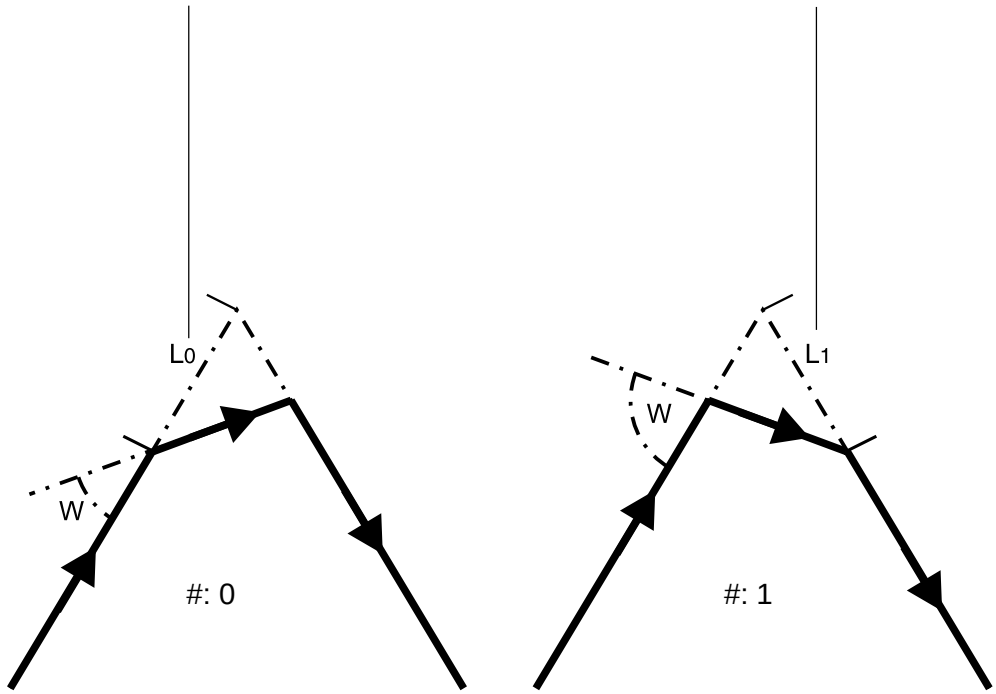
## 2.11.5 Inserting a chamfers or roundness (continued)

chamfers form with leg length


Chamfers at an edge with leg length and angle (w)

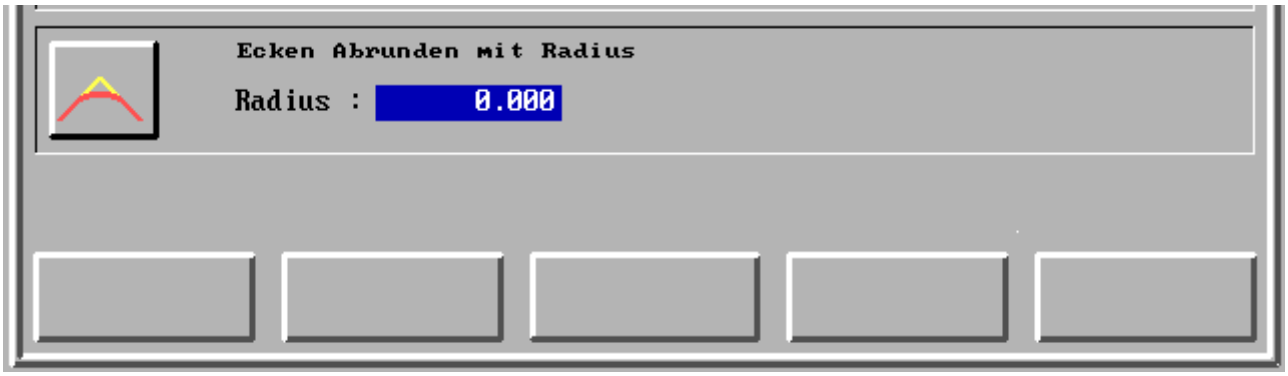
Selection of the length #: 0 1. Length #: 1 2. Length

Examples:



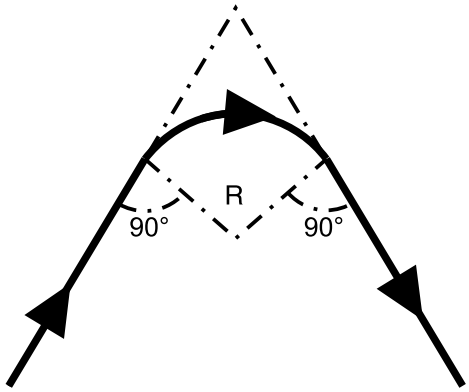
## 2.11.5 Inserting a chamfers or roundness (continued)

### Rounding off with radius




Corner-round off with radius (r)

Example:



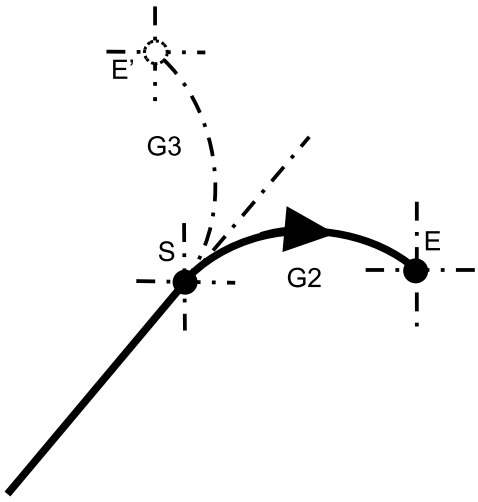
## 2.11.5 Inserting a chamfers or roundness (continued)

### Circle tangential tie up


Circular interpolation with corner point and tagentieller binding

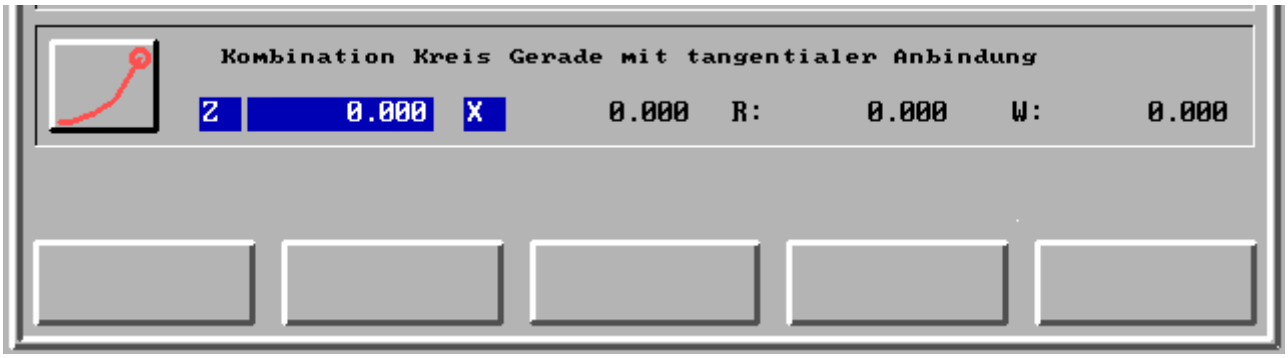
G2 or G3 become automatically
according to the position of the terminator point (E, E ‘) selected

Example:



## 2.11.5 Inserting a chamfers or roundness (continued)

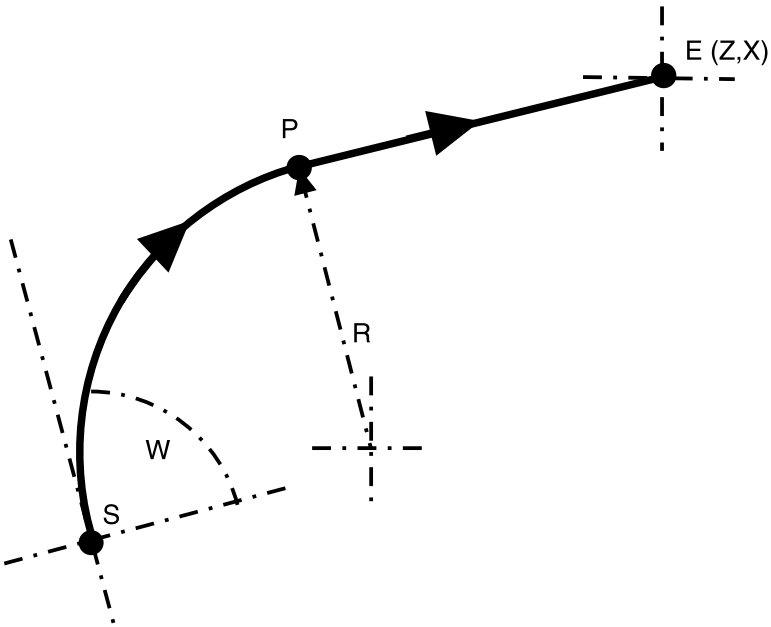
### Circle with linear tangential




Combination circle - linear with tangential binding

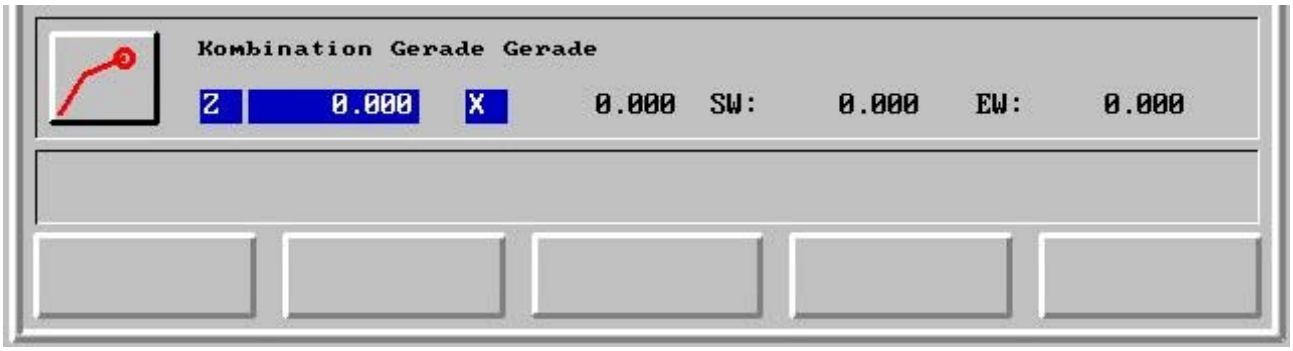
The position of the transition point (p) actual unknown.

Example:



## 2.11.5 Inserting a chamfers or roundness (continued)

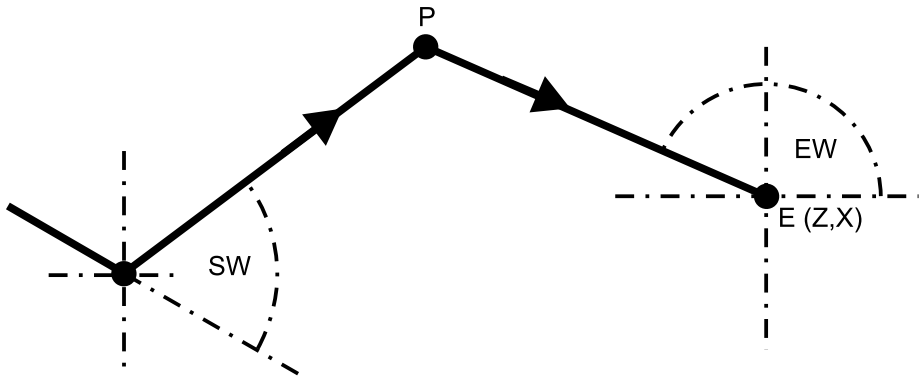
### Combination linear - linear




Combination linear - linear
with start angle, final angle and
Terminator point with the coordinates Z and X
The start angle actual relative
to the preceding block.

The position of the transition point (p)
actual unknown.

Example:



### 2.11.6 Editing

If the processing direction determined, still the functions (F, T, G, M) know actual are inserted into the program.


F1 Program edit with full function range (F, T, G, M, P etc.), if a ASCII keyboard available actual

F2 Processing direction turn around

F3 Mirrors (in both axes)

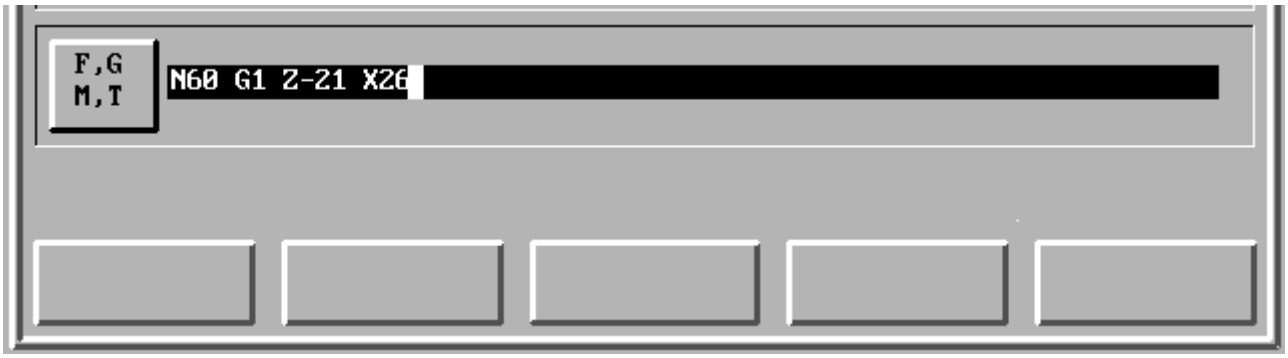
F4 Horizontal zeros (settings the white point on zero)

F5 Vertically zeros (settings the white point on zero)

## 2.11.6 Editing (continued)

### Program edit with full function range

The program can with full function range (F, T, G, M, P etc..) are edited,
if a ASCII keyboard available actual



# 3. Program configuration

# 3. Program configuration

## 3.1 Program

Each program begins with a program number with a maximum of 7 digits (DOS - PC) and/or 9 digits. The program consists of individual blocks.

## 3.2 Block

Each block is identified by a block number with a maximum of 10digits. A block is made up of various words, which contain all instructions for an operation. The block length is variable (maximum 200 signs).
Blocks are identified in the program with ascending block numbers. This determines the sequence when the program is running and means that identical block numbers are not acceptable.

## 3.3 Word

A word consists of an address and a data section. The word length is variable. All words which can be contained in a block are included in the following table.

## 3.4 Mathematicals expression

A number can be also replaced by a mathematical expression in round brackets.

For example: ((110 + P20) / 3)

## 3.5 Block functions

| Word | Address | No. of words per block | Data digits | Dimensional unit | Effect | Description in section |
|---|---|---|---|---|---|---|
| Block number | N | 1 | 10 # | | block by block | |
| Feed | F | 1 | x ~ | mm/min | modal | 3. |
| Spindle speed | S | 8 | x ~ | 1/min | modal | 3. |
| Traverse conditions | G | 8 * | 10 # | | modal/bl.-by-bl. | 4. |
| Circle centre point | I / J / K | 1 | x ~ | | modal | 4. |
| Circle radius | R | 1 | x ~ | | modal | 4. |
| Cycle | G | 8 * | 10 # | | block-by-block | 5. |
| Additonal functions | M | 8 | 3 # | | modal/bl.-by-bl. | 6. |
| Tool | T | 1 | 10 # | | modal | 7. |
| Parameters | P / q | x | x | | modal/bl.-by-bl. | 8. |

Key: ~ Floating point
# Integer

* Traverse condition and cycle together 8 per block

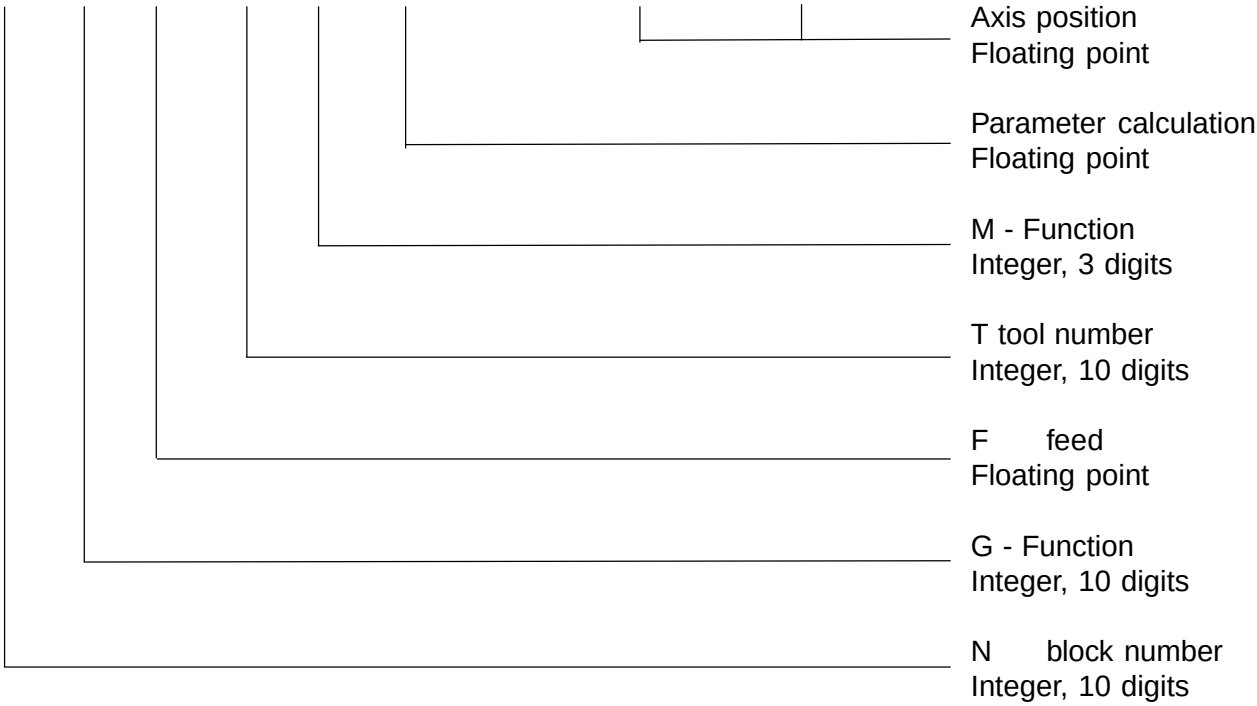
All other letters can be used for axis terms.

## 3.6 Syntax

Fundamental construction of a NC block:

Example :

N10 G01 F100 T03 M100 P30:(P20+35)*3 X200.0000 Y400.550 { comment }




Block length = 200 signs

## 3.6 Syntax (continued)

### General functions

/ Block skip

\ Chain blocks, i.e. several blocks are joined to one NC block.

() Bracket functions, mathematical expressions or comment

{} Bracket comment

: Allocation

$ Signal for hexadecimal numbers
**Hexadezimale expressions must be completed with the separating sign( ; )!**
e.g.: N10 G01 F1000 P500 : $1AF; X: P500

### Axes

Axes can be marked:

- with a letter X, Y, Z, U, V, W . . .
  X100, Z33

- with a letter and index 1 to 8 X1, X2, X3 . . .
  X2:100, Z1:33 . . .

### Clear parameter content

P500: - - clears the content of P500

## 3.6 syntax (continued)

### Comparison operators

| | | | Example : |
|---|---|---|---|
| = | | Equal | P500=110.50<br>(Skip to block 50, if the content of P500 = 110) |
| > | | Larger | |
| < | | Smaller | |
| <> | | Unequal | |
| >= | => | larger equal | |
| <= | >= | smaller equal | |

If the skip - condition is fulfilled, it is skipped to the indicated block number.

### Calculation operators

| | | | Example .: |
|---|---|---|---|
| * | | Multiplication | P500:P200*5 |
| + | | Addition | P500:P200+P201 |
| - | | Subtraction | P500:P200-1 |
| / | % | Division | P500:P200 / 2 |
| \| | mod | Modulus | P500:P200\|10 |
| | | | The trigonometrical functions use degree ! |
| sin | cos | tan | P500:sin(90) |
| asin | acos | atan | P500:acos(P10) |
| or | and | not | Bit operations<br>P500:P500 or $100; |
| sqr | | Square root | |
| int | | Integer value | |
| intr | | Rounding on integer | |
| abs | | Amount | |
| ln | | Logarithm with basis e | |
| lay | | Logarithm with basis 10 | |
| exp | | Exponent | |
| del | test if cleared | | P500:del(510)<br>Feedback value : 0 parameter not cleared<br>1 parameter cleared |

Functions are always written in lower-case letters!

## 3.6 syntax (continued)

### Definition of a tool radius t

If no tool administration is existing in the system, a temporary correciton radius can be defined with identification ‘t’. With this correction radius, the subsequently activated radius correction (G41/42) is working.

Example:

N10..
N20 t:0.5
N30 G1 X100 Y100 G42
N40..

When programming ‘t’
- the tool radius is written and
- the tool radius correction is deleted
  in the active data block (P8150 ...)

The quadrant of the ‘t’-correction is always 0!

## 3.6 Syntax (continued)

### Syntax of symbolic variables

Symbolic variables always do start with the sign '_' (e.g.: _abs, _test5, ...), they may have a maximum length of 30 signs. Capitel and small letters are allowed, but the meaning of _karl may not be the same as _Karl! (case-sensitive).

### Binding a symbol to a parameter

_wegx ::= 500;

According to this definition, _wegx is in place of P500, i.e. both expressions are equivalent according to the above mentioned example (_wegx <—> P500).

P500 : 10
_wegx:=10

Indexing is allowed at parameter variables.
Example

_wegx(0) := 10; (d.h. P500:10)
_wegx(1) := 11; (d.h. P501:11)

### Internal variables

_wegxy := 500;

If a value is assigned to a variable, which is not 'bound' to a parameter, this variable is allocated as internal variable. That means that values can be stored without using a parameter.
Variables that are not initialized have the value 0.
Internal variable do only exist as long as the NC program is active.
Internal variables can not be displayed directly (e.g. at a program test).

Example

n10 _test1::=12 (Binding to P12)
N20 _test2:=10 (internal variable)
N30 G00 X:_test1 Y:_test2
N40 ...

## 3.6 Syntax (continued)

### Text output of NC programs

Arbitrary texts from NC programs can be displayed in the message line. When switching back to MANUAL, texts that are eventually standing in line, are deleted.

### Delete syntax messages

N10 !
N10 M33 P1:23 !

The identification '!' may also be programmed with other NC block elements in the same NC block. However, '!' has to be the last sign of the block!

### Displaying messages with predefined colours

N10 ! this is a message text white letters on blue bottom
N20 !0, this is a message text black letters on grey bottom
N30 !1, this is a message text white letters on blue bottom

### Displaying messages with colour selection that can be defined freely.

N40 !S8E, this is a message text (yellow on black)

N40 !code, this is a message text code = HF + VF

| HF | (background colour) | VF | (Forefront colour) |
|---|---|---|---|
| 80 | black | 0 | black |
| 90 | blue | 1 | blue |
| A0 | green | 2 | green |
| B0 | turquoise | 3 | turquoise |
| C0 | red | 4 | red |
| D0 | magenta | 5 | magenta |
| E0 | brown | 6 | brown |
| F0 | light grey | 7 | light grey |
| | | 8 | dark grey |
| | | 9 | light blue |
| | | A | light green |
| | | B | light turquoise |
| | | C | light red |
| | | D | light magenta |
| | | E | yellow |
| | | F | white |

## 3.6 Syntax (continued)

Working sequence of the block interpreter

1. Parameter calculations, Parameter allocations
   are executed in the sequence programmed in the NC block.

2. Parameter skips
   are executed in the sequence programmed in the NC block.

3. M - Function - Skips
   are executed in the sequence programmed in the NC block.

4. Sub-program call M28

**The sequence of the block elements when dispatching at PLC (real time)**

1. Block number

2. Parameter (real time parameter)

3. S-value

4. T-value

5. M-function before traverses / after traverses

## 3.6 Syntax (continued)

### Enlarged syntax

The NC interpreter offers with System-Calls (sc) further possibilities, to shift the interpreter -mode or to trigger functions.

**Syntax sc: n**

Function numbers

0 Activating of interpreter-mode 0, standard mode.
- Is always preset at NC program start.

- Each block produces a block end. When switching on the interpreter to the next NC block a block change command results, with which the NC block informations are transmitted to the following modules.

1 Activating of interpreter-mode 1, supervision mode.
- In mode 1 the block change command is suppressed. When switching the interpreters to the next NC block no block change command results.
  Because the analyzed NC block elements are only transmitted to the following modules with block change, they remain now for the time being in the block interpreter.
  (This does not count for the additonal functions.)

- When switching back to mode 0 a block change command is given.

2 Activating the interpreter mode 2
- supervision mode at M26

- as mode 1, however, when switching the mode, the system waits until it gets a feedback from the previous NC block. E.g. if you want to make some calculations or supervising loops while an axis is moving, the calculation and/or test loop will start at the beginning of this movement (and the pipeline of the NC control is previously deleted).

- A block change command is sent when switching back to mode 0.

## 3.6 Syntax (continued)

Example of a supervision loop

While N10 is processed, supervision functions can be perceived in the loop (N30 . .. N50).

```
N10     G01  F100  X1000
N20     sc :1                changeover in mode 1
N30     P500>P501.140        skip, if supervision loop should be left.
N40     . ..
N50     M23.30               skip to the beginning of the loop
N140    . ..
N150    sc :0                end  of the supervision loop
N200    G00  X200
```

100 Triggering of a block change command
- In interpreter mode 1 a block change can be forced herewith.

## 3.7 Feed

The feed with the address letter F is programmed in mm or inch according to the set unit of measurement.

G94, G95 and G99 determine the feed modification.

| | |
|---|---|
| G94 | Feed in mm/min |
| G95 | Feed in mm/r |
| G99 | Block end feedrate in mm/min |

A programmed feed is effective modally and can only by overwritten with another feed.

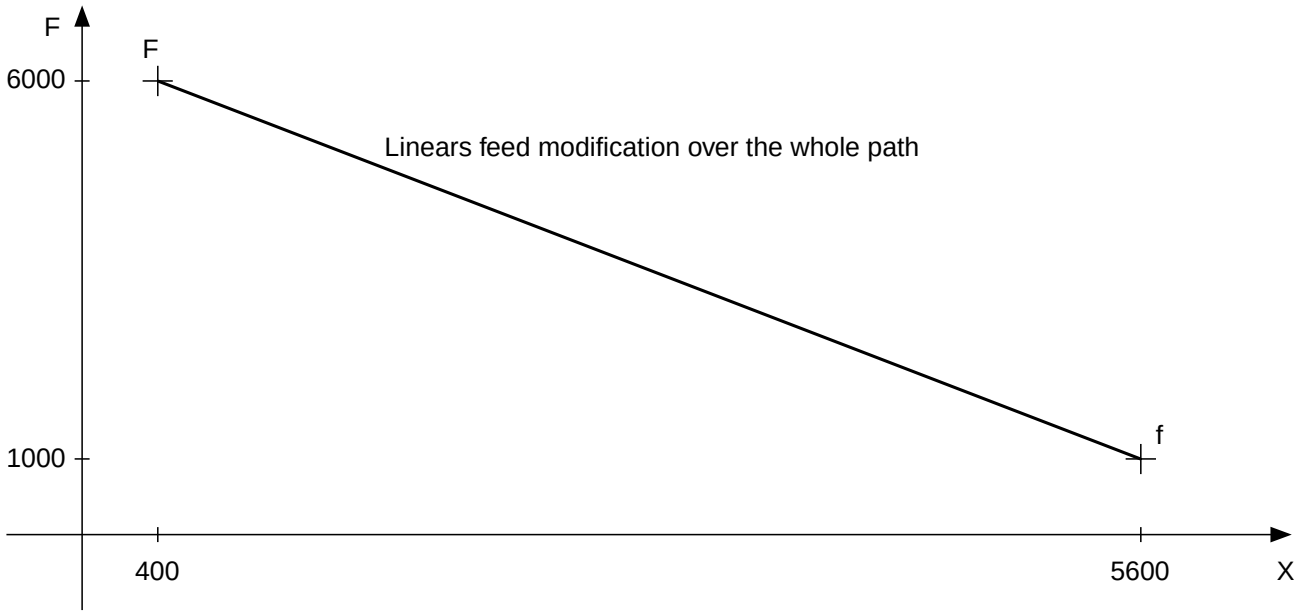
Through positioning in rapid traverse (G00) the previously stored effective feed is not cleared, but becomes effective again with G01, G02 and G03.

With the feed-override-potentiometer the programmed feed can be changed in the area of 0 to 120%.

| | |
|---|---|
| F | path feed |
| f | final feed, i.e. path feed, which are achieved at the end of block. |

Example:

| | | | | |
|---|---|---|---|---|
| N50 | X400 | | | |
| N60 | G1 | F6000 | f1000 | X5600 |



## 3.8 Spindle speed

The spindle speed is programmed with the address letter S. With index 1 to 8 several spindles can be programmed.

Example: S1000

S1:1000
:
S8:8000

G96 and G97 determine the speed modifications.

G96 constant cutting speed in mm/min
G97 number of revolutions in 1/min

The spindle speed is effective modally and can only be overwritten through another spindle speed.

With the spindle-override-potentiometer the programmed spindle speed can be changed in the area of 0 to 120%.

## 3.9 Input / output (I/O)

### DOS data format

### Structure of a NC program file

Blank line (CR, LF)

Identification P/Z with program number (program number with max. 9 digits

NC block beginning with N or /N
...
...
...
NC block

Program end sign (#)

EOF-sign (default : character 04)

Blank line (CR, LF)

Example:
File name : P123456

```
P123456
N10 G0 X0 Y0 Z0
N20 F100 G1 X100
N30 M30
#
```

## 3.9 Input / output

### Structure of a parameter file

| | | |
|---|---|---|
| Blank line | (CR, LF) | |
| Identification D | (at identification D: | parameter status is not overtaken<br>exception: If mantissa programs, |
| | (at identification D+: | parameter status is overtaken<br>Exception: If mantissa programs,<br>however in the parameter status the loading bit<br>(byte 1, bit 1) is not set, than the bit<br>‘ parameter loaded ‘ is set!<br><br>example:<br>D+<br>K1 P1: 123 S:$32000100<br>in this case the status becomes<br>to S:$32000101! |

q parameter number : parameter content [S: parameter status] * * [ ] optional

...
...
...

| | |
|---|---|
| Program end sign | (#) |
| EOF-sign | (default : character 04) |
| Blank line | (CR, LF) |

## 3.9 Input / output

### Structure of a parameter file

Example:

Filename : D123

```
D
q     0:  —                    S:$00000000
q     1:            8          S:$00000001
q     2:            2
q     3:        30000
q     4:  —
q     5:  —                    S:$00000000
#
```

or

```
D
K1:P  10:           1          S:$00000009
K1:P  11:         100          S:$0000000D
K1:P  12:         200          S:$00000001
K1:P  13:           5
K1:P  14:  —
K1:P  15:           2
#
```

### Extensions

starting from version 080 :

With identifier D+ knows the parameter status with the function ‘ SET ‘, or with which old parameter status with the function ‘ OR ‘ is set.

Example: Parameter status with function ‘ SET ‘:
K1 P1: 123 S:$32000101

Parameter status with function ‘ OR ‘:
K1 P1: 123 S|$32000101

# 4. Traverse functions

## 4. Traverse functions

## 4. Traverse functions

The traverse functions, togehter with the traverse information, establish the geometric part of the program. They consist of the address letter G and a 10-digit number. One block may contain 8 traverse functions.

If the traverse functions and the appropriate traverse information are programmed in different blocks, the traverse functions in the program should always precede the traverse information. Traverse functions become effective before the programmed traverse information.

The following table contains the traverse functions made available by the control.

Traverse functions within a group overwrite each other mutually (in addition G92 is overwritten by G53 to G59).

The traverse functions preset at the start of a program are identified by an *.

The traverse functions in the program are displayed when the ‘?’ key is pressed (except for the traverse functions which act block-by-block).

## 4. Traverse functions (continued)

| Traverse functions | | Effect |
|---|---|---|
| G00 | Positioning at rapid traverse | modal |
| G01* | Linear interpolation | modal |
| G02 / G03 | Circular interpolation, CW/CCW | modal |
| G123 | Automatic selection of linear and circular interpolation | modal |
| G04 | Dwell | block-by-block |
| G05 / G06 / G07 | Driving direction of round axes | block-by-block |
| G08 / G09 | Precision stop, on/off | block-by-block |
| G10 / G11* | Polar coordinate programming, on | modal |
| G12 | Contour path, rapid programming | block-by-block |
| G13*/ G14 | Tangential axis off/on | modal |
| G15*/ G16 | Polar transformation off/on | modal |
| G17 / G18 / G19 | Plane selection XY / XZ / YZ | modal |
| G28 / G29* | Switching on/off precision stop | modal |
| G40*/ G41 / G42 | Milling cutter path correction offset, clearing / left / right | modal |
| G43*/ G44 | Axis correction off/on | modal |
| G45 G46* | Turning on/off | modal |
| GG47/G48/G49 | Robot transformation off /<br>Tool / workpiece coordinates | modal |
| G147 | Transformation off | modal |
| G50/G51/G52 | Spline interpolation | modal |
| G53* | Machine zero point | modal |
| G153 | Zero point shift off | modal |
| G54...G59 | Zero points | modal |
| G60*/ G61 / G62 | Mirror imaging, off | modal |

## 4. Traverse functions (continued)

| Traverse functions | | Effect |
|---|---|---|
| G63 / G64* | Switching on feed rate 100% | modal |
| G66 | Switching off all offsets | block by block |
| G90* | Absolute dimension input | modal |
| G91 | Incremental dimension input | modal |
| G92 | Zero point shift | modal |
| G94 | Feed in mm/min | modal |
| G95 | Feed in mm/r | modal |
| G96 | Constant cutting speed | modal |
| G97 | Number of revolution in 1/min | modal |

## 4.1 G00 positioning at rapid traverse rate

Positioning at rapid traverse rate is called up by G00.

All axes can be traversed simultaneously as long as the machine tool is designed for this. Absolute and incremental dimension input are both possible.

G00 acts modally and can be overwritten by G01, G02, G03, G50, G51 and G52.

When traversing at rapid rate the programmed point is homed into via the shortest route.
The axis with the longest programmed traverse distance is traversed at rapid rate and determines the positioning time. The speed of the other axes is chosen by the control system such that they reach their end point simultaneously with the fastest axis.
The feed rate override potentiometer is also operative during positioning at rapid rate.

Any feed rate stored in front of G00 again becomes operative after a rapid traverse through G01, G02, G03, G50, G51 and G52.

Example: positioning at rapid rate

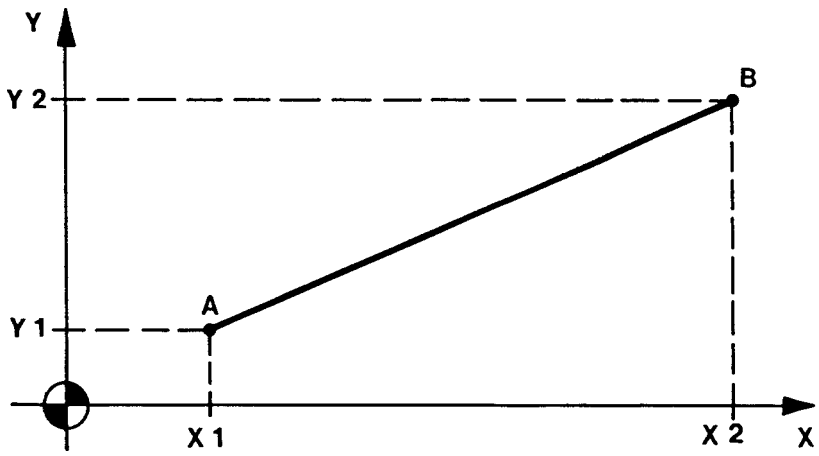



Figure 4-1

## 4.2 G01 Linear interpolation

The programmed target position is homed into by G01 along a straight line. The programmed feed rate is the contouring rate.

G01 acts modally and can be overwritten by G00, G02 and G03. G01 is automatically preset at start of the program.

Example: linear interpolation

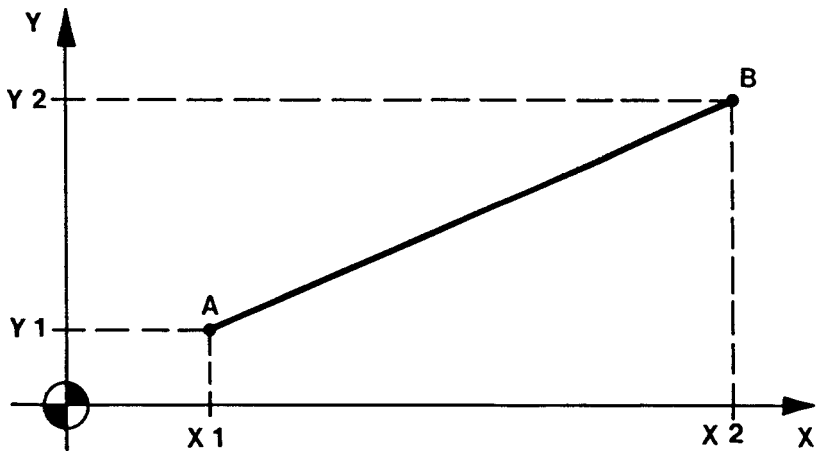



Figure 4-2

## 4.3 G02 / G03 Circular interpolation

When inputting G02 and G03, the programmed target position is homed into along a circle segment having a centre point determined by the interpolation parameters I, J and K and/or having a radius determined by R.

**G02 signifies clockwise circular interpolation and**
**G03 signifies counter-clockwise circular interpolation**

The G02 / G03 functions act modally and overwrite each other mutually and can be cleared by G00, G01, G50, G51 and G52.

### Circle centre point

The circle limit point and the interpolation parameters can be input simultaneously using either absolute or incremental dimensions. For complete circle programming the limit point is equal to the starting point.

Interpolation parameter

| address letter | Circle centre point distance in direction |
|---|---|
| I | X axis |
| J | Y axis |
| K | Z axis |

The speed at which the circle is started is proportional to the stored feed rate which can be adjusted between 0 and 120% by the feed rate override potentiometer.

## 4.3 G02 / G03 Circular interpolation (continued)

The interpolation parameters can be input in such a way that the deviation at A is less than or equal to 10 increments. If A is greater than 10 increments the program is still not shut down. In all cases the control system recalculates the circle centre point where R = (R1 + R2)/2.

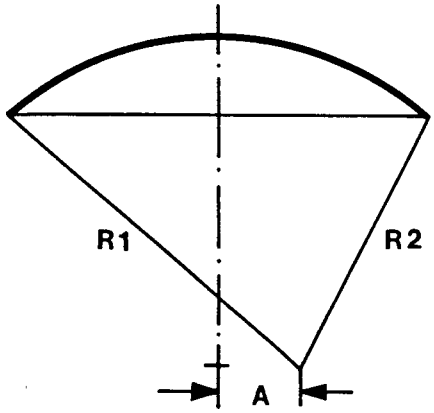



Figure 4-3

**Three-dimensional circular interpolation**

A programmed circle is three-dimensional driven off, if in a block 3 axes (X, Y, Z) and 3 circle center points (I, J, K) are indicated.

With programmed
G02 is executed a long arc,
G03 is executed a short arc.

The area levels G17, G18 and G19 are here without meaning.

## 4.3 G02 / G03 Circular interpolation (continued)

The main planes for the circular interpolation and tool correction offsets are selected by G17, G18 and G19 (see also 4.12 Plane selection).

Main plane Parameters for circle centre point

| | |
|---|---|
| XY | IJ |
| ZX | KI |
| YZ | JK |

Example: clockwise circular interpolation

End point and circle centre point are programmed in absolute dimensions (G90).

A = Starting point
B = End point

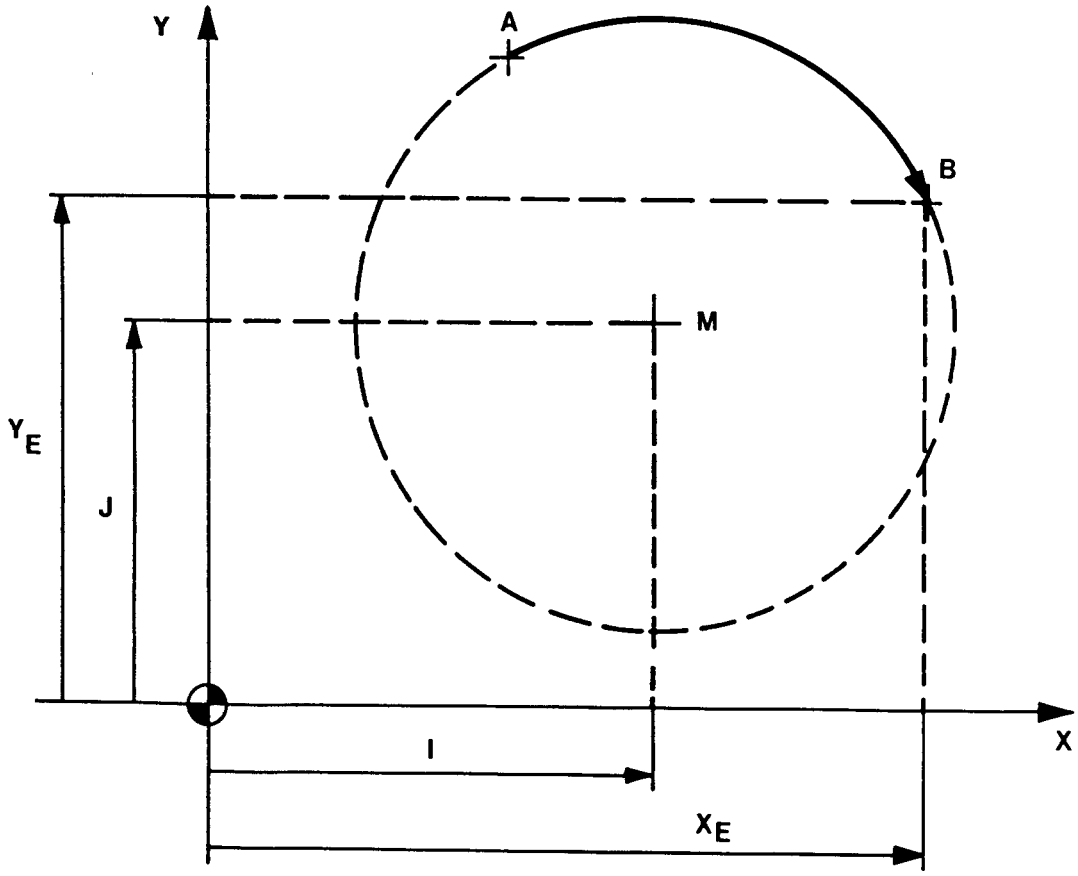



Figure 4-4

## 4.3 G02 / G03 Circular interpolation (continued)

The circle end point can be input in absolute or incremental dimensions. Full circle programming is not permitted.

The smaller and larger angular paths are described by positive and negative radius information respectively.

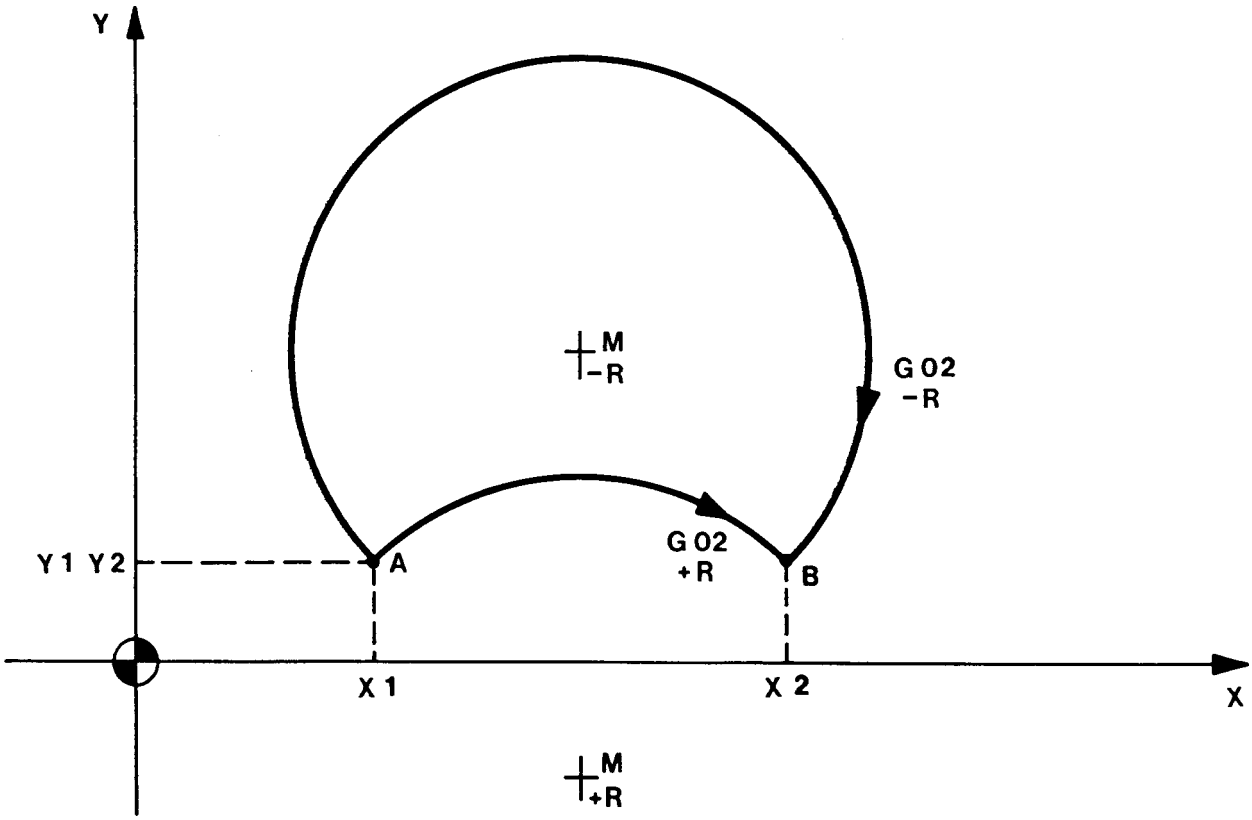



Figure 4-5

Radius R must be greater than or equal to the semi-chord AB/2 in order to give a centre point. If the R being input is less than the semi-chord, message 1407 is initiated and the control system selects an R = AB/2 without the program being shut down.

## 4.4 Automatic selection of linear and circular interpolation

G123 selects automatically after analysis of the position of three points G01 / G02 / G03:

1st point position
2nd point programmed position in the actual block
3rd point programmed position in the next block

Example G123 -> G01

| | | | | |
|---|---|---|---|---|
| N10 | G01 | X20 | Y50 | position |
| N20 | G123 | X70 | Y45 | position in actual block |
| N30 | | X130 | Y40 | position in next block |

Example G123 -> G02

| | | | | |
|---|---|---|---|---|
| N10 | G01 | X20 | Y50 | position |
| N20 | G123 | X70 | Y71,5 | position in actual block |
| N30 | | X130 | Y63 | position in next block |

Example G123 -> G03

| | | | | |
|---|---|---|---|---|
| N10 | G01 | X20 | Y50 | position |
| N20 | G123 | X70 | Y18 | position in actual block |
| N30 | | X130 | Y18 | position in next block |

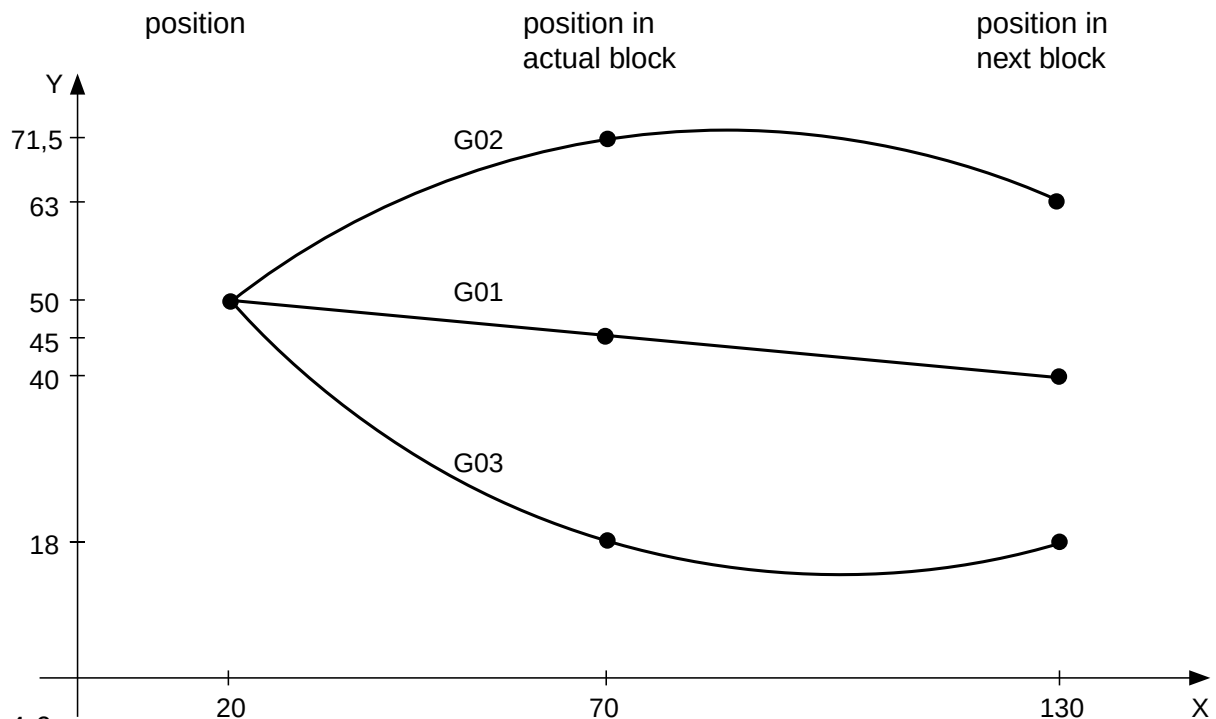



Figure 4-6

## 4.4 Automatic selection of linear and circular interpolation

Program example

```
P2050
N2                                                    { G123 free outline }
N10   G49 G56 G0 F3000   X:0        Y:0        Z:2
N20                      X:21.1     Y:9.300    Z:-1    { point 1 }
N30   G123 G1            X:19.6     Y:54.3             { point 2    selection G02 }
N40                      X:45.0     Y:61.0             { point 3 }
N50   G123               X:63.0     Y:46.7             { point 4    selection G01 }
N60                      X:82.9     Y:30.5             { point 5 }
N70   G123               X:81.2     Y:18.8             { point 6    selection G03 }
N80                      X:108.8    Y:21.6             { point 7 }
N90   G123               X:101.0    Y:33.0             { point 8    selection G02 }
N100                     X:110.3    Y:64.4             { point 9 }
N110  G123               X:108.2    Y:40.6             { point 10   selection G03 }
N120                     X:131.8    Y:25.5             { point 11 }
N130  G123               X:135.7    Y:13.8             { point 12   selection G01 }
N140                     X:138.447  Y:4.4              { point 13 }
N150                                        Z:2
N160  M30
```

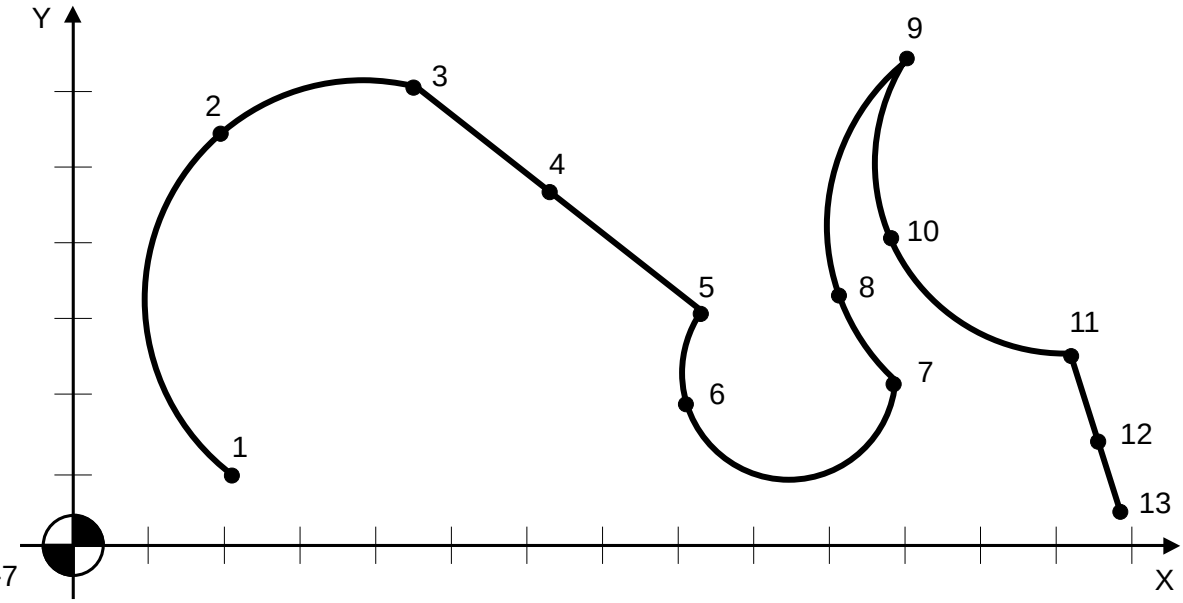



Figure 4-7

## 4.5 G04 Dwell

A dwell is called up by G04 and can be programmed between 0 and 999.999 s. The dwell must be input in the correct format, i.e. leading and trailing zeros and the decimal point should be input.

Example: G04.001.50 (1.5 s dwell)

The G04 function is only operative in the block in which it was written. G04 is operative after the traverse information and before the M functions subsequently active.

## 4.6 G05 / G06 / G07 driving direction of round axes

**G5 driving direction positively, against clockwise direction.**

**G6 driving direction negatively, in the clockwise direction.**

**G7 driving direction neg. / pos., selection shortest path to the target position.**

Examples driving direction, if will absolutely proceed!

| Function | Start pos | Target pos | Direction. | Drive | Display | |
|---|---|---|---|---|---|---|
| - G5 | 0 | 90 | pos. | 90° | 90 | |
| - G5 | 270 | 35 | pos. | 125° | 35 | |
| - G5 | 150 | -45 | pos. | 165° | 315 | |
| - G5 | 350 | -10 | not applicable | 0° | 350 | initial pos = target pos |
| - G5/G91 | 70 | 30ink. | pos. | 30° | 100 | |
| - G5/G91 | 180 | -150ink. | neg. | 150° | 30 | |

Note: With incremental the technique the functions G5/G6/G7 are ineffective.
The driving direction certainly by the sign.

| Function | Start pos | Target pos | Direction. | Drive | Display | |
|---|---|---|---|---|---|---|
| - G6 | 0 | 90 | neg. | 270° | 90 | |
| - G6 | 270 | 35 | neg. | 235° | 35 | |
| - G6 | 150 | -45 | neg. | 195° | 315 | |
| - G6 | 350 | -10 | not applicable | 0° | 350 | initial pos = target pos |
| - G6/G91 | 70 | 30ink. | pos. | 30° | 100 | |
| - G6/G91 | 180 | -150ink. | neg. | 150° | 30 | |

| Function | Start pos | Target pos | Direction. | Drive | Display | |
|---|---|---|---|---|---|---|
| - G7 | 0 | 90 | pos. | 90° | 90 | |
| - G7 | 270 | 35 | pos. | 125° | 35 | |
| - G7 | 150 | -45 | pos. | 165° | 315 | |
| - G7 | 350 | -10 | not applicable | 0° | 350 | initial pos = target pos |
| - G7/G91 | 70 | 30ink. | pos. | 30° | 100 | |
| - G7/G91 | 180 | -150ink. | neg. | 150° | 30 | |

## 4.7 G08 / G09 Precision stop block-by-block

**G08 precision stop, block-by-block, On**
**G08 precision stop, block-by-block, Off**

G08 initiates a precision stop at the end of a block.

The function overwrites a programmed G29 block by block. The precision stop is automatically set block by block with G00 and G81 to G85.

G09 overwrites a precision stop programmed with G28 block by block

## 4.8 G10 / G11 Polar coordinate system

**G10 Polar coordinate system on**
**G11 Polar coordinate system off**

The function G10 is used to activate the programming of target points in polar coordinates.
The function G11 deactivates this function. Both functions act modally.

The coordinates programmed in the block with G10 define the pole, but not the travel of the axes (this is only valid for the two coordinates of the interpolation plane defined with G17...G19). If the coordinates are not programmed, the existing pole is kept.

At the program end or if the program is interrupted, the programmed pole as well as the polar radius (x) and polar angle ( c) are cleared. Polar radius (x) and polar angle ( c) act modally.

The polar coordinate system plane corresponds to the interpolation plane defined with G17...G19.
The polar radius is always interpreted as a positive value!

Polar radius and polar angle can be corrected with G44.

## 4.8 G10 / G11 Polar coordinates (continued)

### Definition of the poles in different interpolation planes

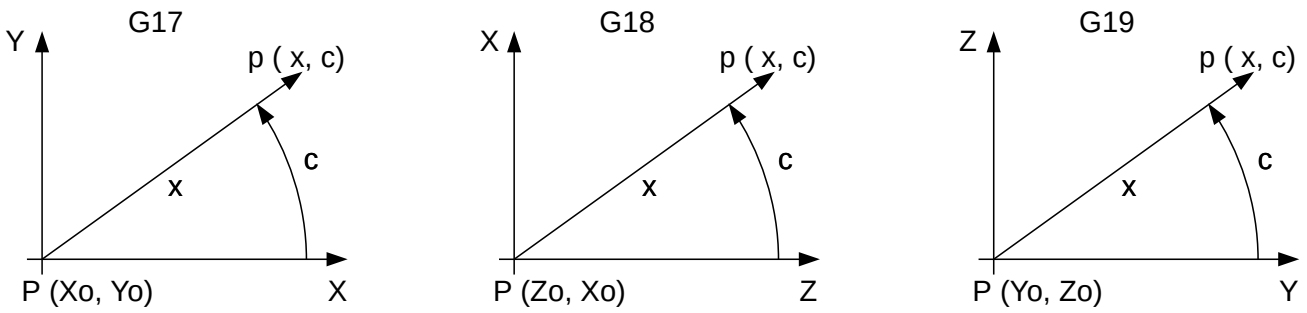



Figure 4-8

### Parameters used for polar coordinate system

| | | |
|---|---|---|
| G10 | Activating the polar coordinate input position with radius vector x and polar angle c | |
| G11 | Deactivating the polar coordinates | |
| G17 | XY plane | pole P() is in plane XY, the X axis is the polar axis |
| G18 | ZX plane | pole P() is in plane ZX, the Z axis is the polar axis |
| G19 | YZ plane | pole P() is in plane YZ, the Y axis is the polar axis |
| q150 | Polar coordinate system: identification for radius vector (e.g. ‘x’)<br>Input of the ASCII-code Default: ‘x’ | |
| q151 | Polar coordinate system: identification for polar angle (e.g. ‘c’)<br>Input of the ASCII-code Default: ‘c’ | |

## 4.8 G10 / G11 Polar coordinates (continued)

**Program example: Coordinates in X / Y**

```
P656
N05   G55 G49  G00  F3000      T1    M16
N10                            X:0         Y:0         Z:2         { point 1 }
N20                G01                                Z:-2
N30                            X:90        Y:0                     { point 2 }
N40                            X:60        Y:25                    { point 3 }
N50                            X:90        Y:60                    { point 4 }
N60                G03         X:30        Y:85        R:34        { point 5 }
N70                G02         X:45        Y:55        R:18        { point 6 }
N80                G01         X:0         Y:0                     { point 1 }
N90                                                    Z:2
N100        M30
```

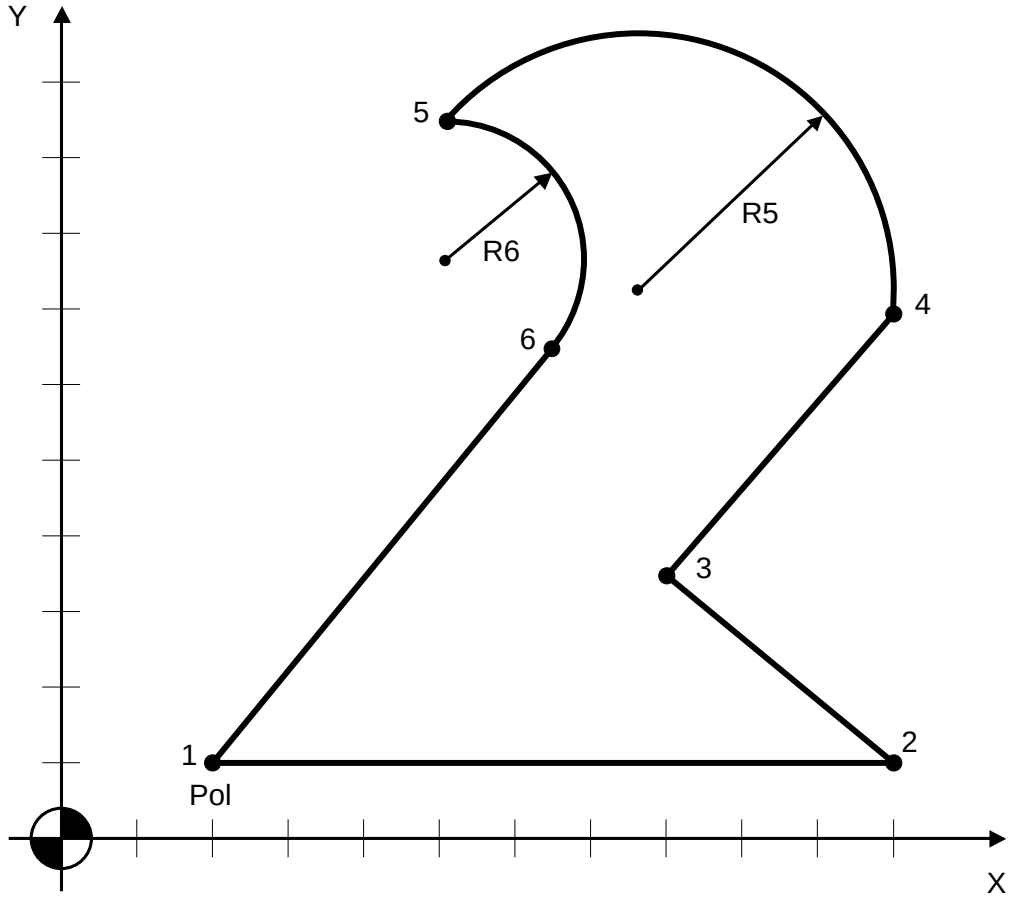



Figure 4-9

## 4.8 G10 / G11 Polar coordinates (continued)

**Program example: Point of pole is the null point X:0 / Y:0**

```
P657
N05   G55 G49  G00  F3000      T1    M16
N10                          X:0        Y:0        Z:2        { point 1 }
N20                G01                             Z:-2
N30          G10             X:0        Y:0                   { point 1  pole set }
N40                          x:90       c:0                   { point 2 }
N50                          x:65       c:22.619              { point 3 }
N60                          x:108.166  c:33.690              { point 4 }
N70                G03       x:90.138   c:70.559   R:34       { point 5 }
N80                G02       x:71.063   c:50.710   R:18       { point 6 }
N90                G01       x:0        c:0                   { point 1 }
N100         G11                                   Z:2
N110         M30
```

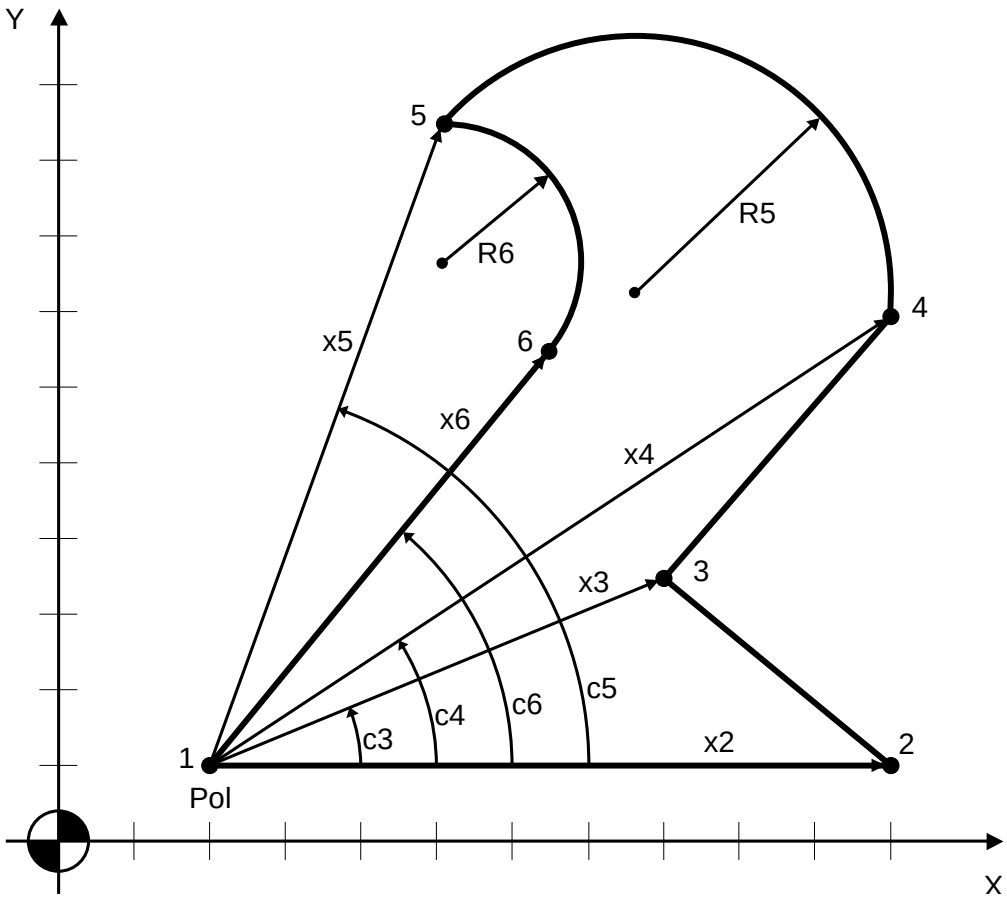



Figure 4-10

## 4.8 G10 / G11 Polar coordinates (continued)

**Program example: Point of pole are thr points 2, 3 und 6**

```
P659
N05   G55 G49  G00  F3000      T1    M16
N10                          X:0        Y:0        Z:2        { point 1 }
N20              G01                               Z:-2
N30                          X:0        Y:0                   { point 2 }
N40        G10               X:90       Y:0                   { point 2 pole set }
N50                          x:39.05    c:140.194             { point 3 }
N60                          X:60       Y:25                  { point 3 pole set }
N70                          x:46.09    c:49:398              { point 4 }
N80        G11  G03          X:30       Y:85       R:34       { point 5 pole reset }
N90             G02          X:45       Y:55       R:18       { point 6 }
N100       G10               X:45       Y:55                  { point 6 pole set }
N110            G01          x:71.062   c:230.710             { point 1 }
N120       G11                                     Z:2        { point 1 pole reset }
N130       M30
```

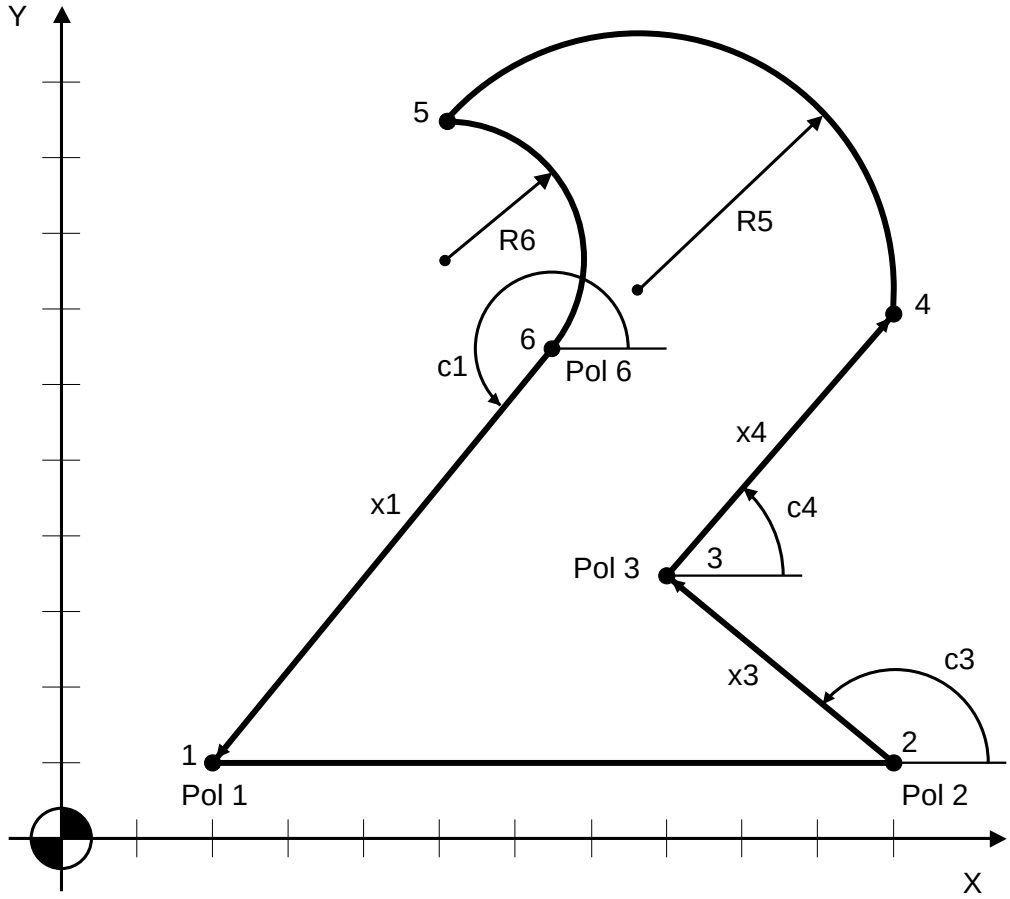



Figure 4-11

## 4.9 G12 Rapid graphical programming environment

Contour sections can be linked by of straight lines and circles.

This function acts block-by-block.

| Parameter | Leg | Radius |
|---|---|---|
| | P70 | P71 |

Rapid programming is only carried out with blocks in which the distance to be traversed is unequal to zero (differences in distances are unequal to zero for straight lines, radius is not equal to zero for circles).
Blocks with distances equal to zero are carried out at the start of the chamfer or circle segment.

### Linear programming

A chamfer can be inserted at the intersection of two straight lines.
The length of the chamfer is given by P70 and the intersection point SP is programmed in the selected interpolation plane.

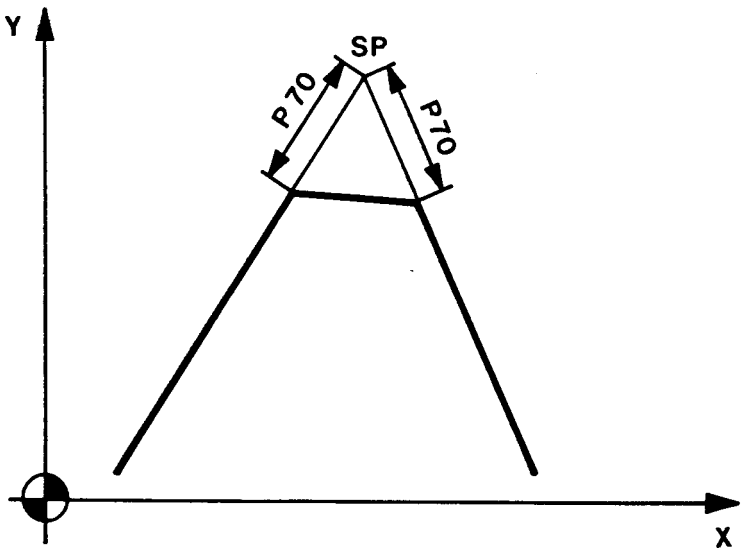



Figure 4-12

## 4.9 G12 Rapid graphical programming environment (continued)

### Radius programming

A circle segment can be inserted at the intersection point of
- two straight lines,
- one straight line and one circle,
- two circles.

The radius of the circle is given by P71 and the intersection point SP is programmed in the selected interpolation plane.

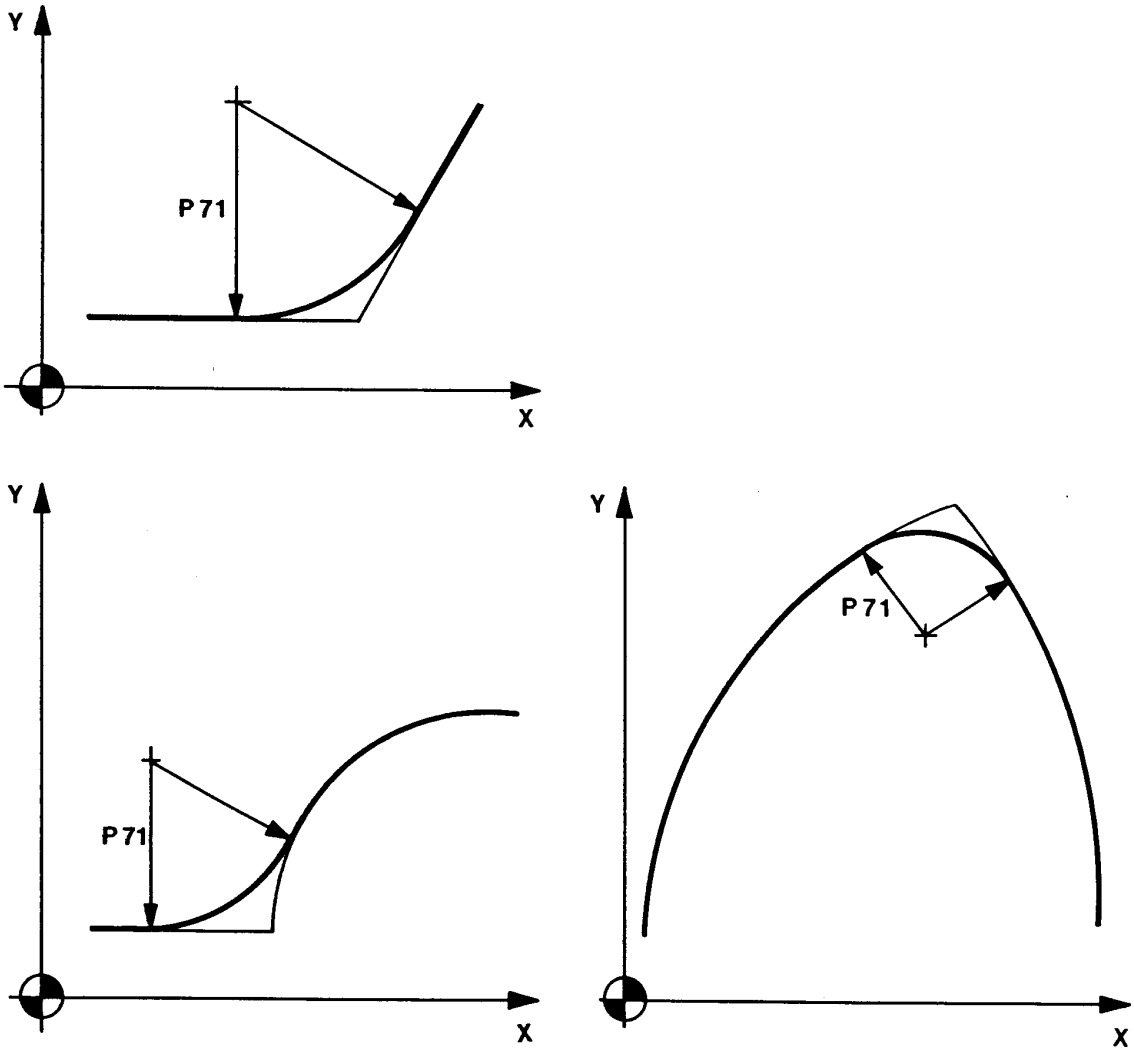



Figure 4-13

## 4.9 G12 Rapid graphical programming environment (continued)

**Program example: Outline path short programming with radius and leg**

```
P391
N10   G55 G29 G48 G00  F2000 T1  M16 X0    Y0   Z2
N20       G01                           Z:-1
N30   G12         P71:8              X:40  Y:0     { point 1  radius }
N40   G12 G02 R65 P71:28             X62.5 Y:91    { point 2  radius }
N50   G12 G02 R65 P71:15             X95   Y:35    { point 3  leg }
N60   G12 G01     P71:8              X120  Y:35    { point 4  radius }
N70   G12 G02     P71:12   I95  J35  X95   Y:10    { point 5  radius }
N80   G12 G03     P71:10   I70  J10  X45   Y:10    { point 6  radius }
N90       G01                        X34.5 Y:10    { point 7  radius }
N100              G00                           Z:2
N110  M30
```

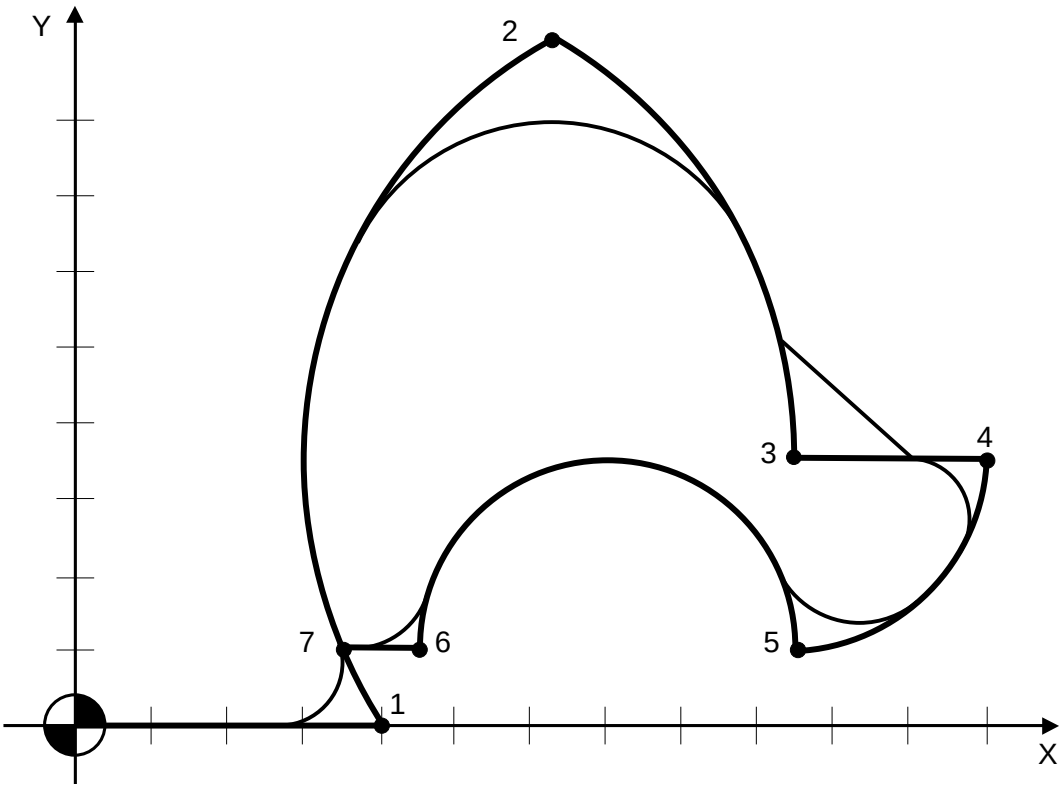



Figure 4-14

## 4.10 G13 / G14 tangential axis

**G13 tangential axis off**
**G14 tangential axis on**

G13 switches the tangential axis off.

G14 switches the tangential axis on.

With this function it is possible to control a round axis so that it is always in a certain position (tangential) to the path of the main axes.
For example for band saws, glass cutting, moist collectors.

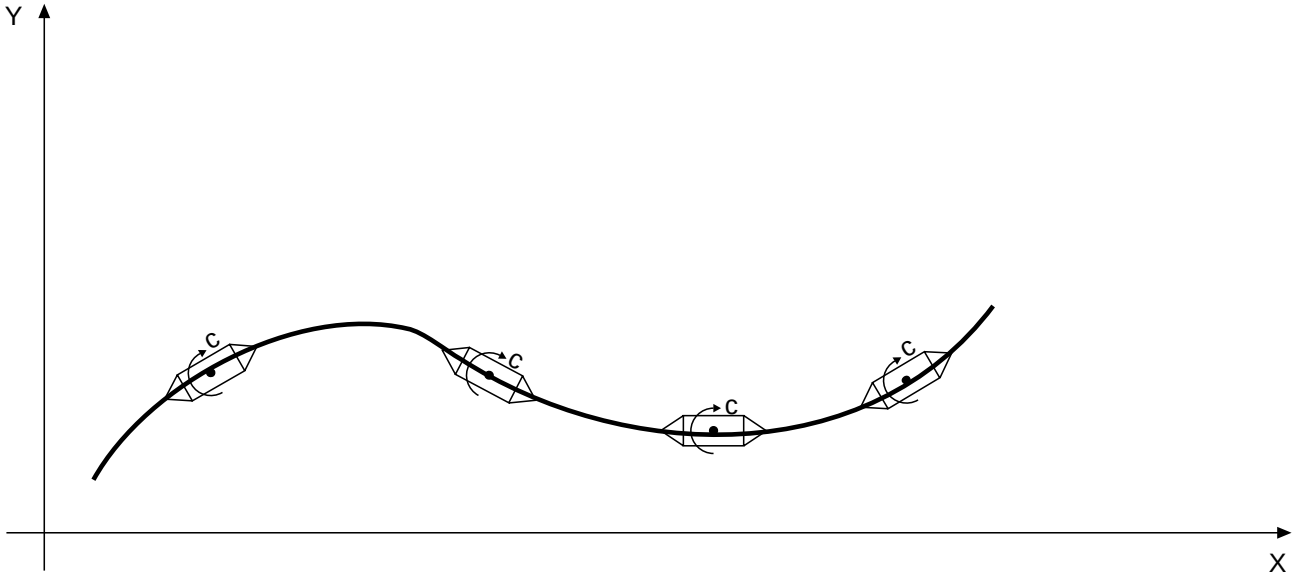



Figure 4-15

## 4.11 G15 / G16 Polar transformation

**G15 Polar transformation off**
**G16 Polar transformation on**

G15 switches the polar transformation off.

G16 switches the polar transformation on.

The polar transformation is applied for example for programming of uneven parts on a grinding machine or lathe with polar coordinate system. Usually the workpiece can be described more easily in the cartesian coordinate system. With the polar transformation G16 the control converts the cartesian coordinates (X/Y/Z) into polar coordinates (radius vector x and polar angle c). This method is very advantageous, because it requires less time for contour featuring.

**Definition of the polar coordinate system**

With the polar coordinates each point of the coordinates are determined by the two values radius vector ‘x’ and polar angle ‘c’.

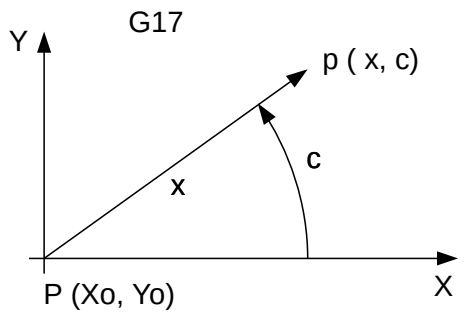



Figure 4-16 Polar coordinates with G 17 (XY - plane )

The radius vector x is the distance of point p(x,c) to the origin P(Xo,Yo).
The polar angle c is between the X-axis and the connecting straight line from the origin P(Xo,Yo) to point p(x,c).
The X - axis is marked as polar axis and the origin P(Xo,Yo ) as pole. The polar angle is positive, if it is measured from the pole axis X counter-clockwise direction. The angle is negative in clockwise direction.

## 4.11 G15 / G16 Polar transformation (continued)

Utilized parameter for polar coordinate system

| | |
|---|---|
| G15 | Selecting the polar coordinate transformation |
| G16 | Call up of the polar coordinate transformation, input position with X, Y |
| G17 | XY plane pole P() lies in XY Plane, X axis is polar axis |
| G18 | ZX Plane pole P() lies in ZX Plane, Z axis is polar axis |
| G19 | YZ Plane pole P() lies in YZ Plane, Y axis is polar axis |
| P11820 | Polar coordinate axis (physical axis number)<br>e.g.<br>Byte 3, 2, 1: the first 2 axes (x, y) 00 02 01 Hex<br>Byte 4 : change of direction (Bit 2, 1) |
| P11821 | Radius vector offset (ro) for polar coordinate transformation [mm ] |
| P11822 | Polar angle offset (wo) for polar coordinate transformation [degrees] |
| P11823 | Pole offset (po) for polar coordinate transformation [mm ] |

## 4.11 G15 / G16 Polar transformation (continued)

Example: Polar transformation G16 for square contour

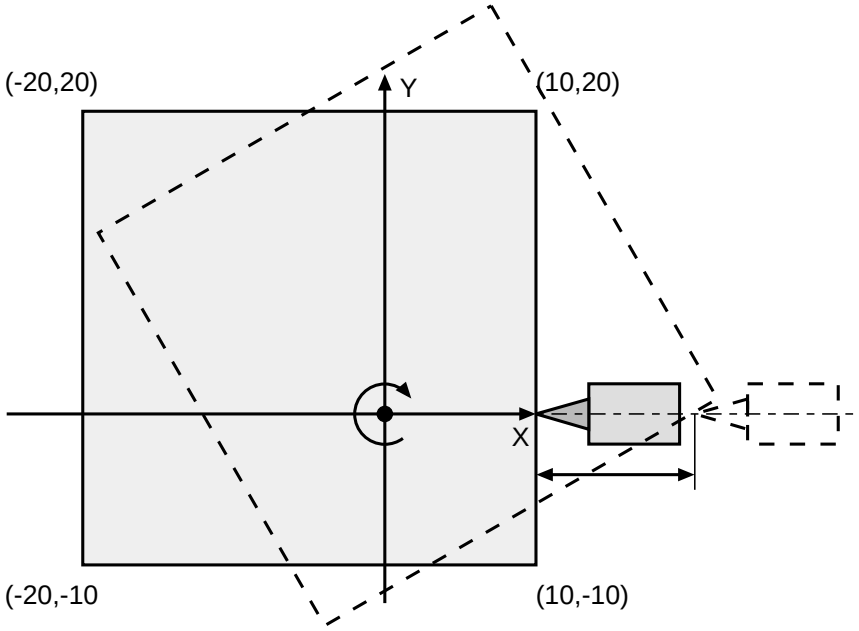



Figure 4-17 Square contour

```
N10  G17 G1 F1000    ;    Definition of coordinate plane
. ..
N150 G16 X10 Y0      ;    Call up polar transformation and X,Y
                     ;    are transformed accord. equation 2 into polar coorinates
                     ;    here: Xo = Yo = 0;
N160  X10 Y 20       ;    Position X= 10 and Y= 20 are transformed into
                     ;    polar coordinates. Approach to transformed position
N170  X - 20 Y 20    ;    X= -20 and Y= 20 are transformed into polar coordinates.
                     ;    Approach to transformed position
N180 X - 20 Y-10     ;    X= -20 and Y= -10 are transformed into polar coordinates.
                     ;    Approach to transformed position
N190 X10 Y-10        ;    X= 10 and Y= -10  are transformed into polar coordinates.
                     ;    Approach to transformed position
N200 X10 Y 0 G15     ;    X= 10 and Y= 0 are transformed into polar coordinates.
                     ;    Approach to transformed position
                     ;    Switch off  polar transformation.
N220 . . .
N230 M30             ;    Program end
```

## 4.11 G15 / G16 Polar transformation (continued)

Example: Polar transformation G16 for cam contour

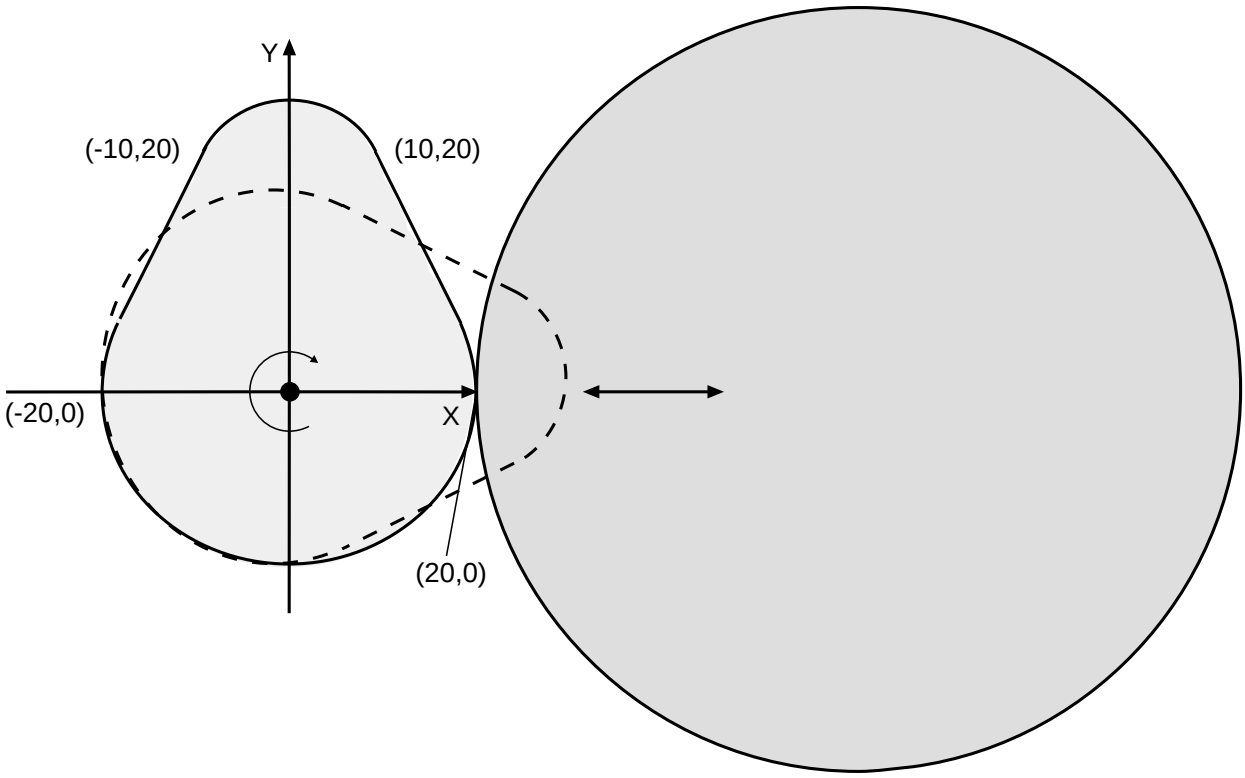



Figure 4-14 Cam contour

```
N10  G17 G1 F1000          ;   Definition coordinate plane
. ..
N150 G16 X20 Y0            ;   Call up polar transformation and X,Y
                           ;   are transformed accord. equation 2 into polar coorinates
                           ;   here: Xo = Yo = 0;
N160  X10 Y 20             ;   Position X= 10 and Y= 20 are transformed into
                           ;   polar coordinates. Approach to transformed position
N170  G2 X -10 Y 20  R11   ;   X= -10 and Y= 20 are transformed into
                           ;   polar coordinates. Approach to G2 until transformed pos.  N180
G1 X -20 Y0                ;   X= -20 and Y= 0 are transformed into polar coordinates
                           ;   Approach to transformed position
N190 G2 X20 Y0 R22         ;   X=20 and Y= 0 are transformed into polar coordinates
                           ;   Approach to G2 until transformed position
N200 G15                   ;   Switch off  polar transformation.
N220 . . .
N230 M30                   ;   Program end
```

## 4.12 G17 / G18 / G19 Plane selection

The main planes for circle interpolation and tool correction offsets are selected using G17, G18 and G19.

| Traverse functions | Main plane | Parameters for circle centre point |
|---|---|---|
| G17 | XY | IJ |
| G18 | ZX | KI |
| G19 | YZ | JK |

These functions act modally and overwrite each other mutually. The plane preset is controlled by the PLC parameter „WZ“ tool axis.
The tool correction offset takes place in the given interpolation plane. The correction offset should be cancelled using G40 before changing the interpolation plane.

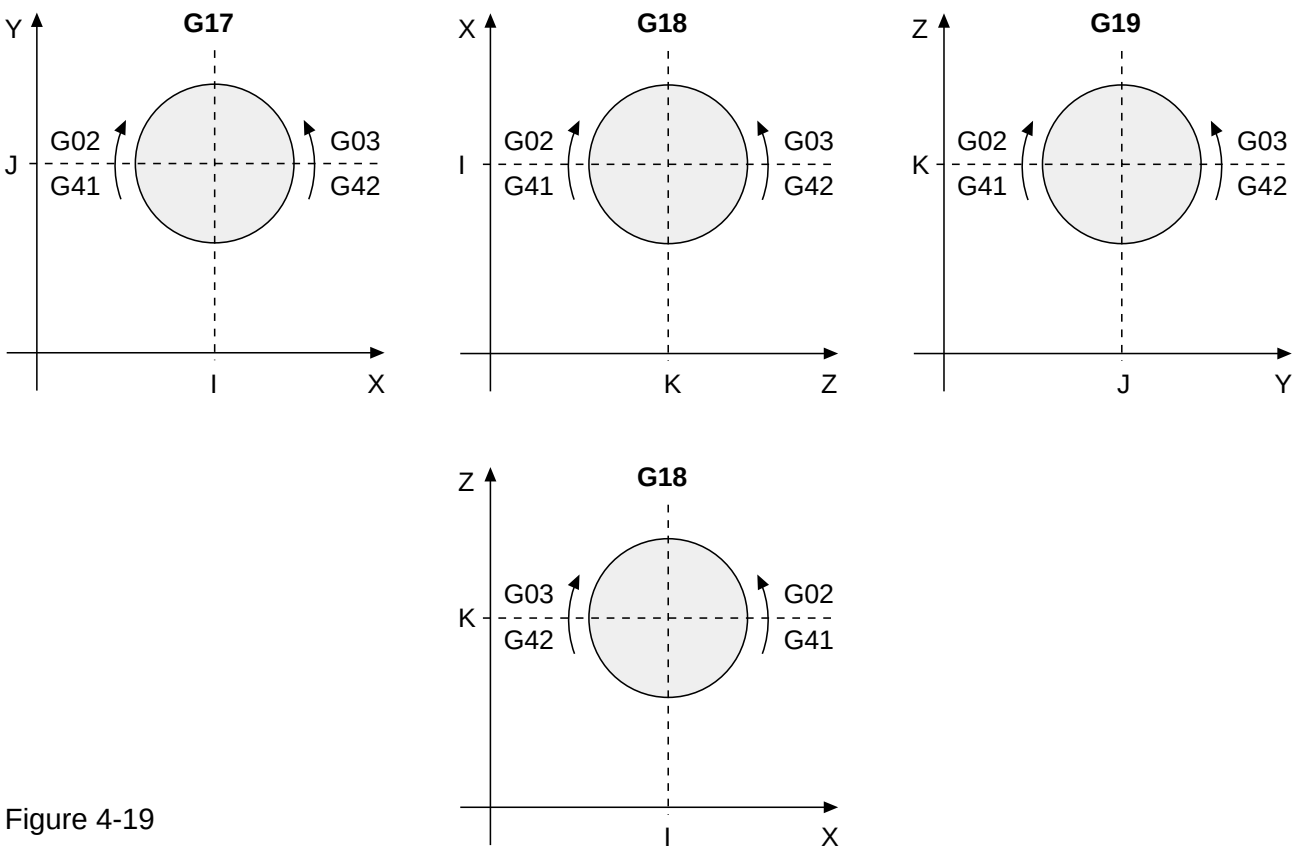



Figure 4-19

## 4.12 G17 / G18 / G19 Plane selection (continued)

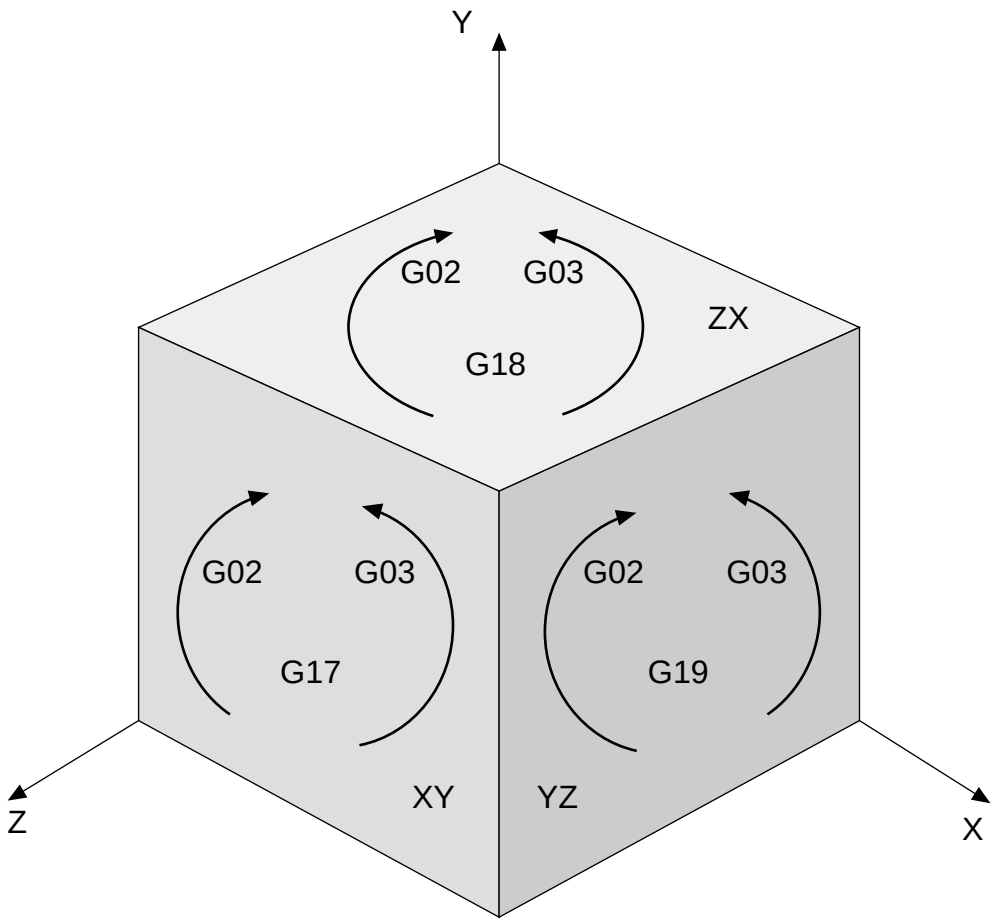



Figure 4-20

## 4.13 G28 / G29 Precision stop modal

### G28 Switching on modal precision stop

G28 initiates a precision stop at the end of a block. The tool traverses to the end point programmed in the block and stops.
Subsequently it traverses to the end point programmed in the next block and stops again.

The function acts modally and can be cleared by G29.

### G29 Switching off modal precision stop

G29 switches off a precision stop programmed with G28.

The function acts modally and can be cleared by G28.

G29 is automatically set when the program starts.

## 4.14 G40 / G41 / G42 Milling cutter path correction offsets

### G40 Clearing milling cutter path correction offsets

The milling cutter path correction offset programmed using G41 or G42 is cleared using G40.

G40 acts modally and can be cleared by G41 and G42. G40 is automatically set when the program starts.

### G41 / G42 Actuating milling cutter path correction offset

A milling cutter path correction offset can be switched on using G41 and G42.

G41 effects a correction to the left of the programmed path.
G42 effects a correction to the right of the programmed path.

The reference direction is in the feed direction in each case.

The functions act modally, overwrite each other mutually and can be cleared by G40.

The feed rate is proportional to the milling cutter centre point path when the tool correction offset is switched on.

Further details on this subject appear in the section „Tool correction offset“.

## 4.15 G43 / G44 Axis correction

With G43 / G44 an axis correction can be programmed.

**G43 axis correction off**
**G44 axis correction on**

The programmed traverse informations in the block with G44 determine the axis correction, whereby no traverse is driven.
These corrections remain modally.

At program end or program abort these corrections are cleared, or switched off with G43.
A programmed G44 correction is a component, which is added on all further traverse information.

With G44 polar angles and polar radius can also be corrected.

Input: e.g.:

N100 G44 X10 Y20 Z30 axes do not drive !

N120 G01 F1000 X100 Y100 Z100 axes drive to X: 110, Y: 120; Z: 130

N130 G43

## 4.16 G45 / G46 Turning of coordinates

The „Turn“ function initiates the turning of a coordinate pair about a given angle E.
The traverse function G45 switches turning on, G46 switches the function off. G45 and G46 act modally.

### G45 / G46 Geometric definition turning

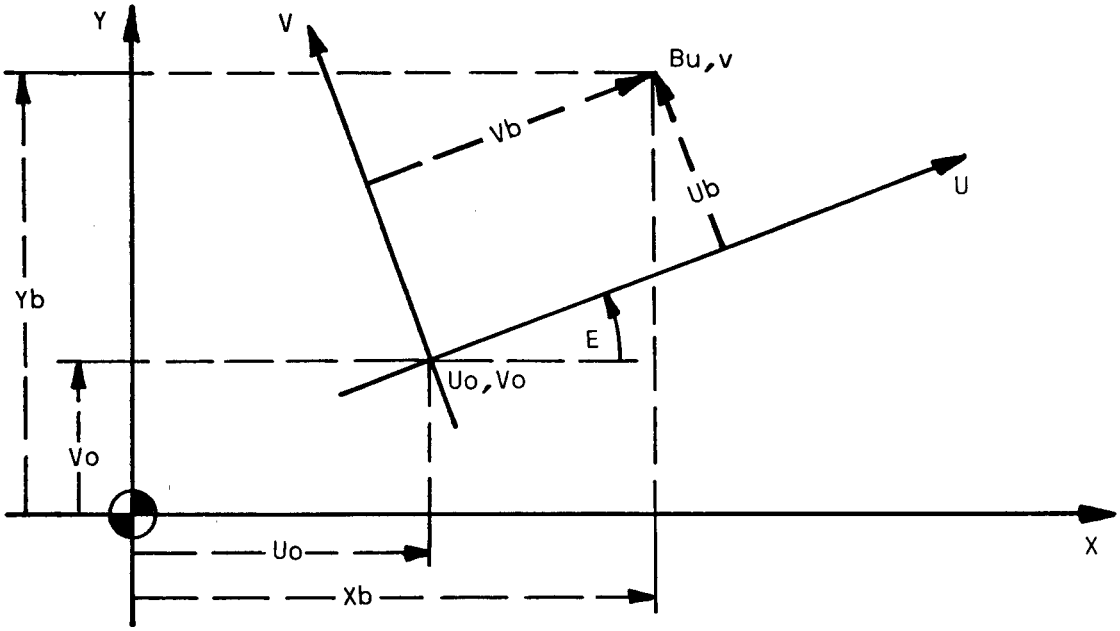



Figure 4-21

X, Y Machine coordinate system
U, V Coordinate axes of the turned coordinate system

E Angle about which the machine system X axis is to be turned in the direction of the machine system Y axis in order to retain the UV coordinate system orientation.
Angle E is positive if measured counter-clockwise to the X axis and negative in the clockwise direction.

Uo, Vo Original UV coordinate system coordinates, referred to the machine XY coordinate system zero point.
Ub, Vb Point B coordinates in UV coordinate system.
Xb, Yb Point B coordinates in XY coordinate system, referred to the effective shift (NP and G92).

Converting the UV system coordinates into those of the XY system
Xb = (U.cosE - V.sinE) + Uo
Yb = (U.sinE + V.cosE) + Vo

## 4.16 G45 / G46 Turning of coordinates (continued)

Programming the coordinate origins U0, V0 (referred to the machine system zero point) and the turning angle E take place via parameters.

| Parameter | Characteristic | Significance |
|---|---|---|
| P160 | Uo | UV system original coordinate |
| P161 | Vo | UV system original coordinate |
| P163 | E | Turning angle |

The parameters act modally.

The parameters P160, P161 and the reference axis for the turning angle are dependant on the plane set.

| Plane set | P160 | P161 | Reference axis for turning angle |
|---|---|---|---|
| G17 (XY) | Xo | Yo | X axis |
| G18 (ZX) | Zo | Xo | Z axis |
| G19 (YZ) | Yo | Zo | Y axis |

**Shifts with additive effect**

In addition to the adjustment values P160, P161, P163, shifts can be programmed which act additively with respect to the direction.

| Parameter | Characteristic | Significance |
|---|---|---|
| P165 | U | Shift in U |
| P166 | V | Shift in V |
| P168 | E | Turning angle incrementation |

When one of these parameters is called up, it's value is added to the former value of the corresponding shift. The value obtained in this way acts modally. The original parameters are retained.

Cancellation of the additive shifts is by re-calling up the adjustment values P160, P161 or P163 (or by switching G45 off with G46).
The additive shifts are plane-dependent, as are the adjustment values.

## 4.16 G45 / G46 Turning of coordinates (continued)

### Mirror imaging of the turned coordinate system

The mirror functions G61 and G62 are referred to the UV coordinate system:
G61 mirror images the U axis
G62 mirror images the V axis

The mirror imaged coordinates are expressed in the machine system XY in the following manner:
Xb = - (U.cosE - V.sinE) + Uo
Yb = - (U.sinE + V.cosE) +Vo

### The effect on G92

The shifts programmed using G92 are carried out.

### The effect on G66 on the turning function

G66 initiates the block-by-block switching off (G46) of turning G45.

### Turning the circle centre point coordinates I, J, K

Turning the circle centre point coordinates I, J, K takes place according to the turning of coordinates as described above.

## 4.16 G45 / G46 Turning of coordinates (continued)

### Example 1 Repeated machining with turning

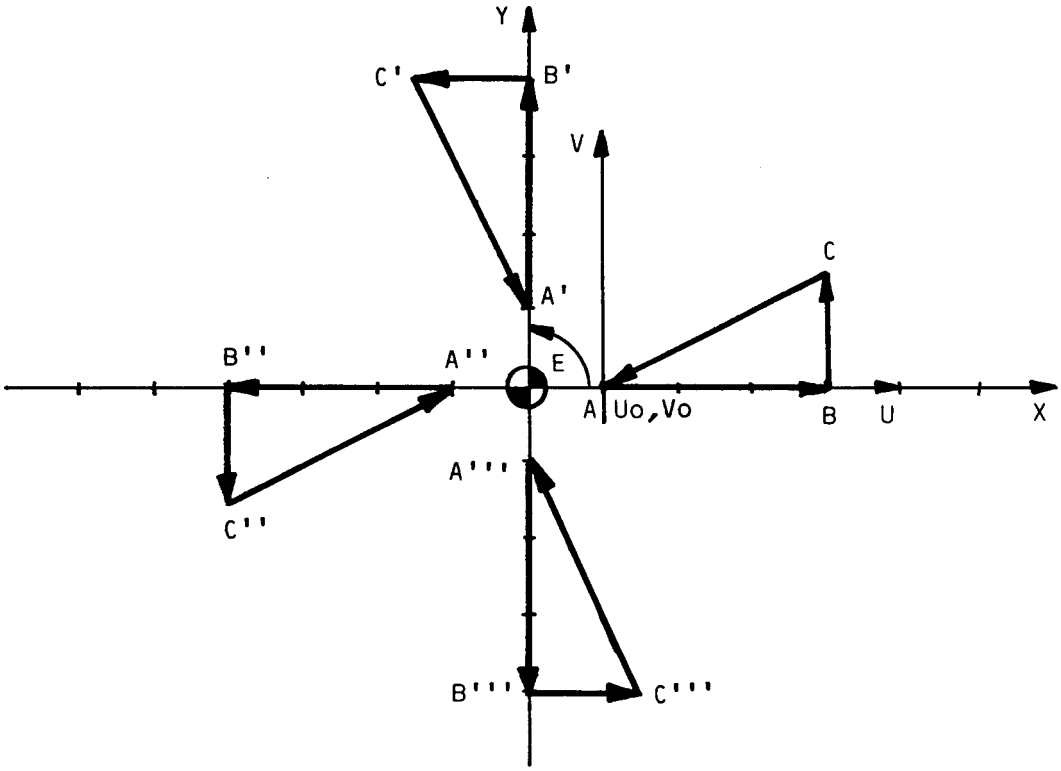



Figure 4-22

```
P1   N10  G45  G00  G54  Z2   P160:0    P161:0    P163:0    F2000    M24.4
N20  G00  X10  Y0
N30  G01  Z-1,5
N40  X40
N50  Y15
N60  X10  Y0
N70  Z2   P168:90   M25
N80  M30
```

The triangular shape ABC is to be machined four times with appropriate orientation of the +X, +Y, -X, -Y coordinate axes.

The machining sequence on the triangle is:
1st. Traverse A to B
2nd. Traverse B to C
3rd. Traverse C to A

## 4.16 G45 / G46 Turning of coordinates (continued)

**Program run, example 1**

Block 10 Switching on the coordinate turning function (G45)

Input set-up data U0=10 (P160) Vo=0 (P161) E=0 (P163)
Uo, Vo coincide with point A
Approach to Z safety dimension, Loop input

Block 20 Positioning to point A = Uo, Vo

Block 30 Tool axis in-feed to machining depth

Block 40 Machining along line AB

Block 50 Machining along line BC

Block 60 Machining along line CA

Block 70 Traversing tool axis away for positioning, incrementing the turning angle to +90 deg., skip back to Block 20

Block 20 Positioning to point „A“

Block 30 In-feed to machining depth
.
.
Block 70

Block 20 Point „A“ Machining, x-orientated
.
.
Block 70

Block 20 Point „A“ Machining, y-orientated
.
.
Block 70

Block 80 End of machining operations

The final machine position is at point „A“.

## 4.16 G45 / G46 Turning of coordinates (continued)

**Example 2 Repeated machining with shift**

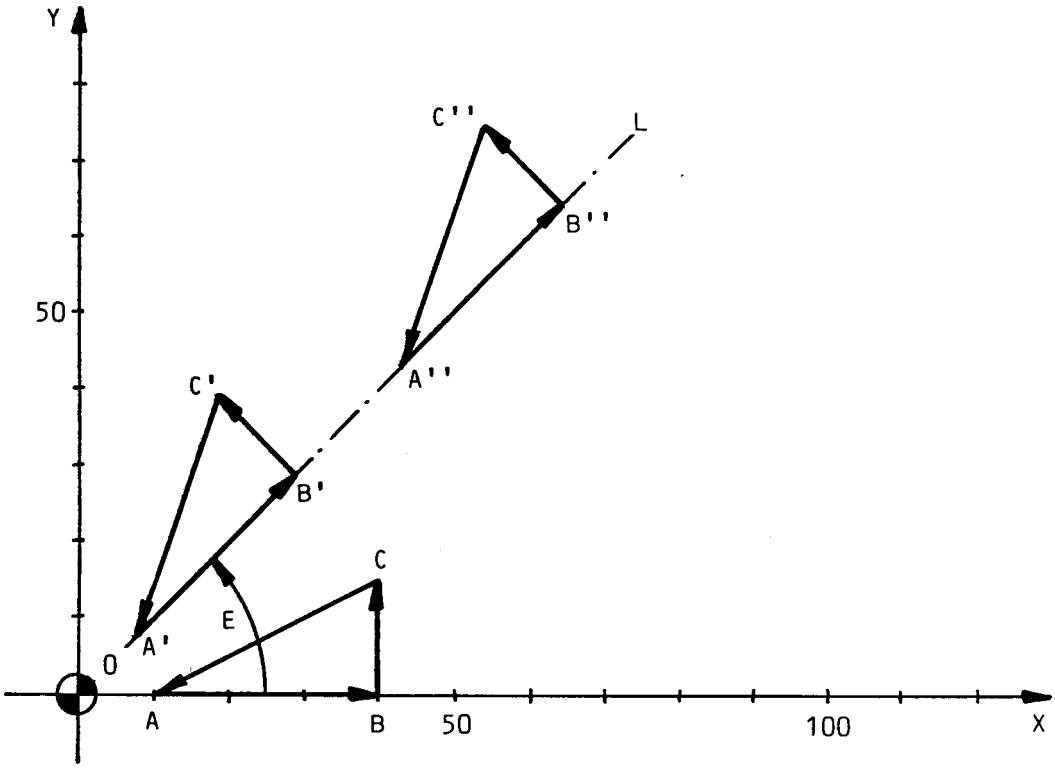



Figure 4-23

```
P2   N10  G45  G0   Z0   P160:0   P161:0   P163:45   F2000   M24.2
     N20  G00  X10  Y0
     N30  G01  Z50
     N40  X40
     N50  Y15
     N60  X10  Y0
     N70  Z70  P165:55   M25
     N80  M30
```

The basic triangular shape ABC is to be machined twice along line OL. Line OL makes an angle E to the axis. The distance between the two triangles A’, B’, C’ and A“, B“, C“ is 55mm (distance A’-A“).

The machining sequence on the triangle is:
1st. Traverse A to B
2nd. Traverse B to C
3rd. Traverse C to A

## 4.16 G45 / G46 Turning of coordinates (continued)

**Program run, example 2**

Block 10 Switching the coordinate turning function on (G45)

Set-up data input Uo=10 (P160) Vo=0 (P161) E=45 (P163)

Approach to Z safety margin, Loop input

Block 20 Positioning to point A’

Block 30 Tool axis in-feed to machining depth

Block 40 Machining along line A’ - B’

Block 50 Machining along line B’ - C’

Block 60 Machining along line C’ - A’

Block 70 tool axis retraction for positioning, shifting the Uo-value P165:55, skip back to Block 20

.
.
.
.

Block 20 Positioning to point A“

Block 30 Tool axis in-feed to machining depth

Block 40 Machining along line A“ - B“

Block 50 Machining along line B“ - C“

Block 60 Machining along line C“ - A“

Block 70 Tool axis retraction

Block 80 End of program

## 4.16 G45 / G46 Turning of coordinates (continued)

### General data for the examples 3, 4 and 5

### Program rectangle figure process

```
P452
N10  G0  F3000  Z1.5
N20  G1  G91  X0  Y0  Z-2.5
N30  X30
N40  Y20
N50  X-30
N60  Y-20
N70  Z2.5
N80  G90  M02
#
```

### Parameter P8859

the parameter P8859 influences the order of rotation and shift.

| | | |
|---|---|---|
| P8859:0 | with G92, G147, G48 and G49 | first turninged, then shifted |
| P8859:1 | with G92, G48 and G49, NP:A>0 | first turninged, then shifted |
| P8859:2 | with G92, G147, G48 and G49 | first shifted, then turninged |
| P8859:3 | with G92, G48 and G49, NP:A>0 | first shifted, then turninged |

## 4.16 G45 / G46 Turning of coordinates (continued)

**Example 3** rectangle figure turn with different brackets, absolutely and incremental

```
P451
N10        T1  M16  G0
N20        G55  G49  G60  G0  F3000  X0  Y0  Z2  M28.452        {W 1}
N30  G45   P160:50  P161:10  P163:30  X0  Y0  Z2  M28.452      {W 2 turning}
N40        P165:50  P166:10  P168:30  X0  Y0  Z2  M28.452      {W 3 incremental turning}
N50  G46   G90                         X0  Y0  Z5
N60        M30
#
```

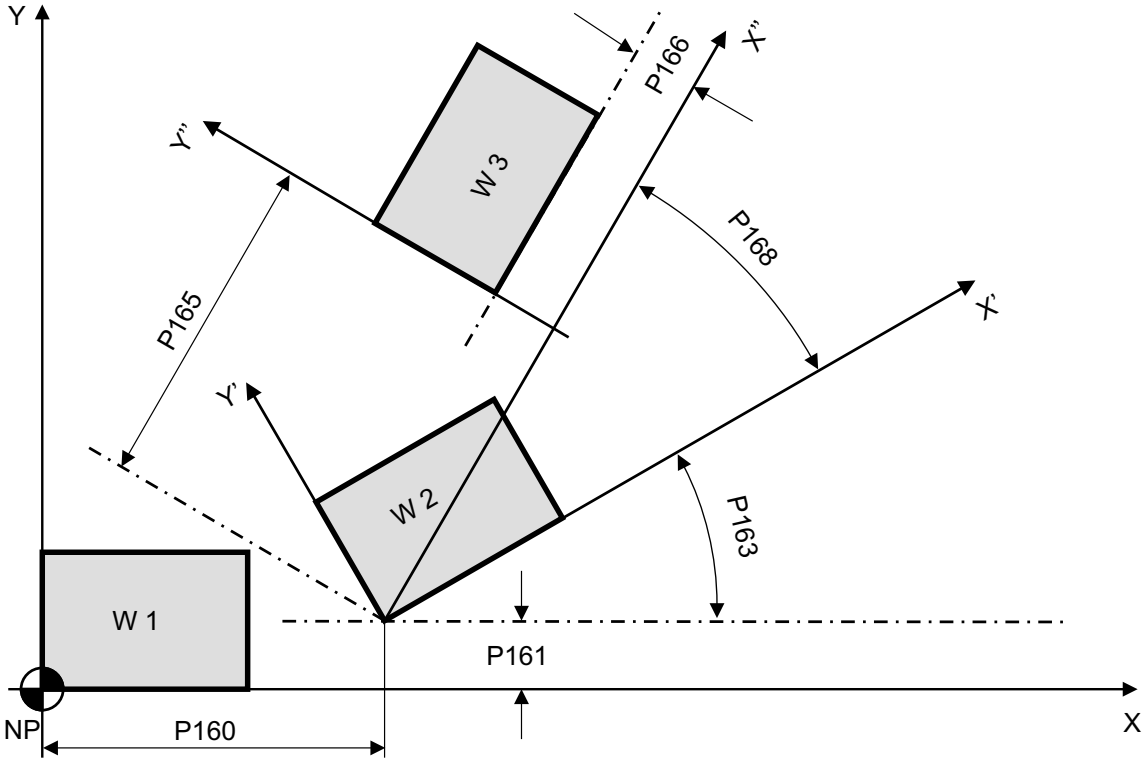



Fig. 4-24

## 4.16 G45 / G46 Turning of coordinates (continued)

**Example 4** rectangle figure shift and turn

P8859:2 first shift by G92 and then turn by G45

```
P451
N10        T1 M16 G0
N20        G55  G147  G0  F3000 X0  Y0  Z2        M28.452    {W 1}
N30  G45   P160:50  P161:10  P163:30  X0  Y0  Z2        M28.452    {W 2 turning}
N40        P165:50  P166:10  P168:30  X0  Y0  Z2        M28.452    {W 3 incremental turning}
N50  G92                               X60 Y0                       {shift}
N60  G45   P160:50  P161:10  P163:30  X10 Y5  Z2 M28.452    {W 2' turning}
N70        P165:50  P166:10  P168:30  X0  Y0  Z2 M28.452    {W 3' incremental turning}
N80  G46   G90                         X0  Y0  Z5
N90        M30
#
```

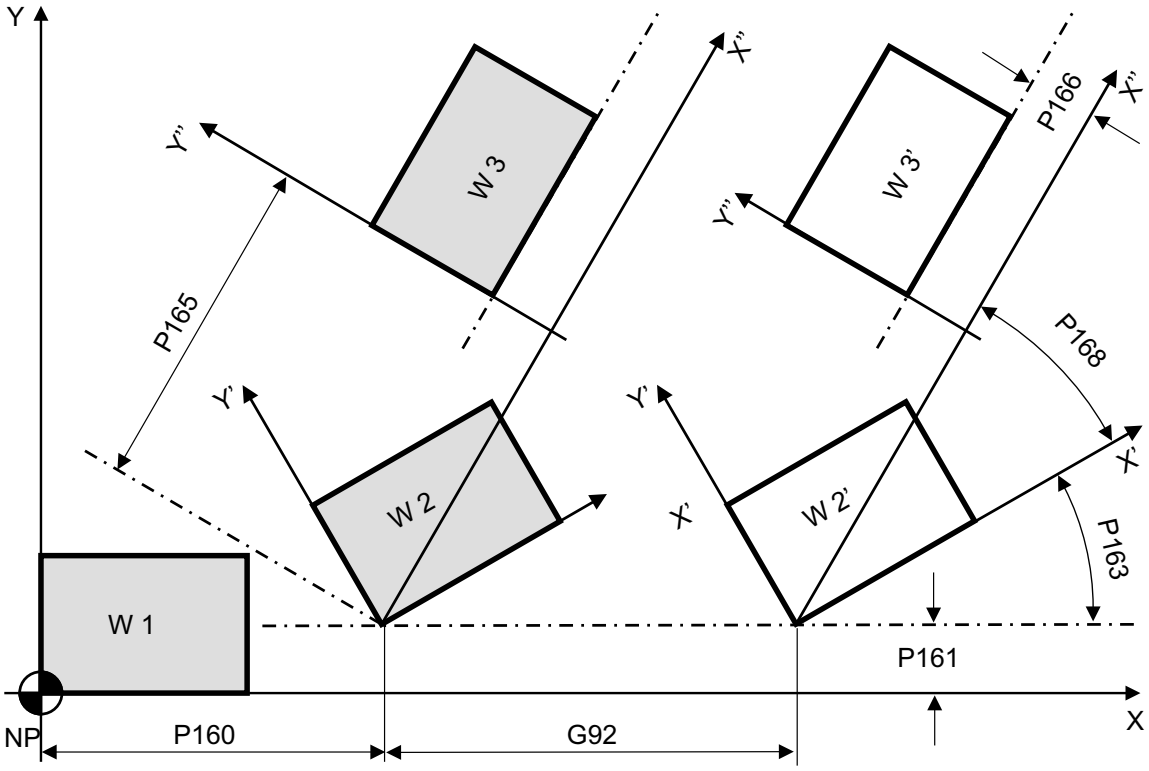



Fig. 4-25

## 4.16 G45 / G46 Turning of coordinates (continued)

**Example 5** rectangle figure turn with different brackets and shift by G92

P8859:0 first turn by G45 and then shift by G92

```
P451
N10        T1 M16 G0
N20        G55  G147  G0  F3000 X0   Y0  Z2        M28.452    {W 1}
N30  G45   P160:50  P161:10  P163:30  X0   Y0  Z2        M28.452    {W 2 turning}
N40        P165:50  P166:10  P168:30  X0   Y0  Z2        M28.452    {W 3 incremental turning}
N58  G92                              X60  Y0                        {shift}
N60  G45   P160:50  P161:10  P163:30  X10  Y5  Z2        M28.452    {W 2'' turning}
N70        P165:50  P166:10  P168:30  X0   Y0  Z2        M28.452    {W 3'' incremental turning}
N80  G46   G90                        X0   Y0  Z5
N90        M30
#
```

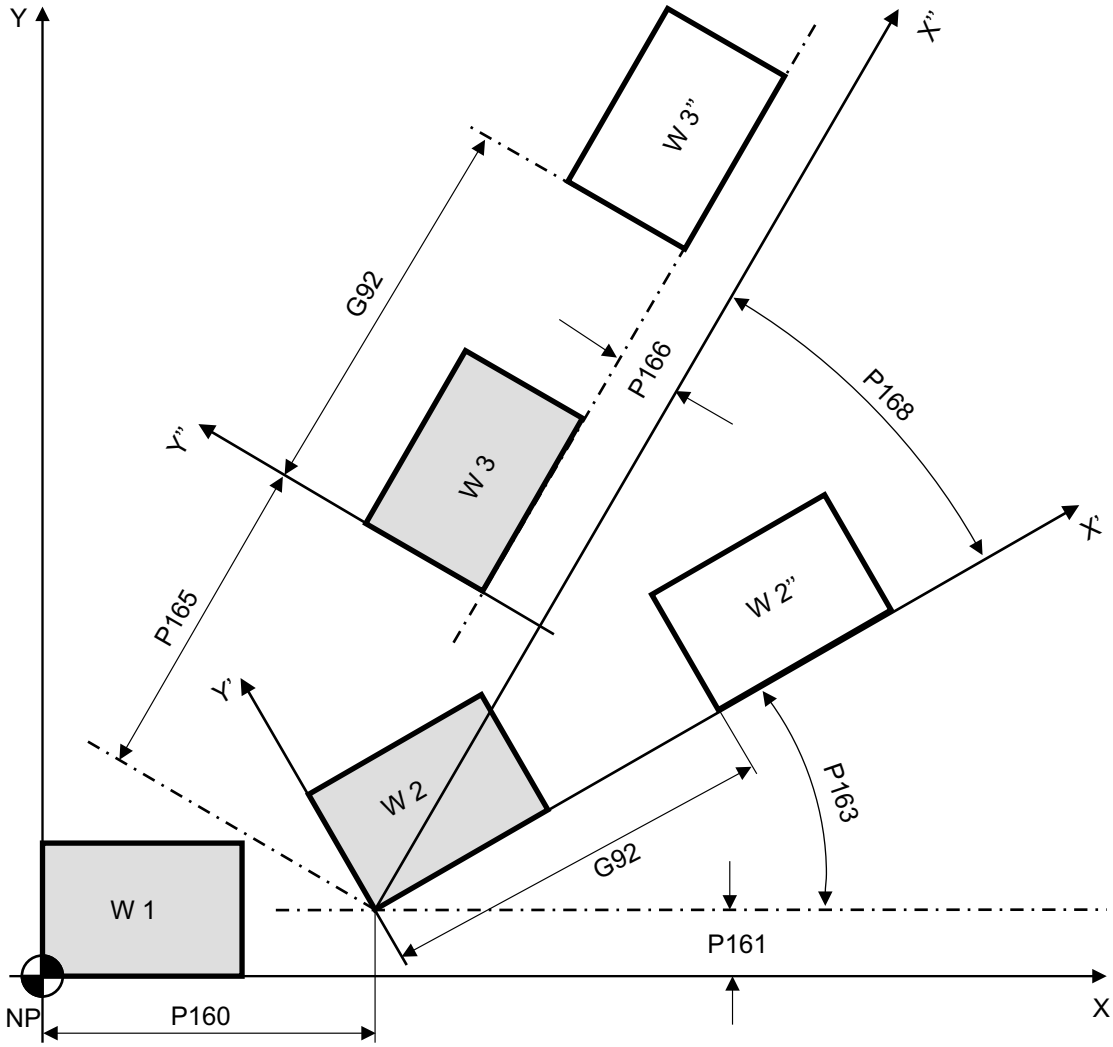



Fig. 4-26

## 4.17 G47 / G48 / G49 / 147 Robot transformation

It is advantageous for different applications, if the user can select the movements in different mode of coordinates when installing the machine (e.g. machine tool or handling system). With the BWO-ROBOT-system three modes of coordinates can be chosen.

### Machine coordinates G47

The general and most frequent case is, that the movement is refered to a machine coordinate system, Thereby the coordinate axes and an origin of coordinates are determined. The cartesian coordinates are used.

### Tool coordinates G48

If the movement is refered to the tool or a grip, infeed movements can be executed very simple for machining - or assembling tasks. In this case, the coordinates are oriented at the tool peak.

### Workpiece coordinates G49

Programming is facilitated for many machining functions, if the movement is refered to a coordinate system oriented at the workpiece.

Switching between the above named modes of coordinates (G47 / G48 / G49) is an essential help for the user at programming with Teach-in, because e.g. for establishing a NC-program the contours of a workpiece only have to be touched and stored (teached). If equal workpieces are processed in different positions, the same NC program can be used through a single transformation of the coordinates.

### Transformation off by G147

G147 switches the transformation off.

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

The coordinate system demands the following axis configuration:

The A - axis turns around an axis parallel to the X - axis.
The C - axis turns around an axis parallel to the Z - axis.
The spindle axis stands vertically on the A - axis.
The intersection of all three rotation axes is the center point M.
The positive rotating direction of C is seen from positive Z-direction in counter-clockwise direction.
The positive rotating direction of A is seen from positive X - direction in counter-clockwise direction.
The reference point offsets are to be determined, so that in position A = C = 0 the tool system is axis parrallel to the basic coordinate system.

| | |
|---|---|
| A. C | Angle |
| M | Center point |
| W | Tool loader dimension |
| L | Tool length |
| S | Tool peak |

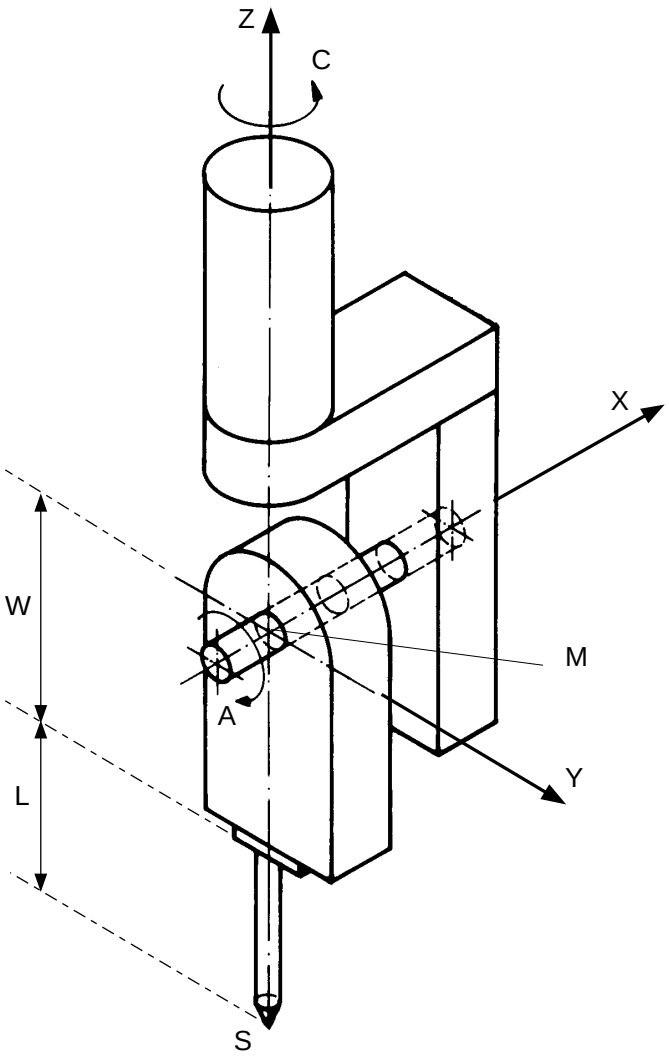



Figure 4-27 Axis configuration

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

### Machine coordinate system (G47)

At the machine coordinate system the coordinates refer to the machine origin.
Thereby the machine axes are defined in cartesian coordinates. The axis movements orientate to the axis coordinates.

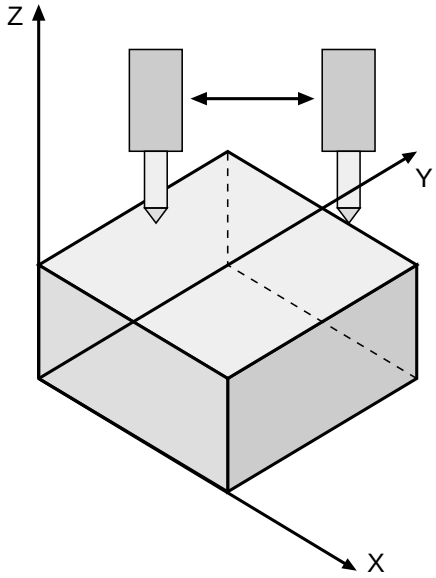



Figure 4-28 Axis movements in the machine coordinate system

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

### Tool cordinate system (G48)

At the tool coordinate system the coordinates refer to the tool. The cartesian coordinate system is only used with a firm unit of length (e.g. mm).

If the tool system is arbitrarily shifted and rotated through the NC program, the system must fulfill the following conditions.

The coordinate source is the point, around which the tool is turned, if its orientation is changed. This point is named tool peak.

At rotating tools the Z-axis is the rotation-axis and indicates from the tool peak into the direction of the chuck.

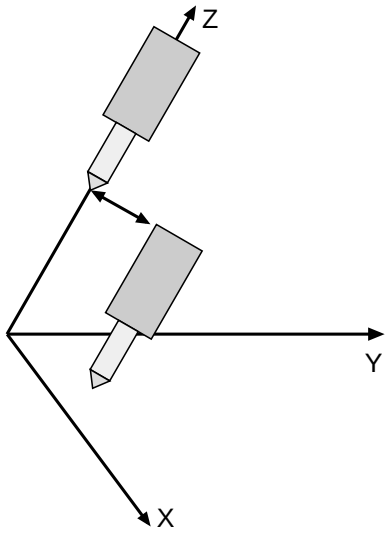



Figure 4-29 Axes movements in too coordinate system

The speed of the tool peak is interpreted as actual working feed.

When activating the tool dimensions the control shifts the tool coordinate system in the Z-direction for an amount corresponding to the tool length.

If the X -, Y - or Z- traverse direction is selected, the X -, Y - or Z - axis traverse according to the position of the rotating angle of the C-axis and the position of the tumbler angle of the A-axis, so that the tool stands always vertically on the X- Y- plane.

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

### Workpiece coordinate system (G49)

At the workpiece coordinate system the coordinates refer to the workpiece.
Only the cartesian coordinate system with a firm unit of length (e.g. mm) is used. The advantage of the workpiece system is, that it can be shifted and turned arbitrarily with the NC program.

For each point a coordinate vector can be allocated in reference to the workpiece system, for example:

- If for the linear axis the X -, Y - or Z- traverse direction is selected, the X -, Y - or Z - movement is parallel to the axes coordinates (independently of the position of the rotating angle of the C-axis and the tumbler angle of the A-axis).

- If only axis C is traversed, X and Y are relocated so that the tool peak is always at the same point. The X - and Y - axis describe a circle around this point. The orbit proceeds vertically under the center point.

- If axis A is traversed, additionally the Z - axis is moved in plus - or minus direction according to the tumbler angle position of A.

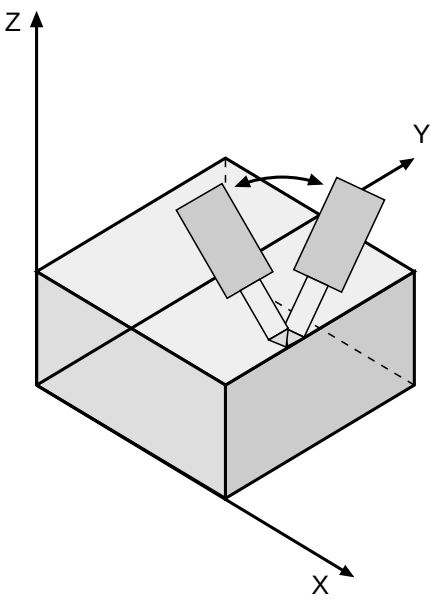



Figure 4-30 Axes movements in workpiece coordinate system

Appearing coordinate transformation when switching over between G47, G48, G49 determines the position and orientation of the tool relative to the workpiece reversable definitely.

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

### Offset functions

Sometimes it is necessary, that at the construction of the machine the point of balance does not correspond to the center point M. In this case, a function for compensating this deviation is necessary.

The system offers three offset functions. By using this function, the mechanical offset is corrected automatically.

Offset in X - direction

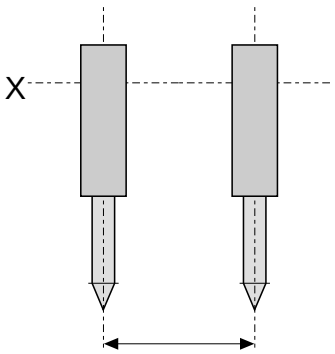



Figure 4-31 Offset in X - direction

Paramter P11802 is offset value [mm].

Offset in Y - direction

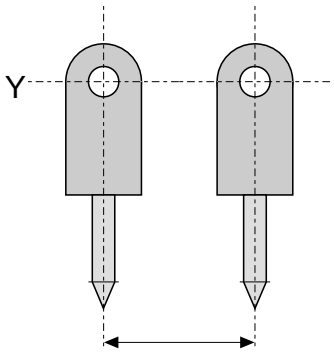



Figure 4-32 Offset in Y - direction

Paramter P11803 is offset value [mm].

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

Offset in Z - direction

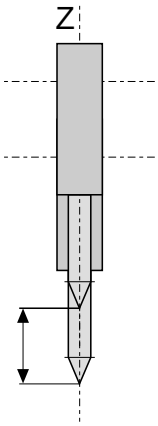



Figure 4-33 Offset in Z - direction

Paramter P11804 is offset value [mm].

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

### Tool carrier with oblique angled axes

The configuration of the tool carrier with oblique angled axes (in zero position) is shown in figure 4.24. The A - axis turns around an axis, which does not stand vertically on the rotation axis Z. That means, that the tilt is not parallel to the X - axis. The paramter P11806 is the tilt angle.

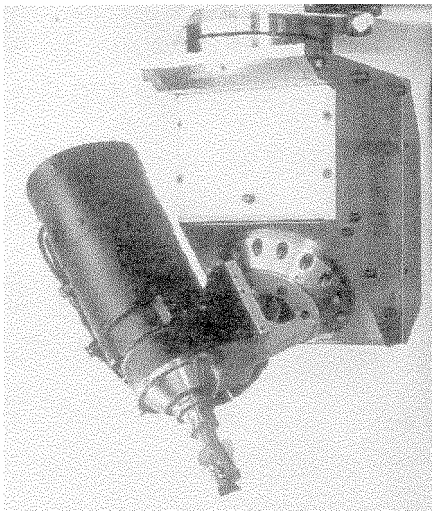


Figure 4-34 Tool carrier with oblique angled axes

### Value areas and handling

The parameter values used are limited in the following areas.

For the parameters P11802, P11804 and P11806 positive or negative values are possible.
The amount of P11806 must be smaller than 180 degrees.
If P11806 is = 0, the presetting is 90 degrees, namely $\xi$ = 90[degree]
If $\xi$ = 90[degree], $\alpha - \alpha 12 = 0$, $\beta - \beta 12 = 0$ and $\theta = 0$

The amount ($\beta$) is dependent on the areas of $\xi$.

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

P8759 Coordinate mode in Manual

| | |
|---|---|
| 0 | Transformation off |
| 15 | Polar transformation off |
| 16 | Polar transformation on |
| 47 | Robot transformaton off |
| 48 | Tool coordinate system |
| 49 | Workpiece coordinate system |

P11800 Robot linear axes (physical axis number)
e.g. the first 3 axes (X, Y, Z)
Byte 3,2,1 03 02 01 Hex
Byte 4 reverse (Bit 3, 2, 1)

P11801 Robot rotation axes (physical axis number)
e.g. the 4th and 5th axis (A, C)
Byte 3, 2, 1 00 05 04 Hex
Byte 4 reverse (Bit 3, 2, 1)

| | | |
|---|---|---|
| P11802 | Offset X, rotation axis - tool axis | [mm] |
| P11803 | Offset Y, rotation axis - tilt | [mm] |
| P11804 | Offset Z, length of tool carrier | [mm] |
| P11805 | Angle between tilt - tool axis | [degree] |
| P11806 | Angle between rotation axis - tilt | [degree] |
| P11807 | Angle where the tool shows downwards | [degree] |

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

### Zero points

The Robot system is given through a block of coordinates, which indicates its position in reference to the machine system. The zero point system G54 to G59 is analogously valid in the Robot system. The zero point indicates the position in reference to the machine system, i.e. the position of the tool is in reference to the workpiece. It can be filed in a zero point memory and is activated by calling up G54 to G59.

The functions G54 to G59 overwrite mutually. Besides they overwrite a shift effective through G92.

### Zero point shift

The Robot system can be shifted and turned again in the NC program. The position of the shifted system relative to the old one is given through a block of coordinates. Calling up results through the zero point shift G92. This position of G92 is the reference to the actual zero point coordinates. In manual mode this zero point shift is not disposable.

The position of the tool in the machine system is given through 3 blocks of coordinates

- Zero point coordinates

- Zero point shift

- Coordinates of the position

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

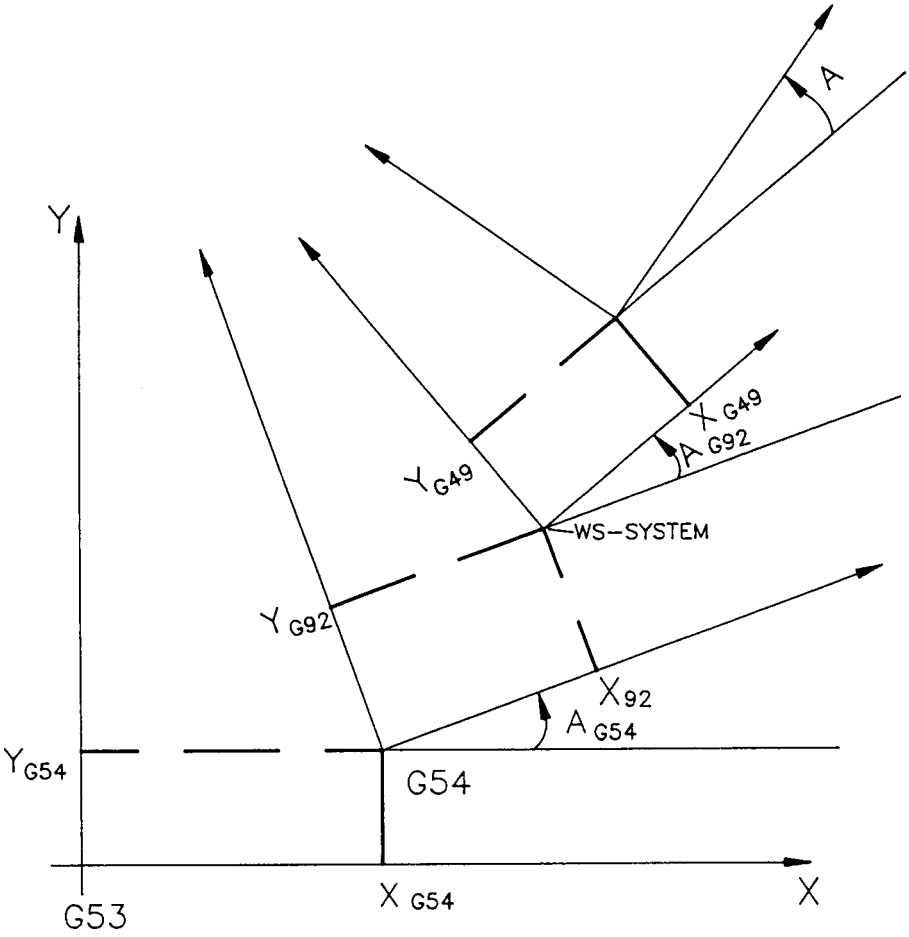



Figure 4-35 Zero point shift

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

Denomination of the 3 axes, e.g. tilt B, linear axes X and Z.

With 3-axes-tool machines, G49 is controlling the axes so that when moving the tilt B, the axes X and Z are always so that the tool peak is always at the same position.

### Configuration and definition for the 3-axes-coordinate system

The 3-axes-coordinate system demands the following axis layout:

- X and Z axis are the basic coordinates.

- The B axis is rotating around an axis that is positioned vertically to the plane XZ.

- The positive rotating direction of B is seen from positive X direction counter-clockwise.

- The reference measures are termined so that the tool system is axis-parallell to the basic coordinates in position B=0.

- The offset between the tool peak and the rotating point is determined by the parameters P11802 (offset radius) and P11803 (offset angle).

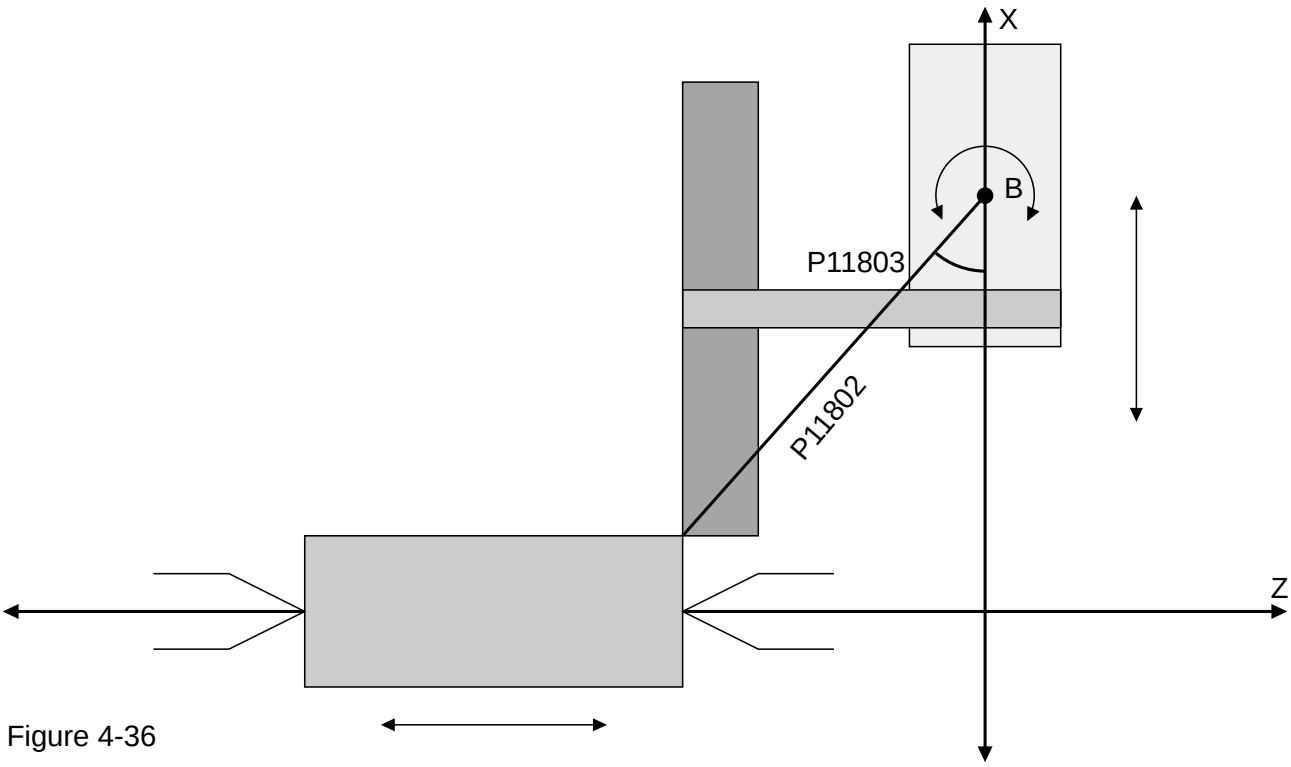



Figure 4-36

## 4.17 G47 / G48 / G49 / 147 Robot transformation (continued)

### Used parameters

P11800 Linear axes(physical axis number)

e.g. the first 2 axes (X,Z)
Byte 3, 2, 1 00 02 01 Hex
Byte 4 reverse (Bit 2, 1)

P11801 Rotation axes (physical axis number)

e.g. the 3rd axis (B)
Byte 3, 2, 1 00 00 03 Hex
Byte 4 reverse (Bit 1)

P11802 Offset radius, tilt - tool peak [mm]

P11803 Offset angle, tilt - tool peak [degree]

## 4.18 G50 / G51 / G52 Spline interpolation

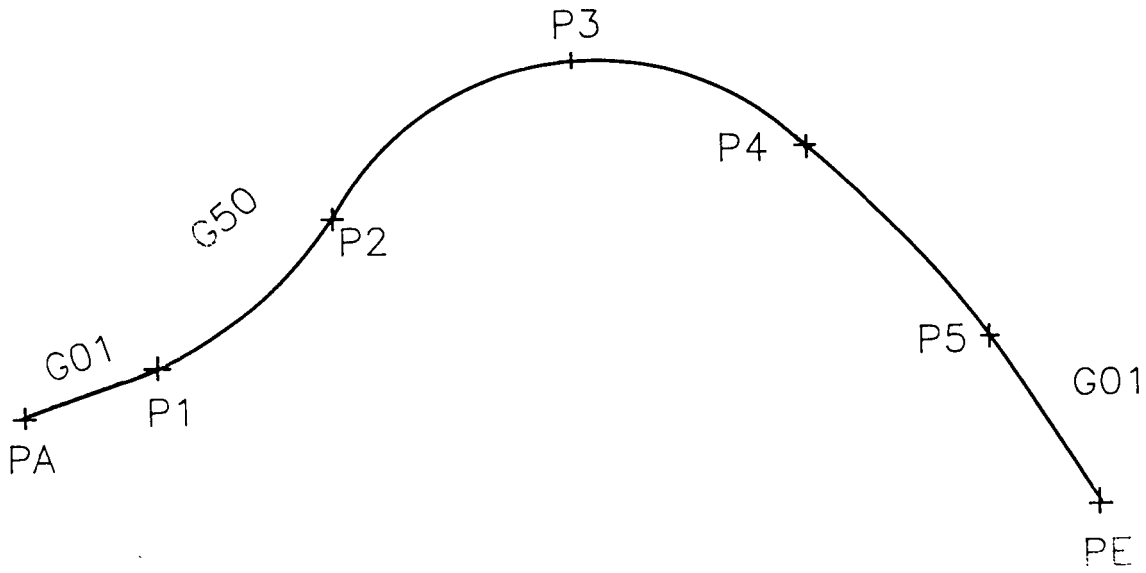
**G50** **Spline interpolation**
**G51** **Spline interpolation with feed adaptation at the contour**
**G52** **Polynom interpolation**

### G50 / G51 Spline interpolation

A sequence of points can be joined tangentially with a smooth curve trace with the spline interpolation. The points can be entered both as NC program as well as in the manual operation mode through „Teaching“ with command=target.

The spline curve is started through a traverse, which is run with G00 or G01. The start can also be with G02 or G03, if the starting position is in a main plane (G17, G18, G19).

The spline interpolation is activated in the subsequent block through G50 / G51. There results a tangential transition, whereby the starting tangent of the spline curve is determined through the starting segment.




| | |
|---|---|
| PA | Starting point |
| PE | End point |
| P1...P5 | Spline points |

Figure 4-37

## 4.18 G50 / G51 / G52 Spline interpolation (continued)

In the corresponding way the spline curve is finished through programming the @@Ausleitungs-segment with G00, G01, G02 or G03.
The traverse conditions G00, G01, G02, G03 and G50 overwrite themselves mutually.

If the starting segment or the finishing segment are not programmed, the NC program stands still, because the spline interpolation can not be started or finished duly. In this case, the key 'Manaul' has to be pressed and the error has to be cleared.

### G52 Polynom interpolation

The path a is described with the formula $\vec{P} = \vec{V}_3\ t^3 + \vec{V}_2\ t^2 + \vec{V}_1\ t^1 + \vec{V}_0$ ,

whereby the variable t can have a value between 0 and 1.

The vectors $V_3$, $V_2$, $V_1$ are programmed in components in the following form:

X : [ $V_{3X}$, $V_{2X}$, $V_{1X}$ ]  Y : [ $V_{3Y}$, $V_{2Y}$, $V_{1Y}$ ]  Z : [ $V_{3Z}$, $V_{2Z}$, $V_{1Z}$ ]

$V_0$ is not programmed, since it is the location of the machine at the beginning of the block.

Starting point $\vec{P}_S = \vec{V}_0$

Final point $\vec{P}_E = \vec{V}_3 + \vec{V}_2 + \vec{V}_1 + \vec{V}_0$

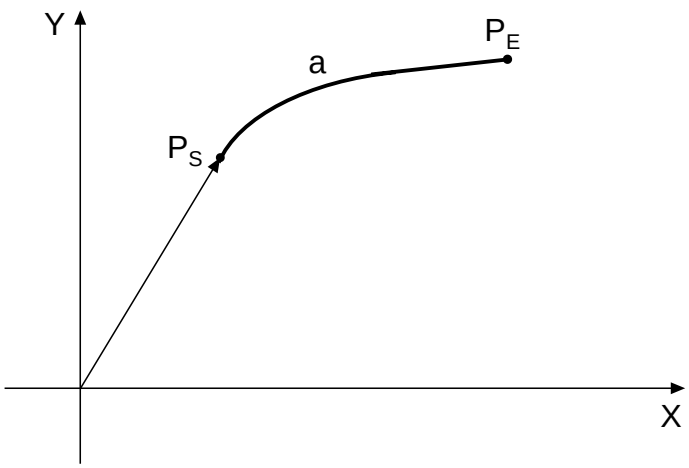
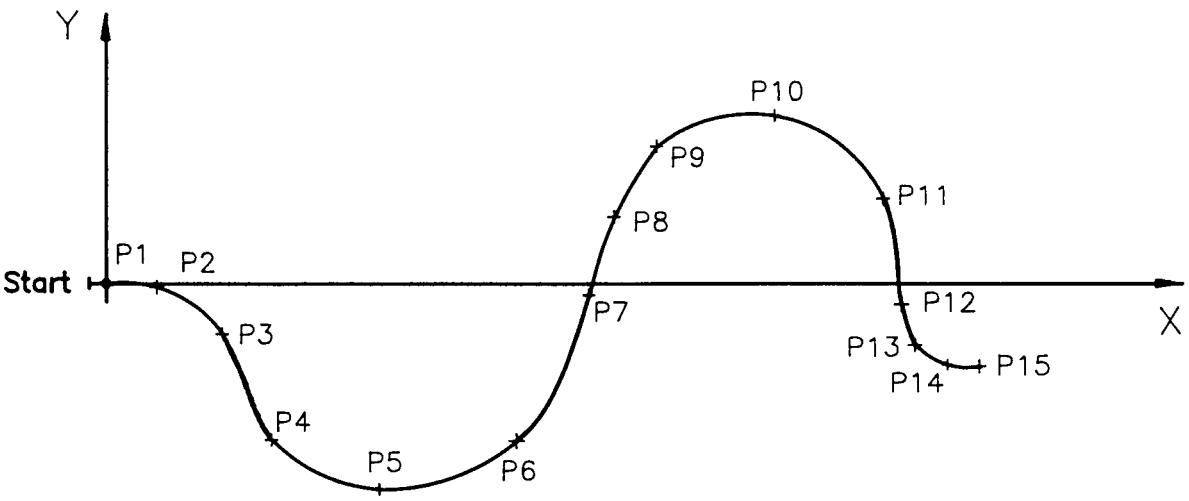



Figure 4-38

## 4.18 G50 / G51 / G52 Programming examples

### Spline contour

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N5 | G54 | G49 | G00 | F2000 | X - 8 | Y0 | Z5 | | Starting point |
| N10 | G01 | | | | X0 | Y0 | Z0 | point 1 | |
| N20 | G50 | | | | X6,8 | Y-0,5 | | point 2 | Spline on |
| N30 | | | | | X15,5 | Y-6,7 | | point 3 | |
| N40 | | | | | X22 | Y-20,6 | | point 4 | |
| N50 | | | | | X36,3 | Y-27,1 | | point 5 | |
| N60 | | | | | X54,3 | Y-20,7 | | point 6 | |
| N70 | | | | | X63,8 | Y-1,5 | | point 7 | |
| N80 | | | | | X67,124 | Y8,749 | | point 8 | |
| N90 | | | | | X72,7 | Y18 | | point 9 | |
| N100 | | | | | X88,1 | Y22 | | point 10 | |
| N110 | | | | | X102,5 | Y11,1 | | point 11 | |
| N120 | | | | | X104,9 | Y-2,8 | | point 12 | |
| N130 | | | | | X106,7 | Y-8,1 | | point 13 | |
| N140 | | | | | X111 | Y-10,7 | | point 14 | |
| N150 | G01 | | | | X115,2 | Y-10,9 | | point 15 | Spline off |
| N160 | M30 | | | | | | Z5 | | |




| | |
|---|---|
| Point 1 | Zero point |
| Point 2 | Switching on spline interpolation |
| Points 3 - 14 | Spline points |
| Point 15 | Switching off of spline interpolation |

Figure 4-39

## 4.19 G53 Machine zero point

With the input of G53 with G54 to G59 as well as with G92 programmed zero point shifts become ineffective. The program refers then to the machine zero point.

The function is effective modal and can be overwritten by G54 to G59.
With the program start G53 is automatically adjusted.

G153 switches the zero shift off G53 as well as G54 to G59.

## 4.20 G 54 to G59 Zero points

With G54 to G59 points of zero can be called within the program.

The functions are effective modal and overwrite themselves opposite-acting. Additionally one is reset by G92 programmed shift.

The points of zero are called in the program with G54 to G59 in the null point memory. The size of the zero shift is determined by the stored values in the null point table.

Example: programming zero points

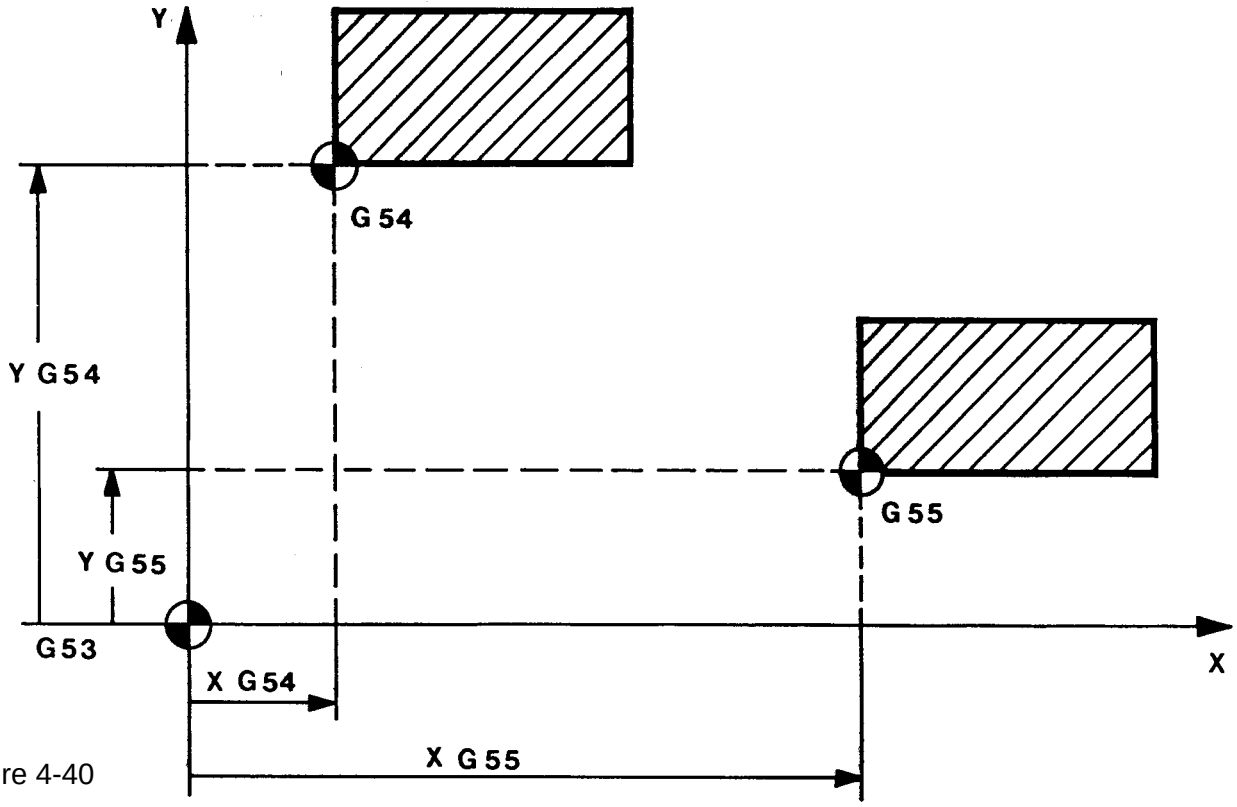



Figure 4-40

## 4.21 G60 / G61 / G62 Mirror imaging of coordinates

The mirror imaging function inverts the sign of programmed coordinates.
The G61 function inverts the sign of the 1st main axis program values.
The G62 function inverts the sign of the 2nd main axis program values.

| Set plane | G61 | G62 |
|---|---|---|
| G17 (XY) | X becomes -X | Y becomes -Y |
| G18 (ZX) | Z becomes -Z | X becomes -X |
| G19 (YZ) | Y becomes -Y | Z becomes -Z |

G60 cancels the mirror imaging functions G61 and G62 out. G60, G61 and G62 act modally.

### Geometric definition

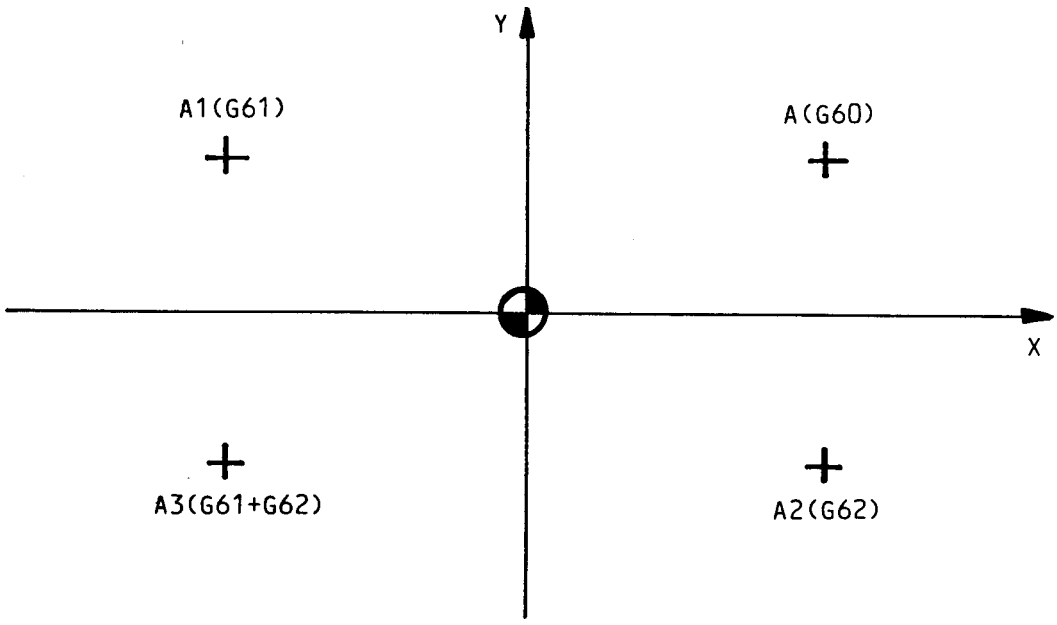



Figure 4-33

The programmed coordinates for point A are Xa and Ya.

When G61 is switched on point A becomes point A1 with -Xa and Ya.
When G62 is switched on point A becomes point A2 with Xa and -Ya.
When G61 and G62 are switched on point A becomes point A3 with -Xa and -Ya.

## 4.21 G60 / G61 / G62 Mirror imaging of coordinates (continued)

### Circle centre point coordinates I, J, K

The circle centre point coordinates are mirror imaged according to the plane and functions set.

### Zero points G53 to G59

Zero points G53 to G59 are not mirror-imaged.

### Shift G92

The values of shift G92 are mirror imaged according to the appropriate plane and functions set.

### Circular interpolation G02 and G03

When circular interpolation is switched on and G61 and G62 are active, G02 becomes G03 and G03 becomes G02. The direction of rotation remains unchanged when G61 and G62 are switched on.

### Tool correction offset G41 and G42

When the tool correction offset is switched on and G61 and G62 are active, G41 becomes G42 and G42 becomes G41. The selected correction offset remains unchanged when G61 and G62 are switched on.

### Effect of G66

G66 effects the block by block switching off of the mirror-imaging functions G61 and G62.

### Incremental dimension programming G91

Using G91, the target point in the system that has not been mirror-imaged is firstly determined and is then mirror-imaged according to the appropriate plane and mirror-imaging functions set.

## 4.22 G63 / G64 „Feed rate 100%“

### G63 Override 100% switch on

With G63 the Override value is set firmly to 100%, i.e. the override is not active any longer. NC program processing runs with the programmed feed.

The function is modal effectively and can by G64 again be switched off.

### G64 Override 100% switch off

G64 switches G63 out

The function is modal effectively and can by G63 be overwritten.

With the program start G64 is preset.

## 4.23 G66 Switching off all correction offsets

When programming G66, the machine zero point is taken as the reference point. All dimension inputs then refer to the machine zero point.

The G66 function is effective only in the block in which it was written.

In this particular block the zero points set by G54 to G59 and shift G92 are inoperative, as are any tool length and tool radius correction offsets.
They remain stored, however, and are effective in the next block again.

## 4.24 G90 Absolute dimension input

When G90 is being programmed absolute dimension input is chosen, i.e. all dimensions are referred to the program zero point (programmable using G54 to G59 and G92).

G90 operates modally and can be overwritten by G91. G90 is automatically set when the control system is switched on.

Example: Absolute dimension input

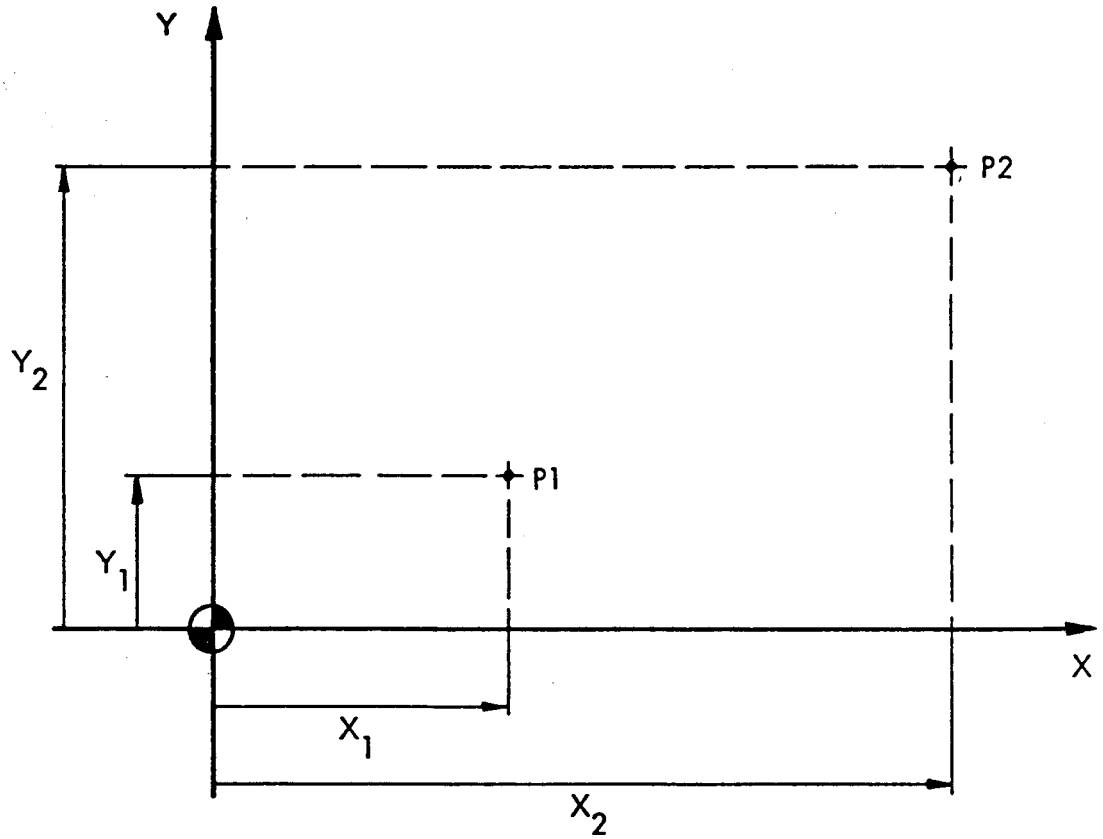



Figure 4-34

## 4.25 G91 Incremental dimension input

With the programming of G91 the chain measure input is selected. It always refers to the location of the axes started last.

G91 is modal effectively and can by G90 be overwritten.

Example: Incremental dimension input

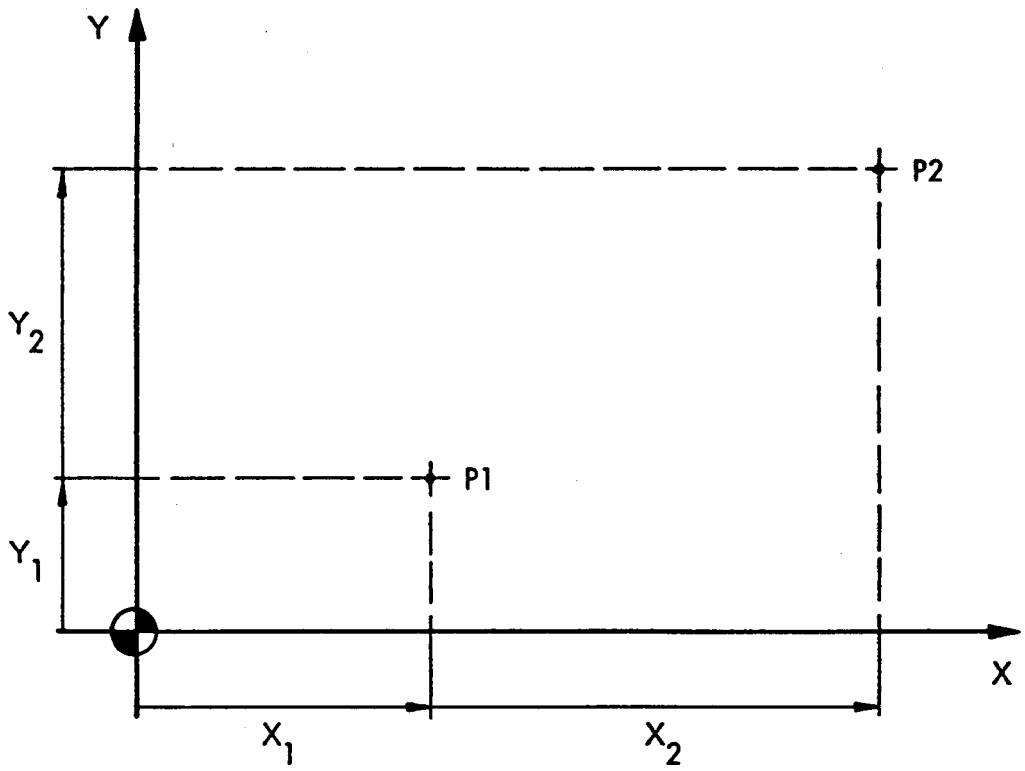



Figure 4-35

## 4.26 G92 Zero point shift

Zero point shifs programmed by G92 are a fixed part of the NC program and therefore independent of the clamping of the workpiece. In contrast, zero points are programmed outside the NC program by G54 to G59 and activated in the NC program.

Traverse information in the block with G92 determines the zero point shift, but no traverse is activated.

Input: G92 X... Y... Z...

The zero point is shifted by the programmed amounts.

The zero point shift programmed by G92 operates modally and is always referred absolutely to the machine zero point (G53) or to a set zero point (G54 to G59).
G92 can be cleared by G53 to G59 or overwritten by a new G92.

Example: Zero point shift

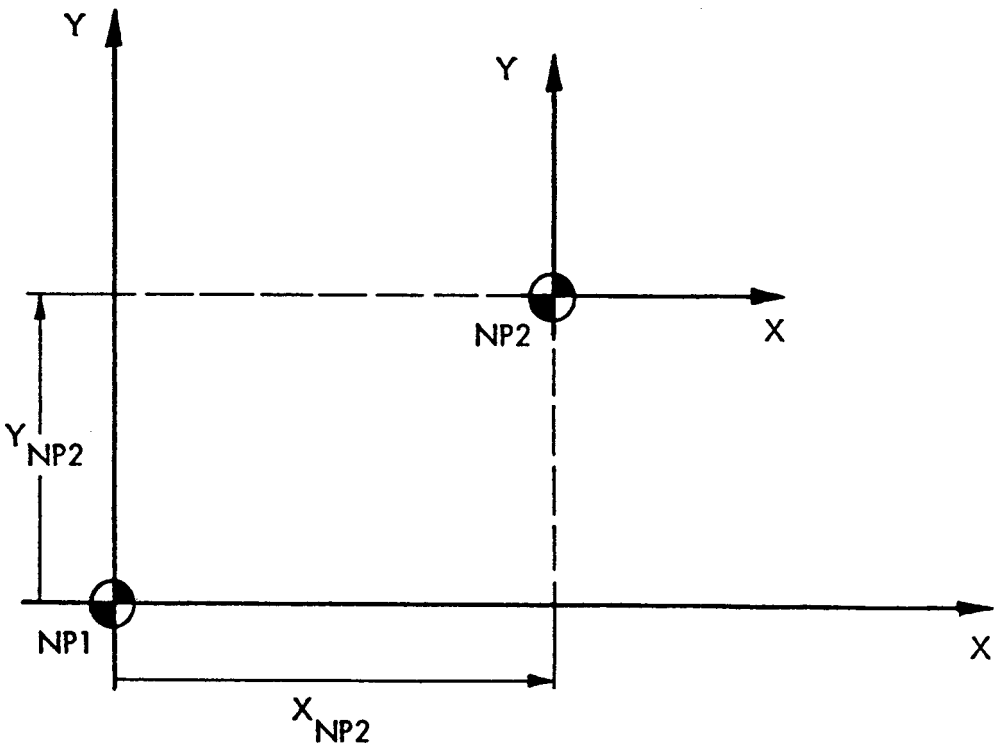



Figure 4-36

## 4.27 G94 / G95 Feed modification

The functions determine the feed modifications:

**G94 Feed in mm/min**

**G95 Feed in mm/r (revolution)**

## 4.28 G96 / G97 Number of revolution modification

The functions define the speed modifications:

**G96** **constant cutting velocity in mm/min**

**G97** **speed in U/min**

In order to activate G96 / G97, the following parameters must be set:

P11640 spindle affects axis (physical axis)
(example round axis C corresponds the 6. Axis Input P11640:6)

P11641 datum axis for G96 (physical axis)
(example procedure axis Y corresponds the 2. Axis Input P11641:2)
If P11641 = 0 applies, then the reference position in P11642.

P11642 reference position for G96 [ mm ]
(e.g.: disk diameters)

P11643 reference factor for G96 [ mm/min ]
0 or — mm/min
1000 m/min

P11644 max. speed for G96

P11645 max. speed for G97

P11646 reference factor for G97 [ U/min ]
0 or — U/min
1 degree/min

P11647 speed definition G96 / G97
Presetting 0 = G97
96 = G96

## 4.28 G96 / G97 Number of revolution modification (continuation)

In the display selection menu the inputs under „ spindle parameters „ can be input.

Spindle axis: 6
Datum axis: 2

Example NC Progr.:

N10 G0 Y:50
N20 G96 G1 F50 S100 Y:0
The speed of the round axis increases the more,
the more near processing toward the position Y:0 comes.

N10 G0 Y:0
N20 G96 G1 F50 S100 Y:50
The speed of the round axis decreases itself the more,
the more near processing toward the position Y:50 comes.

## 4.29 G99 End feed, traverse dependant feed adaptation

The starting feed is the value programmed under ‘F’, the end feed is written in P608.
This parameter has to be programmed at the latest in the block in which G99 is to be found.

# 5. Cycles

## 5.1 G69 measuring cycles

### General

The measuring cycle is a NC program with the term Z69. This cycle must like all other cycles into the NC memory be loaded. The measuring cycle is called with G69.

Measuring cycles use the parameters P140 to P160 for programming. These parameters contain two types of information:

- Data, e.g.. P141 safety margin

- Parameter numbers, which indicate, where the data are stored,
  e.g.. P149: 500 (P149 is a pointer on another parameter).

Measuring cycles use the parameters P200 to P299 for internal calculations.
Parts it safely that only free parameters are used for the addressing of data fields.
Measuring cycles activate G40 (tool radius path correction out).

## 5.1 G69 measuring cycles (continued)

### Measuring preparation

- Connecting it the sensor with the measuring input on the AAZ module (15pol. HD Sub Socket). If the measuring axes are distributed on several modules, all interconnect you Measuring inputs together (MT+ / MT-).

- Checking it the measuring logic for each measuring axis (P12045: $xxxx1010...).

- Checking it the tool data of the used sensor. G69 requires tool length and tool radius of the sensor.

## 5.1 G69 measuring cycles (continued)

### Compilation of the cycle parameters

| Parameter | | meaning |
|---|---|---|
| P140 | | cycle selection |
| P141 | [ mm ] | safety margin |
| P143 | [ mm/min ] | measuring speed |
| P144 | [ n ] | number of measurements at the same point (> 0) |
| P147 | | pointer on the measuring tolerance data |
| (P147)+4 | [ mm ] | confidence range |
| P148 | | measuring axis in plane system (1... 3) |
| P149 | | pointer on the data of point of trigger |
| (P149)+0 | [ mm ] | XN, point of trigger in negative direction 1. axis |
| (P149)+1 | [ mm ] | XP, point of trigger in positive direction 1. axis |
| (P149)+2 | [ mm ] | YN, point of trigger in negative direction 2. axis |
| (P149)+3 | [ mm ] | YP, point of trigger in positive direction 2. axis |
| (P149)+4 | [ mm ] | ZN, point of trigger in negative direction 3. axis |
| (P149)+5 | [ mm ] | ZP, point of trigger in positive direction 3. axis |
| P150 | | pointer on the calibration drilling data |
| (P150)+0 | [ mm ] | position of the calibration drilling focal point 1. axis (I) |
| (P150)+1 | [ mm ] | position of the calibration drilling focal point 2. axis (J) |
| (P150)+2 | [ mm ] | position of the calibration drilling focal point 3. axis (K) |
| (P150)+3 | [ mm ] | calibration drilling diameter |
| P152 | [ mm ] | expected drilling diameter |
| P154 | | pointer on the measuring data |
| (P154)+0 | [ mm ] | measuring position 1. axis |
| (P154)+1 | [ mm ] | measuring position 2. axis |
| (P154)+2 | [ mm ] | measuring position 3. axis |

## 5.1 G69 measuring cycles (continued)

| Cycle | Parameter | Calibrate of the sensor in drilling | Calibrate of the sensor at area | Determining of centre a drilling | Determining of positions at area |
|---|---|---|---|---|---|
| Cycle selection | P140 | 1 | 2 | 60 | 40 |
| Safety margin | P141 | x | x | x | x |
| Measuring speed | P143 | x | x | x | x |
| Number of measurem. | P144 | x | x | x | x |
| Measuring tolerance | P147 | x | x | x | x |
| Confidence range | (P147)+4 | x | x | x | x |
| Measuring axis in plane | P148 | | | | x |
| Data of point of trigger | P149 | x | x | x | x |
| Point of trigger XN | (P149)+0 | o | | x | x |
| Point of trigger XP | (P149)+1 | o | | x | x |
| Point of trigger YN | (P149)+2 | o | | x | x |
| Point of trigger YP | (P149)+3 | o | | x | x |
| Point of trigger ZN | (P149)+4 | | | | |
| Point of trigger ZP | (P149)+5 | | o | | x |
| Calibration drilling data | P150 | x | | | |
| Centre position 1.axis I | (P150)+0 | x** | x* | | |
| Centre position 1.axis J | (P150)+1 | x** | x* | | |
| Centre position 1.axis K | (P150)+2 | x** | x* | | |
| Drilling diameter | (P150)+3 | x | | | |
| Expected diameter | P152 | | | x | |
| Output data of the pos. | P154 | | | x | x |
| Measuring pos. 1. axis | (P154)+0 | | | o** | o* |
| Measuring pos. 2. axis | (P154)+1 | | | o** | o* |
| Measuring pos. 3. axis | (P154)+2 | | | o** | o* |

x: Parameter must be programmed
o: cycle edition

* : one of these
**: two of these

## 5.1 G69 measuring cycles (continued)

| Message | Meaning |
|---|---|
| 8130 | uppersize |
| 8131 | undersize |
| 8132 | permissible measure difference exceeded |
| 8133 | confidence range exceeded |
| 8134 | reference drilling smaller than sensor |
| 8135 | boring axis is measuring axis |
| 8136 | sensor cannot be initiated |
| 8137 | P140 incorrectly programs |
| 8138 | P141 incorrectly programs |
| 8139 | P142 incorrectly programs |
| 8140 | P143 incorrectly programs |
| 8141 | P144 incorrectly programs |
| 8142 | P145/147/149/150 incorrectly programs |
| 8143 | empirical value incorrectly programs |
| 8144 | P146 incorrectly programs |
| 8145 | measuring tolerance 1 incorrectly programs |
| 8146 | measuring tolerance 2 incorrectly programs |
| 8147 | measuring tolerance 3 incorrectly programs |
| 8148 | measuring tolerance 4 incorrectly programs |
| 8149 | measuring tolerance 5 incorrectly programs |
| 8150 | P148 incorrectly programs |
| 8151 | point of trigger XN incorrectly programs |
| 8152 | point of trigger XP incorrectly programs |
| 8153 | point of trigger YN incorrectly programs |
| 8154 | point of trigger YP incorrectly programs |
| 8155 | point of trigger ZN incorrectly programs |
| 8156 | point of trigger ZP incorrectly programs |

## 5.1 G69 measuring cycles (continued)

| Message | Meaning |
|---|---|
| 8157 | point of drilling I incorrectly programs |
| 8158 | point of drilling J incorrectly programs |
| 8159 | point of drilling K incorrectly programs |
| 8160 | point of drilling R incorrectly programs |
| 8161 | P151 incorrectly programs |
| 8162 | P152 incorrectly programs |
| 8163 | P153 incorrectly programs |
| 8164 | tool not called |
| 8165 | G53 not actively |
| 8166 | G54 to G59 not actively |
| 8167 | sensor actively outside of the safety area |
| 8168 | P154 incorrectly programs |

## 5.1 G69 measuring cycles (continued)

### Calibration of the sensor in drilling G69 P140:1

The cycle requires a calibration drilling and a sensor. Measuring is executed with the two axes of the selected interpolation plane.

The sensor must be pre-positioned first on the drilling centre point in the selected interpolation plane and the sensor ball within the drilling.

If for example G17 is defined, the centre point of the calibration drilling must in (P150)+0 and (P150)+1 and the diameter in (P150)+3 to be defined.

The cycle positions first the 1. and 2. axis in the interpolation plane to the programmed centre point of the drilling. Now the cycle moves the 1. axis in positive direction to the drilling edge. The axis starts with the feed of the NC program and reduces the feed to F:p143 at the distance of P141 (safety margin) before the expected drilling edge. If a measuring signal before the safety margin occurs, a message is output (M8167).

From the safety margin the cycle moves the axis to the expected drilling edge plus confidence interval. If there is still no signal, a message (M8136) appears.

If there is a signal of the sensor, immediately the axis movement stops and the cycle calculates the point of trigger of the sensor and writes it in (P149)+n (axis movement positively: Point of trigger negatively).

If P144 is > 1, the cycle returns to the safety margin. From here the cycle starts a new measuring movement to the same drilling edge. Afterwards the cycle looks the other side up of the drilling. Become subsequently, the movements with the 2. Axis executed.

If the cycle is finished, then is the data field (P149)+n with the points of trigger of the sensor described. Following measuring cycles can operate with these data. The position of the moved axes now is in the center of the drilling.

Parts it safely,
- that the tool radius of the sensor is correct (P8160).
- to operate in the null point, in which the parameter data (P150) apply.

## 5.1 G69 measuring cycles (continued)

**Example: The calibration of the sensor in drilling G69 P140:1**

```
N20     T1   M16
N30     G17 G53  G0   X600.000  Y300.000  Z280.000  A0   B0
N40     G1   Z270     F3000

N100                                                {Cycle G69 / 1 initialize }
N110    P140:1                                      {Cycle type}
N120    P141:3                                      {Safety margin }
N130    P143:100                                    {Measuring speed }
N140    P144:2                                      {Number of the measurements }
N150    P147:500                                    {Pointer on tolerance data }
N160    P504:5                                      {Confidence range }
N170    P149:510                                    {Pointer on trigger data }
N180    P150:520                                    {Pointer on measuring data }
N182    P520:624.96    P521:324.3     P523:54       {I, J, D }
N230    G69                                         {Cycle call }

N240    G0   Z280      M30
```

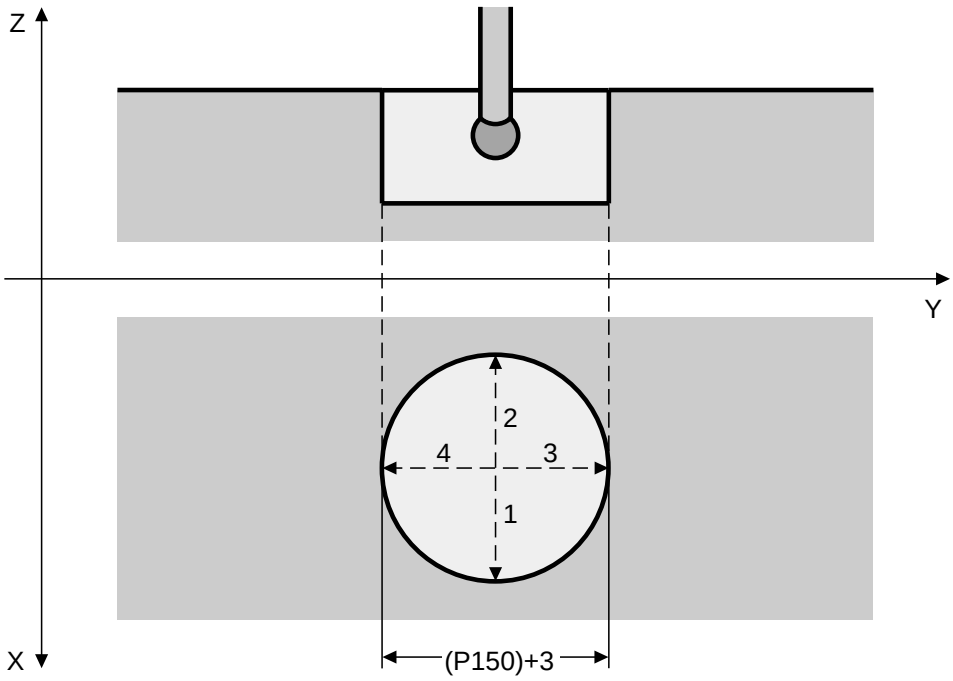



Figure 5-1

## 5.1 G69 measuring cycles (continued)

**Calibration of the sensor at area G69 P140:2**

The cycle requires a calibrationing area and a sensor. Measuring becomes with the 3. axis of the selected interpolation plane executed (definition of G17...).
The sensor must be pre-positioned on the calibrationing area.

If for example G17 is defined, the position on the calibrationing area must in (P150)+2 to be defined.

The cycle moves now 3. axis toward the calibrationing area. The axis starts with the feed of the NC program and reduces the feed to F:p143 at the distance of P141 (safety margin) before the expected area. If a measuring signal before the safety margin occurs, a message is output (M8167).

From the safety margin the cycle moves the axis to the expected area plus confidence interval. If there is still no signal, a message (M8136) appears.

If there is a signal of the sensor, immediately the axis movement stops and the cycle calculates the point of trigger of the sensor and writes it in (P149)+n (axis movement positively: Point of trigger negatively).

If P144 is > 1, the cycle turns back to the safety margin. From here the cycle starts a new measuring movement to the same area.

If the cycle is finished, then is the data field (P149)+n with the points of trigger of the sensor described. Following measuring cycles can operate with these data. The position of the moved axis now is in the safety margin.

Parts it safely,
- that the tool radius of the sensor is correct (P8160, P8162).
- to operate in the null point, in which the parameter data (P150) apply.

## 5.1 G69 measuring cycles (continued)

**Example: The calibration of the sensor in drilling G69 P140:2**

```
N20     T1   M16
N30     G17 G53  G0   X600.000  Y300.000  Z280.000  A0   B0
N40     G1   Z270     F3000

N100                                                {Cycle G69 / 2 initialize }
N110    P140:2                                      {Cycle type}
N120    P141:3                                      {Safety margin }
N130    P143:100                                    {Measuring speed }
N140    P144:2                                      {Number of the measurements }
N150    P147:500                                    {Pointer on tolerance data }
N160    P504:5                                      {Confidence range }
N170    P149:510                                    {Pointer on trigger data }
N180    P150:520                                    {Pointer on measuring data }
N182    P522:260.20                                 {K }
N230    G69                                         {Cycle call }

N240    G0   Z280     M30
```

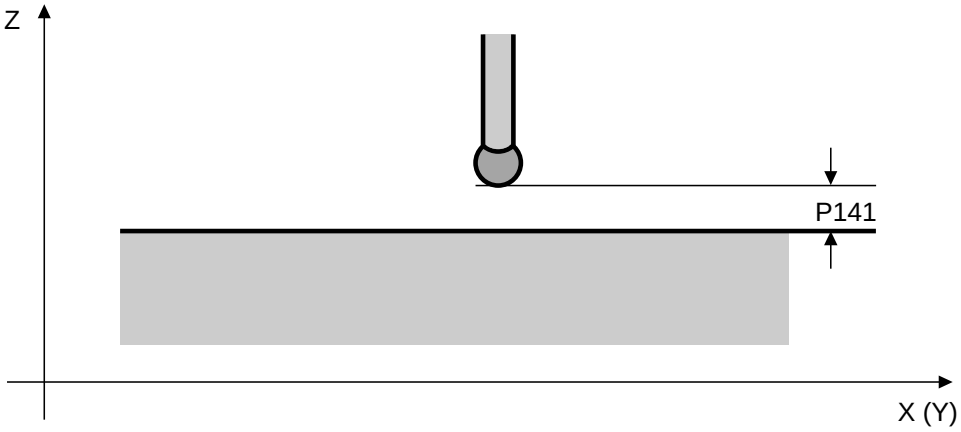



Figure 5-2

## 5.1 G69 measuring cycles (continued)

**Determining the center of a drilling G69 P140:60**

The measurement is executed with both axes of the selected interpolation plane (see G17...). The sensor should be at the beginning approximately on the drilling centre point in the selected interpolation plane and the sensor ball within the drilling pre-positioned.

The cycle moves the 1. axis in positive direction to the drilling edge. The axis starts with the feed of the NC program and reduces the feed to F:p143 at the distance
(diameters / 2 - safety margin) = (P152 / 2 - P141).

If a measuring signal before this point occurs, a message is output (M8167).

From here the cycle moves the axis to the expected drilling edge plus confidence interval. If there is still no signal, a message (M8136) appears.

If there is a signal of the sensor, immediately the axis movement stops and the cycle calculates the edge position.

If P144 is > 1, the cycle turns back to the safety margin. From here the cycle starts a new measuring movement to the same drilling edge. Afterwards the cycle looks the other side up of the drilling. Now become the movements with the 2. axis made.

If the cycle is finished, then is the data field (P154)+n with the drilling centre point described. The position of the moved axes now is in the center of the drilling.

Parts it safely that the tool radius of the sensor is correct (P8161, P8163).

## 5.1 G69 measuring cycles (continued)

**Example: The calibration of the sensor in drilling G69 P140:60**

```
N20     T1   M16
N30     G17 G53  G0   X600.000  Y300.000  Z280.000  A0   B0
N40     G1   Z270     F3000

N100                                                {Cycle G69 / 60 initialize }
N110    P140:60                                     {Cycle type}
N120    P141:3                                      {Safety margin }
N130    P143:100                                    {Measuring speed }
N140    P144:2                                      {Number of the measurements }
N150    P147:500                                    {Pointer on tolerance data }
N160    P504:5                                      {Confidence range }
N170    P149:510                                    {Pointer on trigger data }
N180    P150:520                                    {Pointer on measuring data }
N182    P154:530                                    {Pointer on output }
N230    G69                                         {Cycle call }

N240    G0   Z280     M30
```

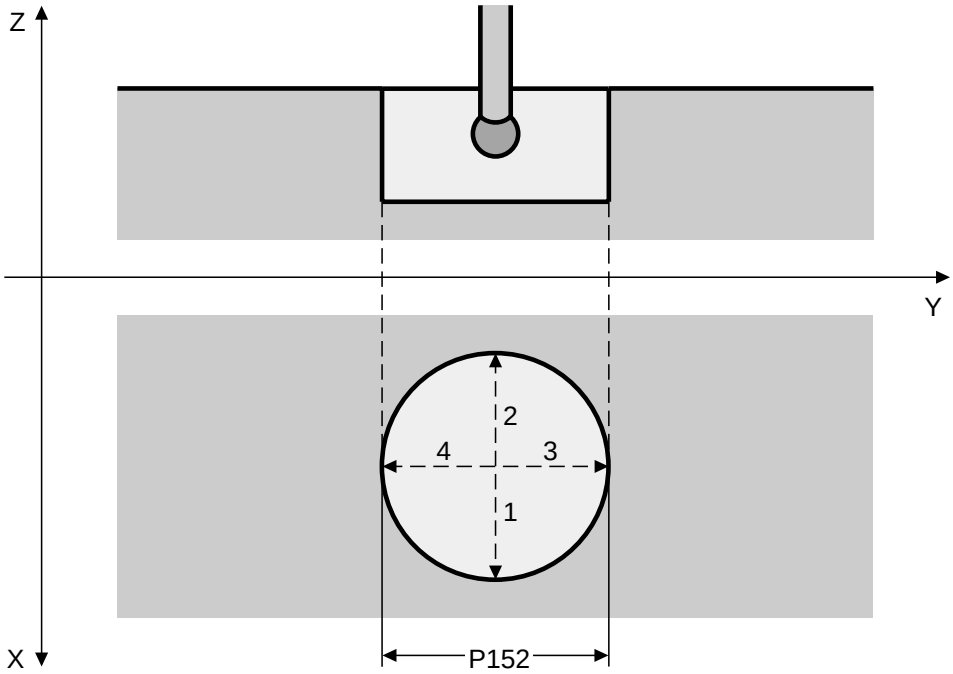



Figure 5-3

## 5.1 G69 measuring cycles (continued)

**determining an individual item in the area G69 P140:40**

The sensor must be pre-positioned at the beginning over the contact surface.
The measurement is executed with the axis defined in P148.

The cycle starts into negative direction with measuring speed (P143)
If there is still no signal of the sensor, the axes in the position (initial position - confidence interval (P147)+4) stop and a message (M8136) appears.

If there is a signal of the sensor, immediately the axis movement stops and the cycle calculates the position on the area and writes the data in (P154)+n.

| | | | |
|---|---|---|---|
| Example G17 | with P148:3 | writes after cycle | P(154)+2 |
| | with P148:2 | writes after cycle | P(154)+1 |
| | with P148:1 | writes after cycle | P(154)+0 |

If P144 is > 1, the cycle turns back to the safety margin. From here the cycle starts a new measuring movement to the same area.

The position of the moved axes is in the safety margin.

Parts it safely,
- that the tool length of the sensor is correct (P8161, P8163), if 3. axis is selected
- that the tool radius of the sensor is correct (P8160, P8162), if 1. or 2. axis is selected

## 5.1 G69 measuring cycles (continued)

**Example: The calibration of the sensor in drilling G69 P140:40**

```
N20     T1   M16
N30     G17 G53  G0   X600.000  Y300.000  Z280.000  A0   B0
N40     G1   Z270     F3000

N100                                                {Cycle G69 / 40 initialize }
N110    P140:40                                     {Cycle type}
N120    P141:3                                      {Safety margin }
N130    P143:100                                    {Measuring speed }
N140    P144:2                                      {Number of the measurements }
N150    P147:500                                    {Pointer on tolerance data }
N160    P504:5                                      {Confidence range }
N170    P144:3                                      {Measuring axes }
N180    P149:510                                    {Pointer on trigger data }
N182    P150:520                                    {Pointer on measuring data }
N230    G69                                         {Cycle call }

N240    G0   Z280     M30
```

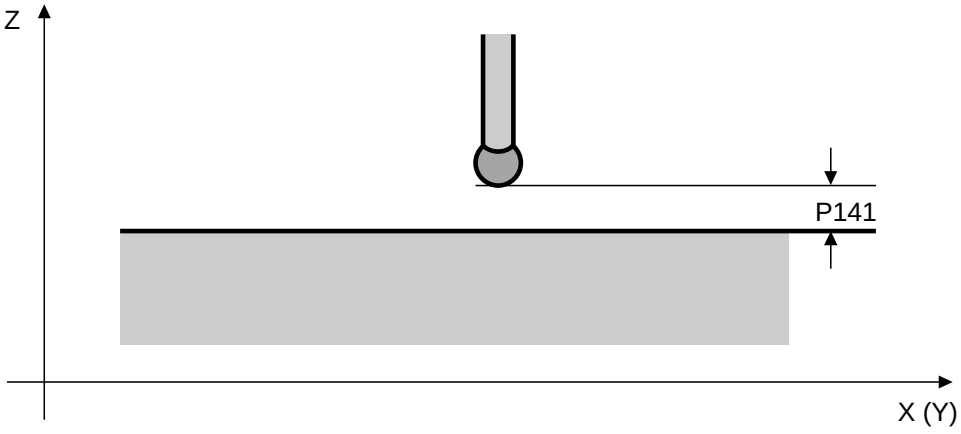



Figure 5-4

## 5.2 G71 / G72 / G73 / G74 / G75 Milling cycles

### List of canned milling cycles

G71 Rectangular pocket roughing, conventional
G72 Rectungular pocket roughing, conventional and climb
G73 Rectangular pocket roughing and finishing
G74 Circular pocket roughing
G75 Circular pocket roughing and finishing

The millinging cycles are block by block effective.
The parameter inputs remain against it modal effectively.

In order to avoid over regulation, all parameters are to be reset, with a programming type not to be used.

### Messages

The numbers for cycle messages start with 8xxx.
A list can be found in section messages

## 5.2.1 G71 Rectangular pocket roughing, conventional

### Starting point definition

Before starting any machining cycles, the milling cutter should be above the workpiece by the safety margin and at the centre of the pocket.

Whether the starting point S1 or S2 is homed into depends on the sign of the programmed in-feed P16.
Positive sign: starting point S1
Negative sign: starting point S2

The milling direction is established by the CNC and always in the direction of the longer pocket side. If the pocket sides are the same, milling takes place in the X direction.

### Parameter input

All parameters except for P16 should have positive sign when inputting.

| Parameter | Significance |
|---|---|
| P11 | Pocket dimension in X direction |
| P12 | Pocket dimension in Y direction |
| P13 | Pocket depth in Z direction |
| P14 | Corner radius |
| P15 | Contour allowance in X and Y directions |
| P16 | In-feed dimension in X or Y directions (prefix + or -) |
| P17 | In-feed dimension in Z direction |
| P18 | Pocket depth allowance in Z direction |
| P19 | Safety margin in Z direction |
| P21 | Feed rate in Z direction (when plunging into material) |

During cycle processing a possibly programmed correction becomes G41 / G42 switched off, since the tool radius correction in the cycle is considered.

Feed in z-direction (only when immersing into the material) is programmable with P21.
Is P21 programmed, does not become immersing into the material with under F programmed feed executed.

## 5.2.1 G71 Rectangular pocket roughing, conventional (continued)

**Machining sequence**

- Home in on starting point S1 or S2 (depending on prefix of P16)
- In-feed in Z direction at feed rate P21 (if programmed)
- Conventional milling to pocket dimension less allowance P15 in X and Y directions
- Retraction of milling cutter by 2 mm in Z direction
- Retraction in X or Y direction
- In-feed in Z direction
- In-feed in X or Y direction
- In-feed repetition until pocket dimension less allowance P15 is reached
- Milling over burrs
- Retraction in Z direction to safety margin
- Retraction to starting position in XY plane
- Repetition of in-feeds until pocket depth less allowance P18 is reached
- Retraction to starting position (centre of pocket)

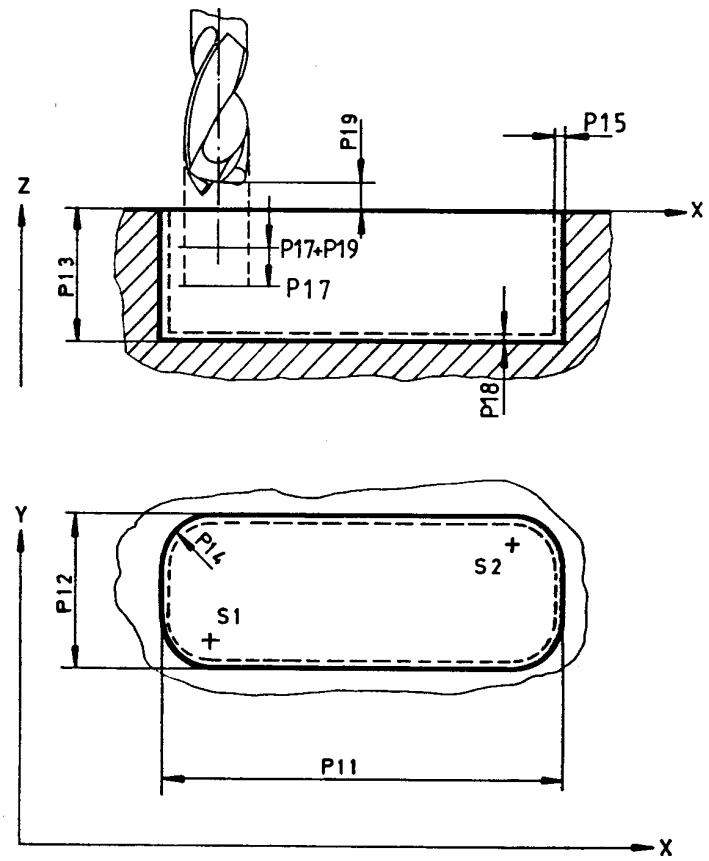



Figure 5-5

## 5.2.1 G71 Rectangular pocket roughing, conventional (continued)

**G 71 Example 1**: Pocket dimensions X=71mm, Y=41mm, Z=5mm; Tool-radius=3mm

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N10 | G00 | G54 | G90 | F2500 | S900 | T02 | M06 | M03 | M07 |
| N20 | G71<br>P14:-- | X55,5<br>P15:0 | Y40,5<br>P16:4 | Z2<br>P17:3 | P11:71<br>P19:2 | P12:41<br>P21:100 | P13:5 | | M30 |

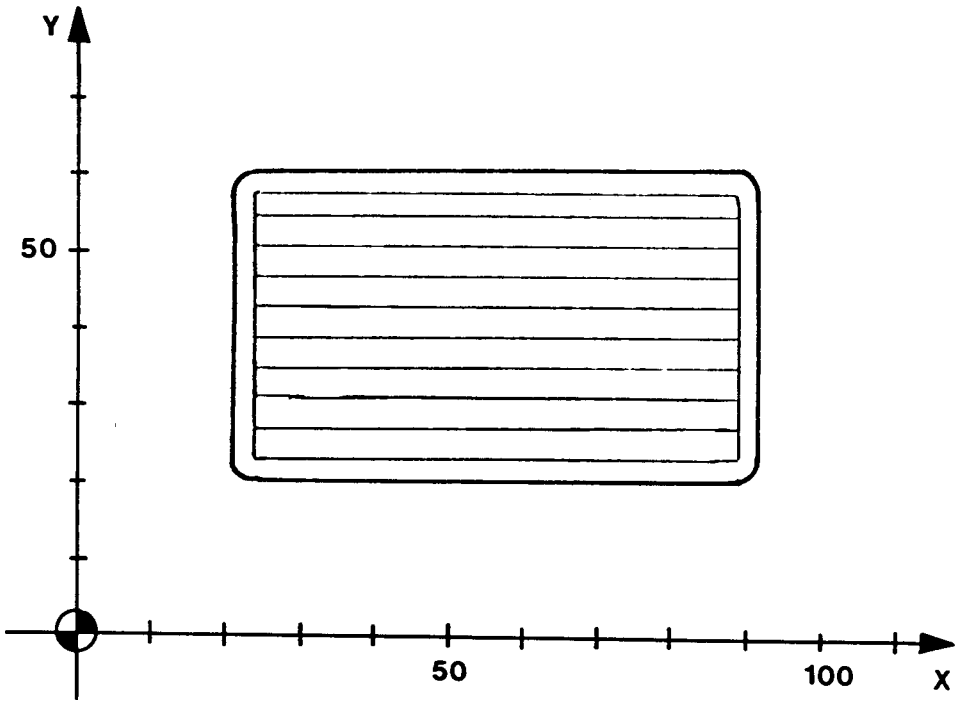



Figure 5-6

Parameters:

| | |
|---|---|
| P11, P12, P13 | Pocket dimensions in X, Y, Z direction |
| P16, P17 | In-feed in Y, Z direction |
| P19 | Safety margin in Z direction |
| P21 | Feed rate in Z direction |

Run: Block 10 Zero point, absolute dimension, feed rate, spindle, tool
Block 20 Cycle call-up, positioning on centre of pocket X, Y, Z, pocket dimensions P11, P12, P13, in-feed dimensions P16, P17, safety margin P19

Remarks: Since the corner radius P14 is not programmed, it becomes with the programmed tool radius equated.

## 5.2.1 G71 Rectangular pocket roughing, conventional (continued)

**G71 Example 2:** Pocket dimensions X=46mm, Y=81mm, Z=30mm;
Tool-radius=3mm, corner radius=13mm

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N10 | G00 | G54 | G90 | F1000 | S750 | T02 | M06 | M03 | M07 |
| N20 | G71<br>P14:13 | X43<br>P16:-4 | Y60,5<br>P17:7 | Z1<br>P19:1 | P11:46<br>P21:400 | P12:81<br>M30 | | P13:30 | |

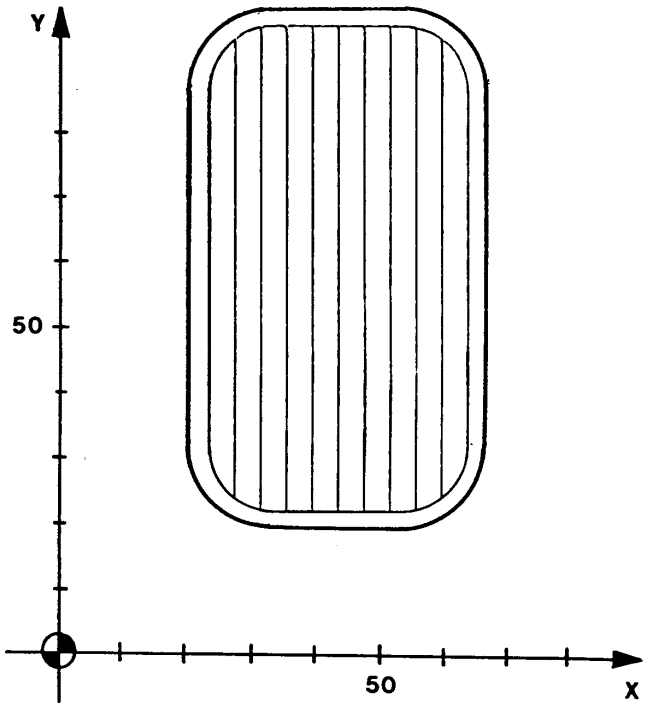



Figure 5-7

Parameters:

| | |
|---|---|
| P11, P12, P13 | Pocket dimensions in X, Y, Z direction |
| P14 | Corner radius |
| P16, P17 | In-feed in X, Z direction |
| P19 | Safety margin in Z direction |
| P21 | Feed rate in Z direction |

Run:

| | |
|---|---|
| Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z; pocket dimensions P11, P12, P13, in-feed dimensions P16, P17, corner radius P14, safety margin P19 |

Remarks: If P14 = 0 is or smaller than the tool radius, then becomes after that start clearing the program execution stopped and message 8001 indicated.

## 5.2.2 G72 Rectangular pocket roughing, climb and conventional

### Starting point definition

Before the start of the machining cycles the milling cutter should be above the workpiece by the safety margin and in the middle of the pocket.

Whether the starting point S1 or S2 is homed into depends on the sign of the programmed in-feed P16.
Sign, positive: starting point S1
Sign, negative: starting point S2

The determination of the milling direction takes place in the CNC and always in the direction of the longer pocket side. If the pocket sides are the same, milling takes place along the X direction.

### Parameter input

All parameters except for P16 should have a positive sign during inputting.

| Parameter | Significance |
|---|---|
| P11 | Pocket dimension in X direction |
| P12 | Pocket dimension in Y direction |
| P13 | Pocket depth in Z direction |
| P14 | Corner radius |
| P15 | Contour allowance in X and Y directions |
| P16 | In-feed dimension in X or Y directions (sign +/-) |
| P17 | In-feed dimension in Z direction |
| P18 | Pocket depth allowance in Z direction |
| P19 | Safety margin in Z direction |
| P21 | Feed rate in Z direction (when plunging into material) |

## 5.2.2 G72 Rectangular pocket roughing, climb and conventional (continued)

**Machining sequence**

- Home in on starting point S1 or S2 (each according to sign of P16)
- In-feed in Z direction at feed rate P21 (if programmed)
- Conventional milling to pocket dimension less the allowance P15 in X and Y direction
- In-feed in X or Y direction
- Milling in conventional direction
- In-feed in X or Y direction
- In-feed repetition until pocket dimension less allowance P15 is reached
- Milling over burrs along edge
- Retraction in Z direction to safety margin
- Retraction to starting position in XY plane
- In-feed in Z direction to previous dimension
- Milling over burrs along other edge
- Retraction in Z direction to safety margin
- Retraction to starting position in XY plane
- Repetition of in-feeds until pocket depth less allowance P18 is reached
- Retraction to starting position (centre of pocket)

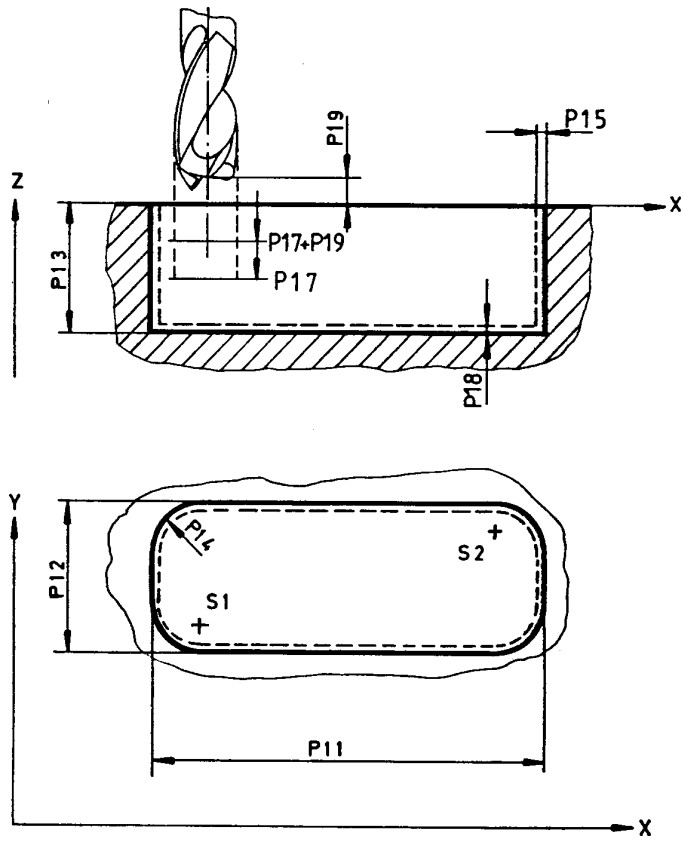



Figure 5-8

## 5.2.2 G72 Rectangular pocket roughing, climb and conventional milling (cont.)

**G72 Example 1:** Pocket dimensions X=66mm, Y=31mm, Z=5mm; Tool-radius=3mm

```
N10  G00  G54  G90      F2000    S850     T02      M06  M03  M07

N20  G72  X53  Y35,5    Z1       P11:66   P12:31   P13:5    P14:--   P15:0
     P16:5,1   P17:3    P19:1    M30
```

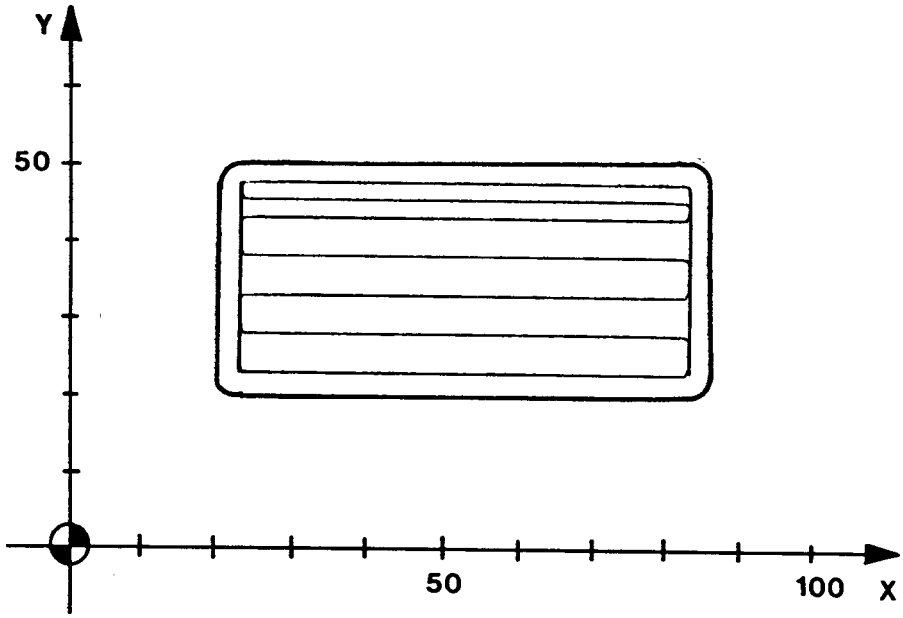



Figure 5-9

Parameters:

| | |
|---|---|
| P11, P12, P13 | Pocket dimensions in X, Y, Z direction |
| P16, P17 | In-feed in Y, Z direction |
| P19 | Safety margin in Z direction |

| | | |
|---|---|---|
| Run: | Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| | Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z; pocket dimensions P11, P12, P13, in-feed dimensions P16, P17, safety margin P19 |

Remarks: As the corner radius P14 is not programmed it is identified along with the programmed tool radius.

## 5.2.2 G72 Rectangular pocket roughing, climb and conventional milling (cont.)

**G72 Example 2:** Pocket dimensions X=44mm, Y=69mm, Z=3mm; Tool radius=3mm, corner radius=15mm

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N10 | G00 | G54 | G90 | F2000 | S950 | T02 | M06 | M03 | M07 |
| N20 | G72 | X42 | Y54,5 | Z1 | P11:44 | P12:69 | P13:3 | P14:15 | P15=0 |
| | P16:5,5 | | P17:3 | P19:1 | P21:100 | M30 | | | |

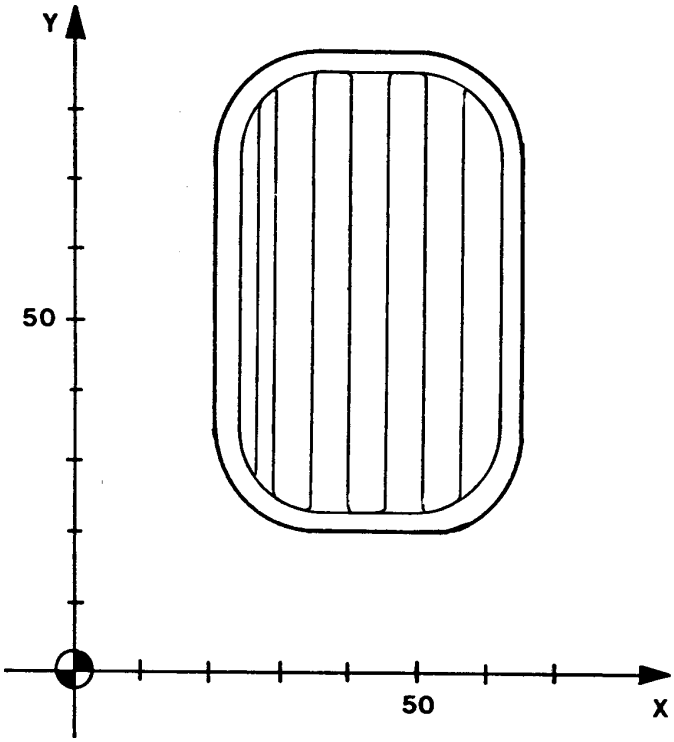



Figure 5-110

Parameters:

| | |
|---|---|
| P11, P12, P13 | Pocket dimensions in X, Y, Z direction |
| P14 | Corner radius |
| P16, P17 | In-feed in X, Z direction |
| P19 | Safety margin in Z direction |
| P21 | Feed rate in Z direction |

| | | |
|---|---|---|
| Run: | Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| | Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z; pocket dimensions P11, P12, P13, in-feed dimensions P16, P17, corner radius P14, safety margin P19 |

Remarks: If P14=0 or is smaller than the tool radius the program run is shut down after the start and fault feed-back 1301 (geometry fault) is displayed.

## 5.2.3 G73 Rectangular pocket roughing and finishing

### Starting point definition

Before the start of the machining cycles, the milling cutter should be above the workpiece at the safety margin and in the middle of the pocket.

Whether the starting point S1 or S2 is homed into depends on the sign of the programmed in-feed P16.
Sign, positive: starting point S1
Sign, negative: starting point S2

The milling direction is established in the CNC and is always in the direction of the longer pocket side. If the pocket sides are the same, milling takes place along the X direction.

### Parameter input

All parameters except for P16 should have a positive sign when inputting.

| Parameter | Significance |
|---|---|
| P11 | Pocket dimension in X direction |
| P12 | Pocket dimension in Y direction |
| P13 | Pocket depth in Z direction |
| P14 | Corner radius |
| P15 | Contour allowance in X and Y direction |
| P16 | In-feed dimension in X or Y direction (sign +/-) |
| P17 | In-feed dimension in Z direction |
| P18 | Pocket depth allowance in Z direction |
| P19 | Safety margin in Z direction |
| P20 | In-feed dimension when finishing, to remove allowance P15; In-feed direction as for P16 |
| P21 | Feed rate in Z direction (when plunging into material) |

## 5.2.3 G73 Rectangular pocket roughing and finishing (continued)

### Machining

- Home in on starting point S1 or S2 (each according to sign of P16)
- In-feed in Z direction at feed rate P21 (if programmed)
- Milling pocket contour (less allowance P15) to starting point
- In-feed repetition until pocket depth P13 less allowance P18 is reached
- Retraction to starting plane
- In-feed in X or Y direction
- In-feed in Z direction at feed rate P21 (if programmed)
- Conventional and climb milling of remaining material
- Retraction in Z direction and to starting position and in-feed
- In-feed repetition until pocket dimension less allowance P18 is reached.
- Retraction in Z direction to starting plane
- In-feed for finishing
- In-feed in Z direction at 0.5 of the programmed feed rate F to pocket depth less P18
- Finishing contour to starting point at 0.5 of the programmed feed rate
- In-feed repetition until finished contour is reached
- Retraction to starting position at programmed feed rate

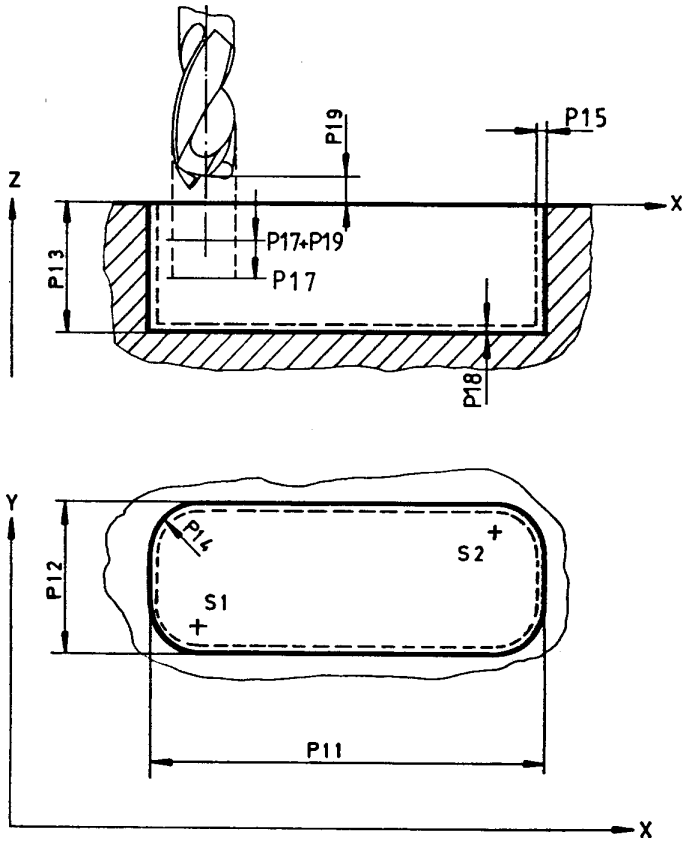



Figure 5-11

## 5.2.3 G73 Rectangular pocket roughing and finishing (continued)

**G73 Example 1**: Pocket dimensions X=64mm, Y=35mm, Z=5mm; Tool radius=3mm

```
N10  G00  G54      G90      F1500    S950     T02      M06      M03      M07

N20  G73  X52,5    Y37,5    Z1       P11:64   P12:35   P13:5    P14=0
     P15:1         P16:4,5       P17:2    P19:1    P20:1    M30
```

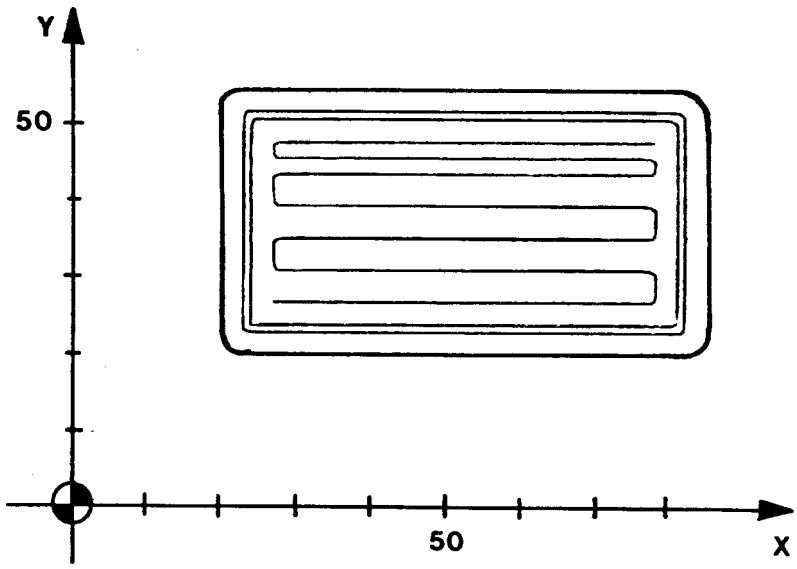



Figure 5-12

Parameters:

| | |
|---|---|
| P11, P12, P13 | Pocket dimensions in X, Y, Z direction |
| P15 | Allowance in X and Y direction |
| P16, P17 | In-feed in Y, Z direction |
| P19 | Safety margin in Z direction |
| P20 | Allowance during finishing |

Run:

| | |
|---|---|
| Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z; pocket dimensions P11, P12, P13, in-feed dimensions P16, P17, allowance P15, safety margin P19, in-feed dimension when finishing P20 |

Remarks: As the corner radius P14 is not programmed it is made equal to the programmed tool radius.

## 5.2.3 G73 Rectangular pocket roughing and finishing (continued)

**G73 Example 2**: Pocket dimensions X=65mm, Y=35mm, Z=5mm; Tool radius=3mm, corner radius=11mm

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N10 | G00 | G54 | G90 | F1500 | S950 | T02 | M06 | M03 | M07 |
| N20 | G73 | X52,5 | Y37,5 | Z1 | P11:65 | P12:35 | P13:5 | P14:11 | |
| | P15:1,5 | | P16:4,2 | P17:2 | P19:1 | P20:1 | M30 | | |

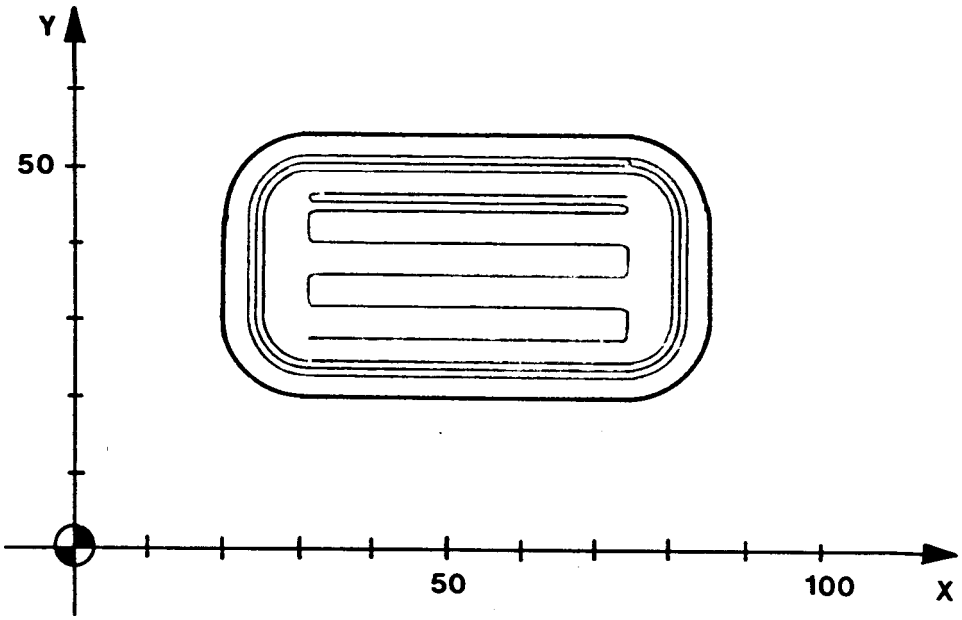



Figure 5-13

Parameters:

| | |
|---|---|
| P11, P12, P13 | Pocket dimensions in X, Y, Z direction |
| P14 | Corner radius |
| P15 | Allowance in X and Y direction |
| P16, P17 | In-feed in Y, Z direction |
| P19 | Safety margin in Z direction |
| P20 | Allowance during finishing |

Run:

| | |
|---|---|
| Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z; pocket dimensions P11, P12, P13, in-feed dimensions P16, P17, corner radius P14, safety margin P19, allowance P15, infeed dimension during finishing P20 |

Remarks: If P14=0 or is smaller than the tool radius the program run is shut down after the start and message 1301 (geometry fault) is displayed.

## 5.2.4 G74 circular pocket roughing

### Starting point definition

Before the start of the machining cycles the milling cutter should be above the workpiece at the safety margin and at the centre of the pocket.

### Parameter input

All parameters except for P16 should have a positive sign when inputting. The sign of P16 determines the direction of milling, i.e.:
Milling direction G02, the sign of P16 is positive
Milling direction G03, the sign of P16 is negative

| Parameter | Significance |
|---|---|
| P11 | Internal radius (if core drilled) |
| P12 | Depth of pocket |
| P14 | Pocket radius |
| P15 | Allowance at circumference |
| P16 | In-feed dimension in X direction |
| P17 | In-feed dimension in Z direction |
| P18 | Pocket depth allowance in Z direction |
| P19 | Safety margin |
| P21 | Feed rate in Z direction (when plunging into material) |

When specifying the internal radius P11, the first in-feed in the X direction is corrected by the appropriate amount: 1st in-feed = P11 + P16.

## 5.2.4 G74 circular pocket roughing (continued)

**Machining**

- In-feed in Z direction at feed rate P21 (if programmed)
- In-feed in X direction
- Spiral milling
- Milling circular pocket to finished size less allowance P15
- Retraction along the semicircle with R=2.5mm max.
- Retraction in Z direction by 2mm
- Retraction to centre of pocket
- In-feed repetition until pocket dimension less allowance P18 in Z direction is reached
- Retraction to starting position

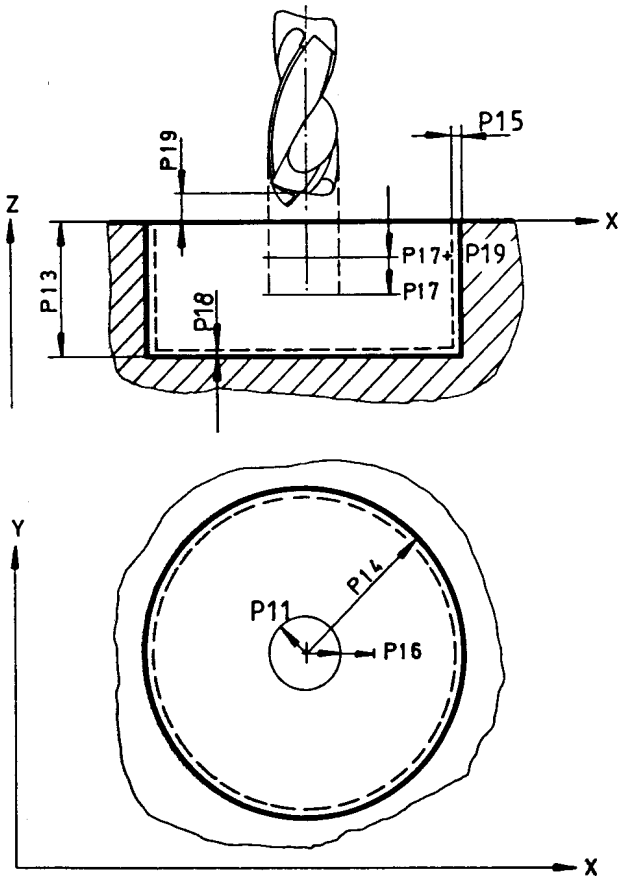



Figure 5-14

## 5.2.4 G74 Circular pocket roughing (continued)

**G74 Example 1**: Pocket radius R=33mm, pocket depth Z=27mm; Tool radius=3mm

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N10 | G00 | G54 | G90 | F1500 | S950 | T02 | M06 | M03 | M07 | |
| N20 | G74 | X53 | Y53 | Z1 | P13:27 | P14:33 | P16:5,1 | P17:5 | P19:1 | M30 |

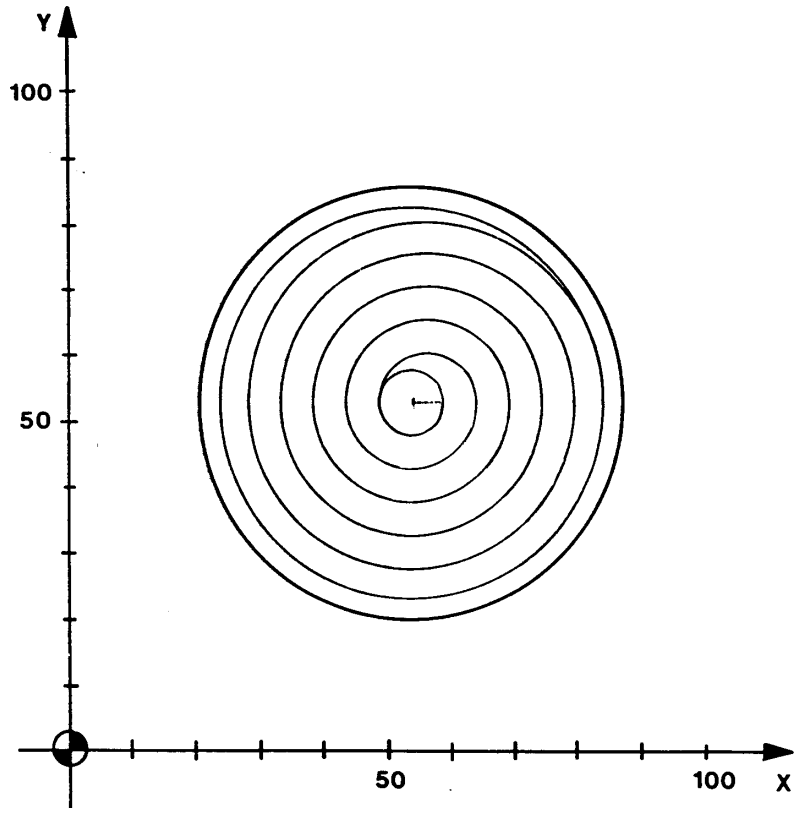



Figure 5-15

Parameters:

| | |
|---|---|
| P13 | Pocket depth in Z direction |
| P16, P17 | In-feed in X, Z direction |
| P14 | Pocket radius |
| P19 | Safety margin in Z direction |

| | | |
|---|---|---|
| Run: | Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| | Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z, pocket depth P13, in-feed dimensions P16, P17, pocket radius P14, safety margin P19 |

## 5.2.4 G74 circular pocket roughing (continued)

**G74 Example 2**: Pocket radius R=30mm, pocket depth Z=31mm; Tool radius=3mm, core bore drilling at 20mm dia.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N10 | G00 | G54 | G90 | F1500 | S950 | T02 | M06 | M03 | M07 |
| N20 | G74 | X50 | Y50 | Z1 | P11:10 | P13:31 | P14:30 | P16:4 | P17:8 |
| | P19:1 | | M30 | | | | | | |

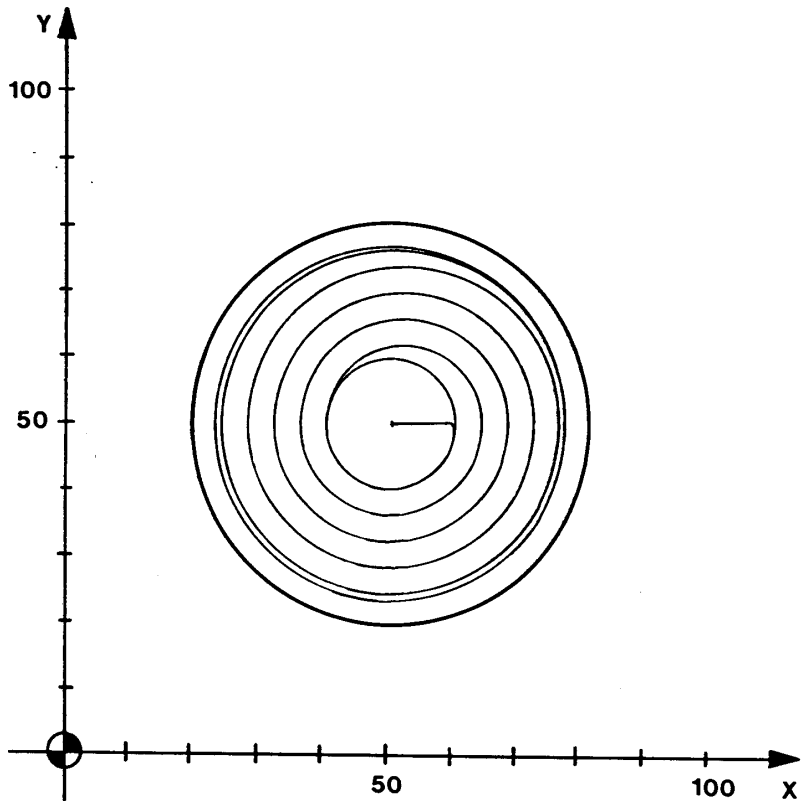



Figure 5-16

Parameters:

| | |
|---|---|
| P11 | Internal radius (if core drilled) |
| P13 | Pocket depth in Z direction |
| P16, P17 | In-feed in X, Z direction |
| P14 | Pocket radius |
| P19 | Safety margin in Z direction |

| | | |
|---|---|---|
| Run: | Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| | Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z, pocket depth P13, in-feed dimensions P16, P17, pocket radius P14, safety margin P19 |

## 5.2.5 G75 circular pocket roughing and finishing

### Starting point definition

Before the start of the machining cycles the milling cutter should be above the workpiece at the safety margin and at the centre of the pocket.

### Parameter input

All parameters except for P16 should have a positive sign when inputting. The sign of P16 determines the direction of milling, i.e.:
Milling direction G02, the sign of P16 is positive
Milling direction G03, the sign of P16 is negative

| Parameter | Significance |
|---|---|
| P11 | Internal radius (if drilled) |
| P13 | Depth of pocket |
| P14 | Pocket radius |
| P15 | Allowance at circumference |
| P16 | In-feed dimension in X direction |
| P17 | In-feed dimension in Z direction |
| P18 | Pocket depth allowance in Z direction |
| P19 | Safety margin |
| P20 | In-feed dimension when finishing, to remove P15, in-feed direction as with P16 |
| P21 | Feed rate in Z direction (when plunging into material) |

With specification of the internal radius P11 the first feed in x-direction becomes around the suitable amount corrects: 1. Feed = P11 + P16.

## 5.2.5 G75 circular pocket roughing and finishing (continued)

**Machining**

- In-feed in Z direction at feed rate P21 (if programmed)
- In-feed in X direction
- Spiral milling
- Milling circular pocket to finished size less allowance P15
- Retraction along the semicircle with R=2.5mm max.
- Retraction in Z direction
- Retraction to centre of pocket
- In-feed repetition until pocket dimension less allowance P18 in Z direction is reached
- Retraction along the semicircle with R=2.5mm max.
- In-feed at half feed rate for finishing along the semicircle
- Milling along the circle at half of the programmed feed rate
- Retraction along the semicircle
- In-feed repetition until finished dimension is reached
- Retraction along the semicircle
- Retraction to starting position at programmed feed rate

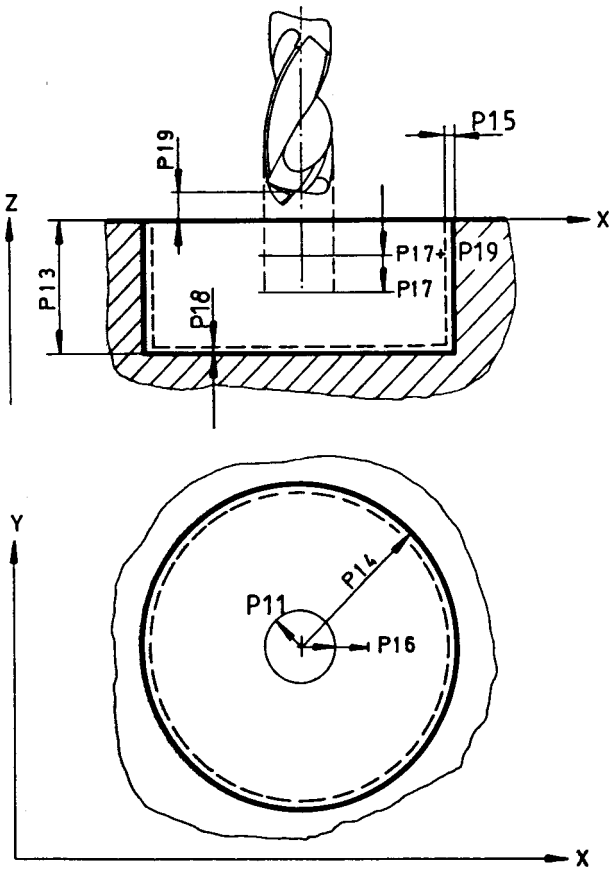



Figure 5-17

## 5.2.5 G75 circular pocket roughing and finishing (continued)

**G75 Example 1:** Pocket radius R=28mm, pocket depth Z=35mm; Tool radius=3mm

```
N10  G00  G54  G90  F1500     S950     T02     M06     M03     M07

N20  G75  X48  Y48  Z1        P13:35   P14:28  P15:2   P16:4,1 P17:8
     P19:1     P20:2     M30
```

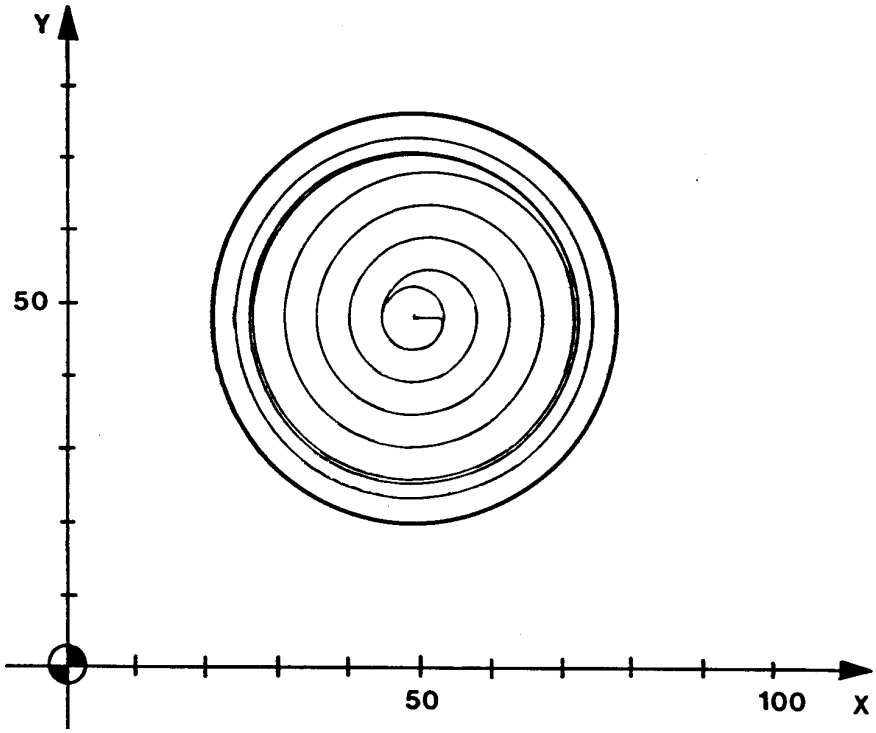



Figure 5-18

Parameters:

| | |
|---|---|
| P13 | Pocket depth in Z direction |
| P14 | Pocket radius |
| P15 | Allowance at circumference |
| P16, P17 | In-feed in X, Z direction |
| P19 | Safety margin in Z direction |
| P20 | In-feed dimension during finishing |

| | | |
|---|---|---|
| Run: | Block 10 | Zero point, absolute dimension, feed rate, spindle, tool |
| | Block 20 | Cycle call-up, positioning on centre of pocket X, Y, Z, pocket depth P13, in-feed dimensions P16, P17, pocket radius P14, safety margin P19, in-feed dimension during finishing P20 |

## 5.3 G80 / G81 / G83 / G84 / G85 Drilling cycles

the drilling cycle functions G81 / G83 / G84 / G85 operate modally and overwrite each other mutually. G80 clears all drilling cycles resulting in G00 (rapid traverse) and G64 (clearing feed rate 100%) becoming effective automatically.

G80 is automatically set at the program start.

**List of drilling cycles**

| Drilling cycle according to DIN 66025 | Programming in CNC900 |
|---|---|
| G81 Drilling with rapid return | G81 |
| G82 Drilling with rapid return and | G81, G04. Free cutting time free-cutting |
| G83 Deep hole drilling | G83 |
| G84 Tapping | G84, G04. Spindle turnaround time |
| G85 Drilling with return at feed rate | G85 |
| G86 Drilling with rapid return, free cutting and spindle „off“ | G81, G04. Free cutting time, M05 |
| G87 Drilling with manual return | - |
| G88 Drilling with manual return and free cutting | - |
| G89 Drilling with return at feed rate and | G85, G04. Free cutting time<br>Further possibilities with the CNC900, e.g.:<br>G83, G04. Free cutting time<br>G83, G04. Free cutting time, M05 |

## 5.3 G80 / G81 / G83 / G84 / G85 Drilling cycles

### Programming of characteristics

for the programming of the drill cycles only parameters can be used.

| Parameter | Meaning | | |
|---|---|---|---|
| P30 | Free cutting time | Turn back time of the spindle after achieving the drilling depth | |
| P31 | Compensating chuck | G84<br>P31 : 3 = thread cutting without compensating chuck right<br>P31 : 4 = thread cutting without compensating chuck left<br>P31 : 0 or - = G84 standard cycle (with compensating chuck) | |
| P32 | Drilling feed | | |
| P32 | Thread pitch | bei G84 | |
| P33 | Drilling depth | | absolute |
| P33 | Thread depth | bei G84 | absolute |
| P34 | Anticipation plane | Safety margin of the processing upper edge | absolute |
| P35 | Retreat plane | To run around of obstacles in the setting axis | absolute |
| P36 | No. of strokes | G83, constant setting depth = (P33 - P34) / P36 | |
| P36 | Setting depth | G83, degressive setting depth | |
| P37 | 1st Stroke | G83, degressive setting depth | |
| P38 | Safety margin | G83, presetting = 1mm | incremental |
| P39 | Gradual decrease | G83, degressive setting depth<br>P39 : 1 = on<br>P39 : 0 or - = off | |

Drilling depth P33, anticipation plane P34 and retreat plane P35 are dependant of the planes set over G17, G18 or G19. In the following examples, G17 is activated with the axis names X (1st axis), Y (2nd axis) and Z (3rd axis).

## 5.3 G80 / G81 / G83 / G84 / G85 Drilling cycles (continued)

### Parameters for drilling cycles

| Drilling cycle | Parameter | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Free cutting time | Drilling feed | Drilling depth | Antici-pation plane | Retreat plane | Number of strokes | 1st stroke | Safety margin | Gradual dec-rease | Dri-ling speed |
| | P30 | P32 | P33 | P43 | P35 | P36 | P37 | P38 | P39 | S |
| G81 | * | * | * | * | * | - | - | - | - | * |
| G83 constant | * | * | * | * | * | * | - | * | - | * |
| G83 degressiv | * | * | * | * | * | * | * | * | * | * |
| G84 | * | * | * | * | * | - | - | - | - | * |
| G85 | * | * | * | * | * | - | - | - | - | * |

When calling up a drilling cycle, a direction of spindle rotation and spindle speed should be active. If these two values have already been set when the cycle is called up they are taken as the preset values for the drilling cycles.

Programming of a safety margin (P38) is optional. If this characteristic is not input a safety margin of 1 mm is preset.

When calling up a drilling cycle, the fields marked * should have been programmed in one way or another.

### Messages

The numbers for cycle messages start with 8xxx.
A list can be found in section messages

### Activation conditions

For a drilling cycle to be carried out, at least one of the X, Y or Z coordinates should be programmed per main block. This also applies to parameter P33 for the drilling depth Z.

## 5.3 G80 / G81 / G83 / G84 / G85 Drilling cycles (continued)

### Positioning speed

The pre-positioning of the axes takes place at rapid traverse. When using polar coordinates programming with interpolation mode G02 or G03 set, positioning is at the programmed feed rate. It is therefore good policy to specify the feed rate with parameter P32.

### Effect of G91 incremental dimensions

Using incremental dimensions, the positioning axes (XY with G17, ZX with G18, YZ with G19) are traversed in incremental mode. The specified coordinates are always taken as absolute for the characteristics (Z, R, K).

### Effect of G66

A programmed G66 is effective throughout the complete drilling cycle.

### Effect of G63/G64

The function, when set, is retained throughout the complete drilling cycle. The tapping cycle G84 automatically sets G63 for period of the in-feed traverse.

### Effect of other additional functions

Other additonal functions are effective in a block with travel information (cycle is executed) before or after the travels that are defined in the cycle.

### 5.3.1 G81 Drilling with return at rapid travers

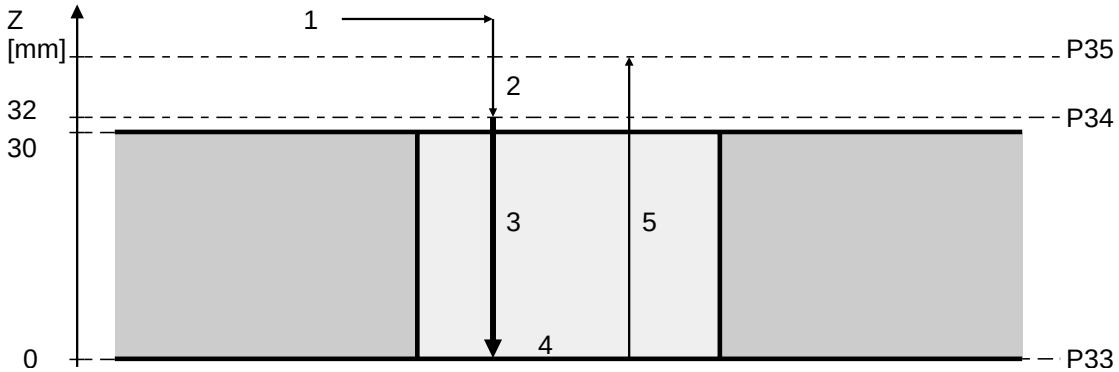



Figure 5-19

**Meaning of the parameters**

| | | |
|---|---|---|
| P30 | Free cutting time | Turn back time of the spindle after achieving the drilling depth |
| P32 | Drilling feed | |
| P33 | Drilling depth | |
| P34 | Anticipation plane | Safety margin of the processing upper edge |
| P35 | Retreat plane | To go around of obstacles in the setting axis |

### 5.3.1 G81 Drilling with return at rapid travers (continued)

**Example**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N20 | G56 | G00 | X0 | Y0 | Z100 | S1200 | F1500 | M03 | T01 | M16 |
| N30 | **G81** | Z80 | P30:1 | | P32:800 | **P33:0** | **P34:32** | P35:60 | | |
| N40 | M05 | ... | | | | | | | | |

**Sequence plan**

1 Switch on spindle (M03, M04) and position X and Y axis in rapid traverse.

2 After reaching the X and Y position, position the Z axis to the anticipation plane (P34) in rapid traverse.

3 After reaching the anticipation plane the Z axis is traversed at working feed rate (P32) to the drilling depth (P33).

4 After reaching the drilling depth any possibly programmed free cutting time (P30) is awaited.

5 After it the Z-axis in rapid traverse moves on the retreat plane (P35) and afterwards the spindle is switched off (M05).

## 5.3.2 G83 Deep-hole drilling with constant setting depth

If the parameter P39:0 or is not programmed, the programmed drilling depth (P33) by repeated constant setting depth of the active drilling depth is achieved.

The active drilling depth is (P33 - P34) * n / P36 , however n = 1, 2, .. (settin depth = stroke) is.

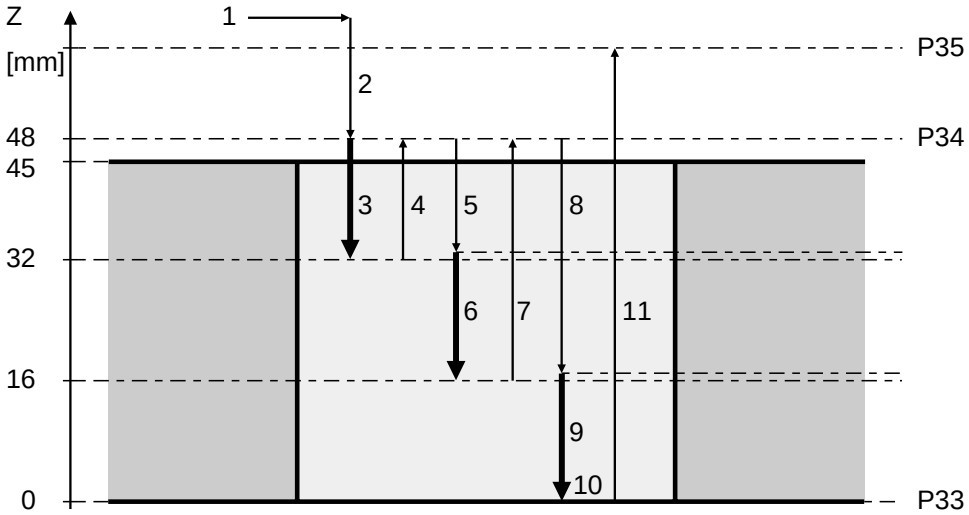



Figure 5-20

**Meaning of the parameters**

| | | |
|---|---|---|
| P30 | Free cutting time | Turn back time of the spindle after achieving the drilling depth |
| P32 | Drilling feed | |
| P33 | Drilling depth | |
| P34 | Anticipation plane | Safety margin of the processing upper edge |
| P35 | Retreat plane | To go around of obstacles in the setting axis |
| P36 | No. of strokes | constant setting depth = (P33 - P34) / P36 |
| P38 | Safety margin | presetting = 1mm |
| P39 | Gradual decrease | 0 or - = off |

## 5.3.2 G83 Deep-hole drilling with constant setting depth (continued)

**Example**

N20 G56 G00 X0 Y0 Z100 S1200 F1500 M03 T01 M16

N30 **G83** Z80 P30:1 P32:800 **P33:0** **P34:48** P35:60 **P36:3** P38:1 P39:0

N40 M05 ...

Sequence plan

1 Switch spindle on (M03, M04) and X and Y axis in rapid traverse position.

2 After achieving the X and Y position the Z-axis runs in rapid traverse on those anticipation plane (P34).

3 After achieving the anticipation plane (P34) the Z axis with working feed moves (P32) to the 1. drilling depth (P34 + ((P33 - P34) * 1 / P36)).

4 After achieving the 1. drilling path the Z axis drives back in rapid traverse up to the anticipation plane.

5 From the anticipation plane the Z axis drives afterwards in rapid traverse up to the 1. drilling depth plus safety margin (P34 + ((P33 - P34) * 1 / P36)) + P38).

6 The Z axis induces itself with working feed (P32) to 2. drilling depth (P34 + ((P33 - P34) * 2 / P36)).

7 After achieving the 2. drilling depth the Z axis drives back in rapid traverse up to the anticipation plane.

8 From the anticipation plane the Z-axis drives afterwards in rapid traverse up to the 2. drilling depth plus safety margin (P34 + ((P33 - P34) * 2 / P36)) + P38).

9 The Z axis induces itself with working feed (P32) to the 3. drilling depth etc. to P33.

10 With the achieving of the drilling depth (P33) a programmed free cutting time (P30) becomes been waiting.

11 Afterwards the Z axis in rapid traverse moves back on the retreat plane (P35) and afterwards the spindle is switched off (M05).

### 5.3.3 G83 Deep-hole drilling with degressive setting depth

If the parameter P39:1 is programmed (the input value is not determining), the programmed drilling depth (P33) by repeated, reduced setting depth (gradual decrease) of the active drilling depth is achieved.

The active drilling depth is P37-(n-1)*P36, whereby n=1, 2,.. is (nth setting depth = stroke).
If P37-(n-1)*P36 ≤ P36, the active drilling depth = P36 is set.

Before each setting depth checked, whether two setting depths (drilling depth calculated + P36 (gradual decrease measure)) still feasible are. If not, then the new drilling depth calculated by remainder path / 2 and executed the final two setting depths with this value.

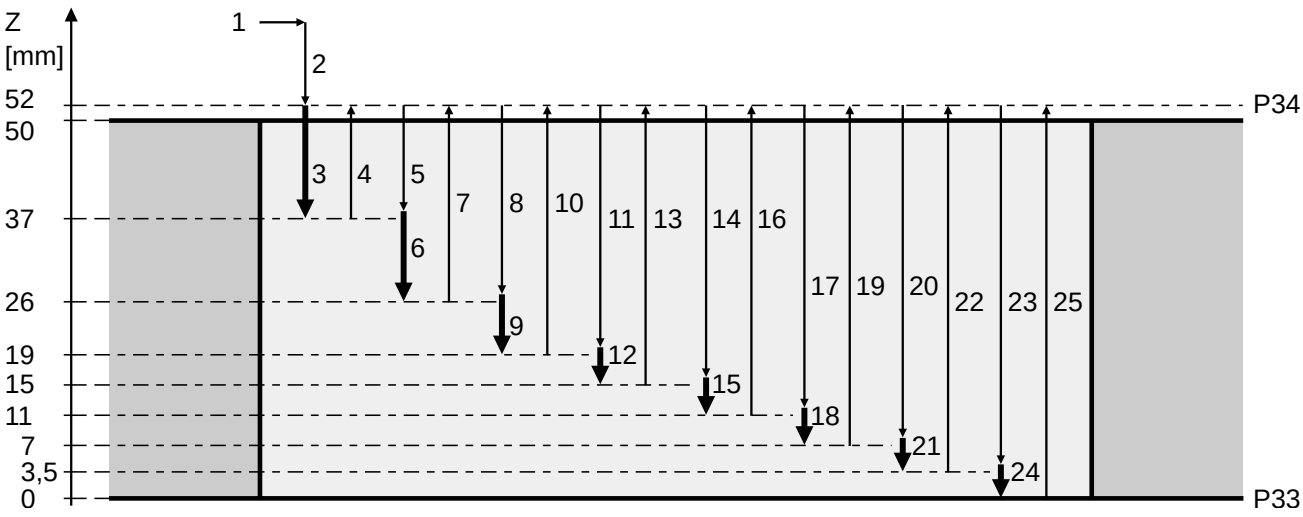



Figure 5-21

**Meaning of the parameters**

| | | |
|---|---|---|
| P32 | drilling feed | |
| P33 | drilling depth | |
| P34 | anticipation plane | safety margin of the processing upper edge |
| P35 | retreat plane | to the run around of obstacles in the setting axis |
| P36 | setting depth | degressive setting depth |
| P37 | 1. stroke | degressive setting depth |
| P38 | safety margin | presetting = 1mm |
| P39 | gradual decrease | degressive setting depth<br>1 = on |

## 5.3.3 G83 Deep-hole drilling with degressive setting depth (continued)

**Example**

N20 G56 G00 X0 Y0 Z100 S1200 F1500 M03 T01 M16

N30 **G83** Z80 P32:800 **P33:0** **P34:52** **P36:4** **P37:15** P38:1 **P39:1**

N40 M05 ...

**Sequence plan**

1 Switch spindle on (M03, M04) and X and Y axis in rapid traverse position.
2 After achieving the X and Y position the Z axis runs on the anticipation plane (P34).

3 After achieving the anticipation plane the Z axis with working feed induces itself to
1. drilling depth (P37) on the Z position: P34 - P37 = 52 - 15 = 37.
4 After achieving 1.drilling depth returns the Z axis in rapid traverse to the anticipation plane.

5 Of the anticipation plane in rapid traverse up to the 1. drilling depth plus safety margin (P38).
6 With working feed to 2. drilling depth on the Z position: 37 - 11 = 26 (11 = 15 - 4).
7 After achieving the 2. drilling depth to the anticipation plane back.

8 Of the anticipation plane in rapid traverse up to 2. drilling depth plus safety margin (P38).
9 With working feed to the 3. drilling depth on the Z position: 26 - 7 = 19 (7 = 11 - 4).
10 After achieving the 3. drilling depth to the anticipation plane back.

11 Of the anticipation plane in rapid traverse up to the 3. drilling depth plus safety margin (P38).
12 With working feed to 4. drilling depth on the Z position: 19 - 4 = 15 (P36:4).
13 After achieving the 4. drilling depth to the anticipation plane back.

14 Of the anticipation plane in rapid traverse up to 4. drilling depth plus safety margin (P38).
15 With working feed to 5. drilling depth on the Z position: 15 - 4 = 11 (P36:4).
16 After achieving the 5. drilling depth to the anticipation plane back.

17 Of the anticipation plane in rapid traverse up to 5. drilling depth plus safety margin (P38).
18 With working feed to 6. drilling depth on the z-position: 11 - 4 = 7 (P36:4).
19 After achieving the 6. drilling depth to the anticipation plane back.

20 Of the anticipation plane in rapid traverse up to 6. drilling depth plus safety margin (P38).
21 With working feed to 7. drilling depth on the Z position: 7 / 2 = 3,5.
22 After achieving the 7. drilling depth to the anticipation plane back.

23 Of the anticipation plane in rapid traverse up to 7. drilling depth plus safety margin (P38).
24 With working feed to 8. drilling depth on the Z position: 3.5 - 3.5 = 0.
25 After achieving 8. drilling depth returns the Z axis in rapid traverse to the anticipation plane.

### 5.3.4 G84 Thread cutting

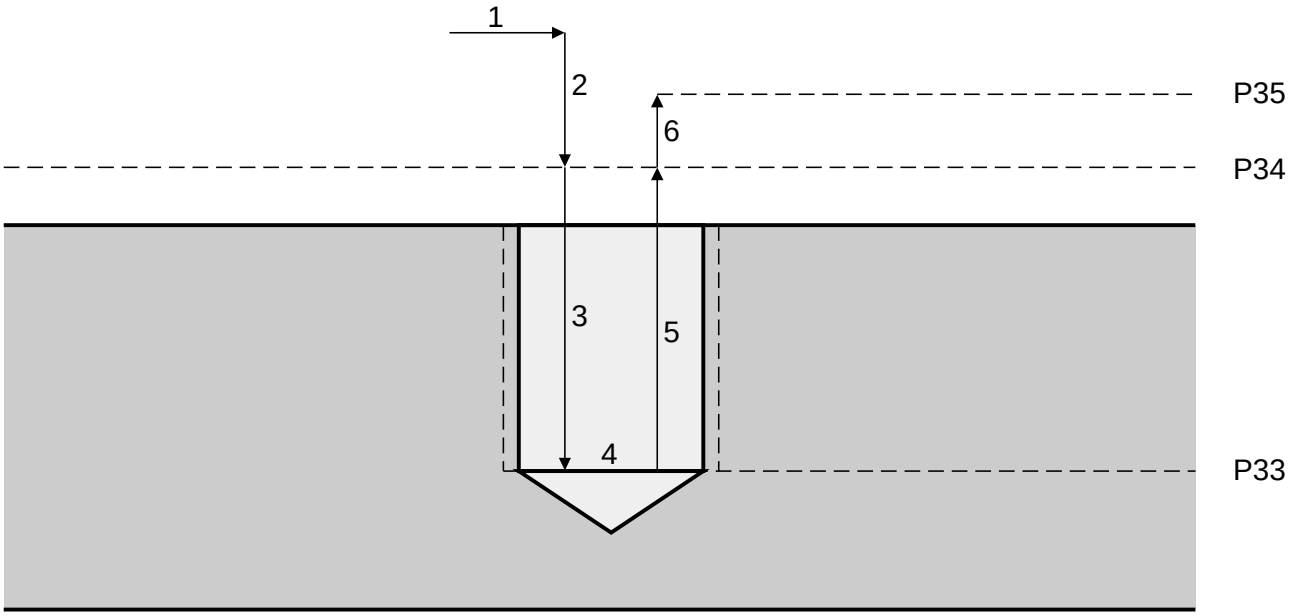



Figure 5-22

**Meaning of the parameters**

| | | | |
|---|---|---|---|
| P31 | balance fodder | P31: 1 | = thread cutting without balance fodder |
| | | P31: 0 or - | = G84 standard cycle (with balance fodder) |
| P32 | thread pitch | | |
| P33 | thread depth | | |
| P34 | anticipation plane | safety margin of the processing upper edge | |
| P35 | retreat plane | to running around obstacles in the setting axis | |

## 5.3.4 G84 Thread cutting (continued)

**Example**

```
N10  ...
N20  G56  G00     X0   Y0   Z100    S1200   F1500   M03     T01  M16
N30  G84  Z80     P32:10   P33:20   P34:52   P35:60
N40  M05  ...
```

**Sequence plan**

1 Switch spindle on (M03, M04) and X and Y axis in rapid traverse position.

2 After achieving the X and Y positions the Z axis runs on the anticipation plane.

3 After achieving the anticipation plane the Z axis is joined with the spindle axis and the Z axis moves to the drilling depth (P33).

4 With the achieving of the drilling depth the spindle rotation is turned around and the spindle reversal time (P30) recalled.

5 At process of the retention time the Z axis returns to the anticipation plane (P34).

6 With the achieving of the anticipation plane the Z-axis in rapid traverse becomes on the retreat plane (P35) driven and afterwards the spindle switched off (M05).

### 5.3.5 G85 Drilling with retraction at feed rate

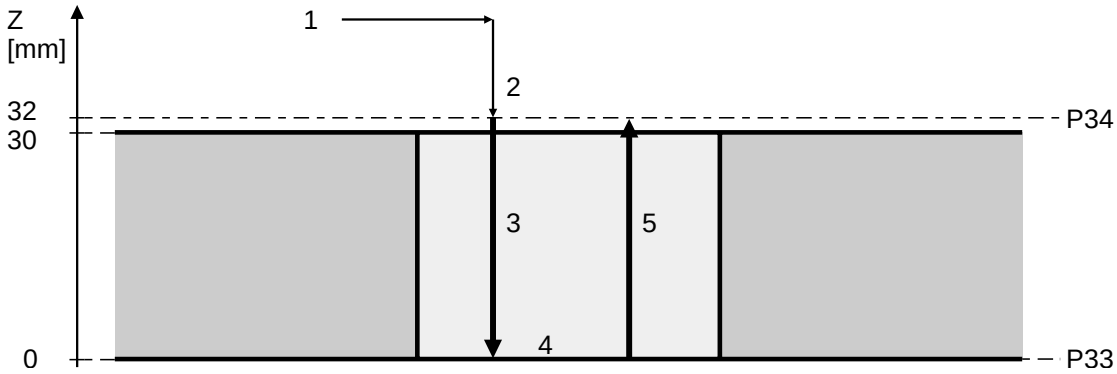



Figure 5-23

**Meaning of the parameters**

| | | |
|---|---|---|
| P30 | free cutting time | |
| P32 | drilling feed | |
| P33 | drilling depth | |
| P34 | anticipation plane | safety margin of the processing upper edge |
| P35 | retreat plane | to running around obstacles in the setting axis |

## 5.3.5 G85 Drilling with retraction at feed rate (continued)

### Example

```
N10  ...
N20  G56  G00     X0   Y0   Z100    S1200   F1500   M03     T01  M16
N30  G85  Z80     P30:1     P32:800 P33:0   P34:32
N40  M05  ...
```

### Sequence plan

1 Switch spindle on (M03, M04) and X and Y axis in rapid traverse position.

2 After achieving the X and Y positions the Z axis runs in rapid traverse on those anticipation plane (P34).

3 After achieving the anticipation plane the Z axis with working feed becomes the drilling depth (P33) moves.

4 With the achieving of the drilling depth a programmed free cutting time (P30) is waited for.

5 Afterwards retreat in the working feed to anticipation plane and becomes following spindle switched off (M05).

## 5.4 G86 / G87 / G88 / G89 cycle patterns

The cycle patterns serve for the repeated version of prozess cycles (boring and milling cycles). Over the programming of certain parameters the points of positioning are described, in which the prozess cycles are to be executed.

The parameters cover the definition of a target as well as the number of points of positioning. For definition of the target and the points of positioning different programming types can be used.

The partitioning of the cycle patterns takes place on the basis of geometrical criteria:

| | |
|---|---|
| G86 | vector type processing |
| G87 | parallelogram type processing |
| G88 | grid type processing |
| G89 | circle type processing |

**The cycle patterns are block by block effective.**

**The parameter inputs remain against it modal effectively.**

In order to avoid over regulation, all parameters are to be reset, which are not used with a programming type.

A compilation of the parameters is listed on the next side.

## 5.4 G86 / G87 / G88 / G89 cycle patterns (continued)

### Parameter for G86 vector type processing

| | |
|---|---|
| P100 | coordinate of the 1. axis (X) |
| P101 | coordinate of the 2. axis (Y) |
| P103 | vector bracket related to the1. axis (X) |
| P104 | vector length |
| P105 | vector splitting |
| P106 | number of points of positioning |

### Parameter for G87 periphery processing of a parallelogram

| Vector 1 | Vector2 | |
|---|---|---|
| P100 | P110 | coordinate of the 1. axis (X) |
| P101 | P111 | coordinate of the 2. axis (Y) |
| P103 | P113 | vector bracket related to the 1. axis (X) |
| P104 | P114 | vector length |
| P105 | P115 | vector splitting |
| P106 | P116 | number of points of positioning |

### Parameter for G88 grid processing

| Vector 1 | Vector 2 | |
|---|---|---|
| P100 | P110 | coordinate of the 1. Axis @@@(x) |
| P101 | P111 | coordinate of the 2. Axis @@@(y) |
| P103 | P113 | vector bracket related to the @@@1.Achse (x) |
| P104 | P114 | vector length |
| P105 | P115 | vector splitting |
| P106 | P116 | number of points of positioning |

### Parameter for G89 circle processing

| | |
|---|---|
| P120 | coordinate of the 1. axis (X) of the pitch diameter focal point |
| P121 | coordinate of the 2. axis (Y) of the pitch diameter focal point |
| P122 | circle diameter |
| P123 | start bracket |
| P124 | travel bracket |
| P125 | vector part |
| P126 | number of points of positioning |

## 5.4 G86 / G87 / G88 G89 cycle patterns (continued)

### Messages

Messages to the cycles have numbers, which start with 8xxx.
A listing is to be found in the paragraph ‘ 9,9 messages of cycles ‘.

Messages appear, if

- the target with a programming type by programming of additional parameters multiple is defined and no agreement is achieved.

- the target is not sufficiently determined.

In these cases the program is interrupted.

Therefore all parameters are to be reset, which are not used with a programming type for the definition of the target.

## 5.4 G86 / G87 / G88 G89 cycle patterns (continued)

### Call of prozess cycles with cycle patterns

Together with a cycle pattern call a process cycle (boring or milling cycle) can be activated, which is then called after each positioning step in the cycle pattern.

### Effectiveness of M functions

Pre path M functions are executed in the starting point A, after path M functions in the target B.

M functions, which are effective within cycles (e.g. M03, M05,..), become for each cycle call pre path or after path actively.

### Start the points of positioning

Starting the respective points of positioning effected with G00. Contains the theorem a cycle call, in each point of positioning the cycle is executed. Otherwise an accurate stop (G08) is activated

### 5.4.1 Vector type processing

**Start point and target point with G86**

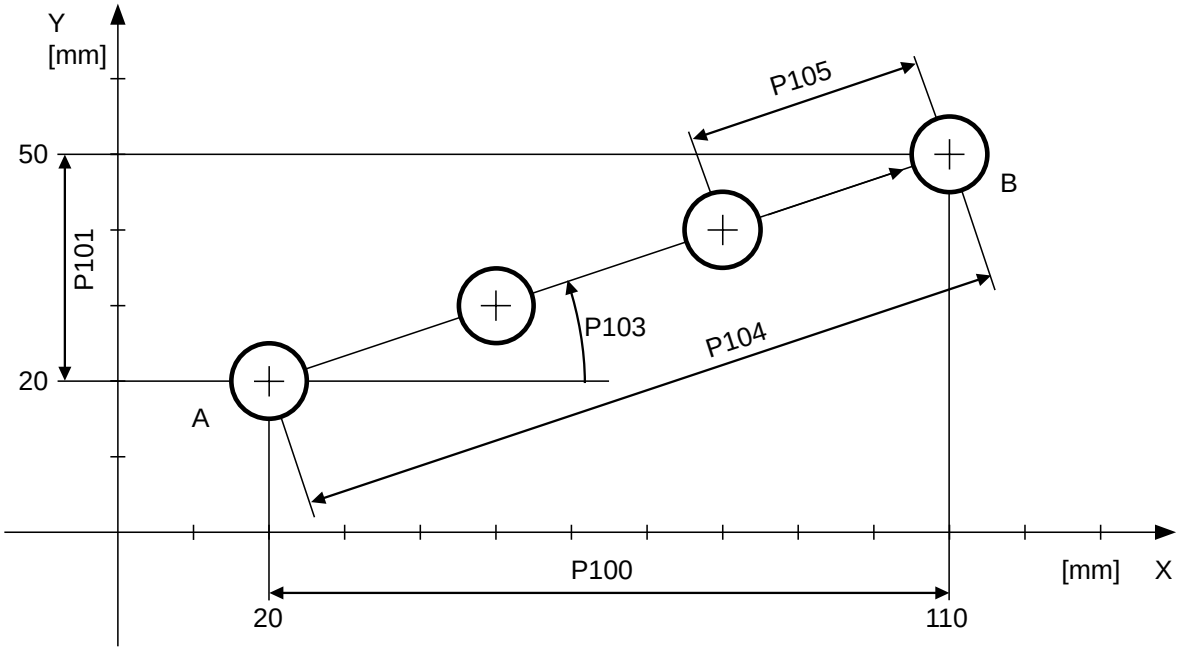



Figure 5-24 A = Start point, B = Target point

**Meaning of the parameters**

P100 AB coordinate of the 1. axis (X)
P101 AB coordinate of the 2. axis (Y)
P103 vector bracket related to the 1. axis (X)
P104 vector length
P105 vector splitting
P106 number of positioning points

## 5.4.1 Vector type processing (continued)

**Example 1: Programming with AB coordinates P100 and P101 and number of points of positioning**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | **P100:90** | **P101:30** | P103:– | P104:– | P105:– | **P106:4** | | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G86** | G81 | | | | | | |

**Example 2: Programming with vector brackets P103 and vector length P104 and number of points of positioning**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | P100:– | P101:– | **P103:20** | **P104:96** | P105:– | **P106:4** | | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G86** | G81 | | | | | | |

**Example 3: Programming with vector brackets P103 and vector splitting P105 and number of points of positioning**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | P100:– | P101:– | **P103:20** | P104:– | **P105:32** | **P106:4** | | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G86** | G81 | | | | | | |

## 5.4.1 Vector type processing (continued)

**Process**

| | |
|---|---|
| N10 | programming of the start point with X and Y |
| N20 | programming of the target point with the parameters<br>P100 and P101 or P103 and P104 or P103 and P105 |
| N30 | programming of the parameters of the process cycle |
| N40 | calls of the cycle pattern and the process cycle |

Sequence of the operation: position first and then process.

Note: not used parameters are to be reset.

## 5.4.1 Vector type processing (continued)

### Programming the start point A

The start point is established by programming the X, Y.. coordinates. If these coordinates have not been programmed the machine stop location coordinates are used as the starting coordinates.

### Programming the target point B

### Programming mode 1

The target point B is established by programming the X (AB) P100 and Y (AB) P101 coordinates.

Bx = Ax + X (AB)
By = Ay + Y (AB)

### Programming mode 2

The target point B is established by programming the angle P103 and the length of vector P104.

X (AB) = P104 * cosP103
Y (AB) = P104 * sinP103

### Programming mode 3

The target point B is established by programming the angle P103, the vector part P105 and the number of positioning points P106.

For P106 equal to or greater than 2 the following apllies:

X (AB) = P105 * (P106-1) * cosP103
Y (AB) = P105 * (P106-1) * sinP103

For P106=0 and P106=1:

X (AB) = P105 * P106 * cosP103
Y (AB) = P105 * P106 * sinP103

## 5.4.1 Vector type processing (continued)

### Data analysis

### Angel P103

≥ 0°: angle in positive mathematical sense (left-handed rotation) referred on the positive vector of the 1. axis (X)

< 0°: angle in negative mathematical sense (right-handed rotation) referred on the positive vector of the 1. axis (X)

≥ 360°: reduction of the angle on smaller 360°

### Influence of the planes that are switched on

The sizes X and Y and the angle P103 are plane-oriented.

| Plane | Axis | P103 referred on the positive vector of the axis |
|---|---|---|
| G17 (XY) | X<br>Y | X |
| G18 (ZX) | Z<br>X | Z |
| G19 (YZ) | Y<br>Z | Y |

### Vector length P104 and vector part P105

Negative values are changed into positive values without indication.

## 5.4.1 Vector type processing (continued)

### Number of positioning points P106

Negative values are changed into positive values.
Non-integer values are round down to the next smaller integer value.

Number of positioning points P106=0
The target point B (from A to B) is approached directly; eventually activated cycles are not executed.

Number of positioning points P106=1
The target point B (from A to B) is approached directly and an eventually activated cycle is executed in the target point.

### Number of positioning points P106 and vector part P105

Further identifications for the programming modes 1 and 2 could be the number of positioning points P106 or the vector part P105.

When indicating the vector part P105, the number of positioning points is determined:

N = (AB / P105) + 1

After this, the vector part is calculated:

T’ = AB / (P106 - 1)

If the calculated number N is an integer number:

P105' = P105

If the calculated number N is not an integer number:

P105' unequal to P105

The positioning points is executed with the value T’.

## 5.4.2 G87 Parallelogram type processing

### Start and target point with G87

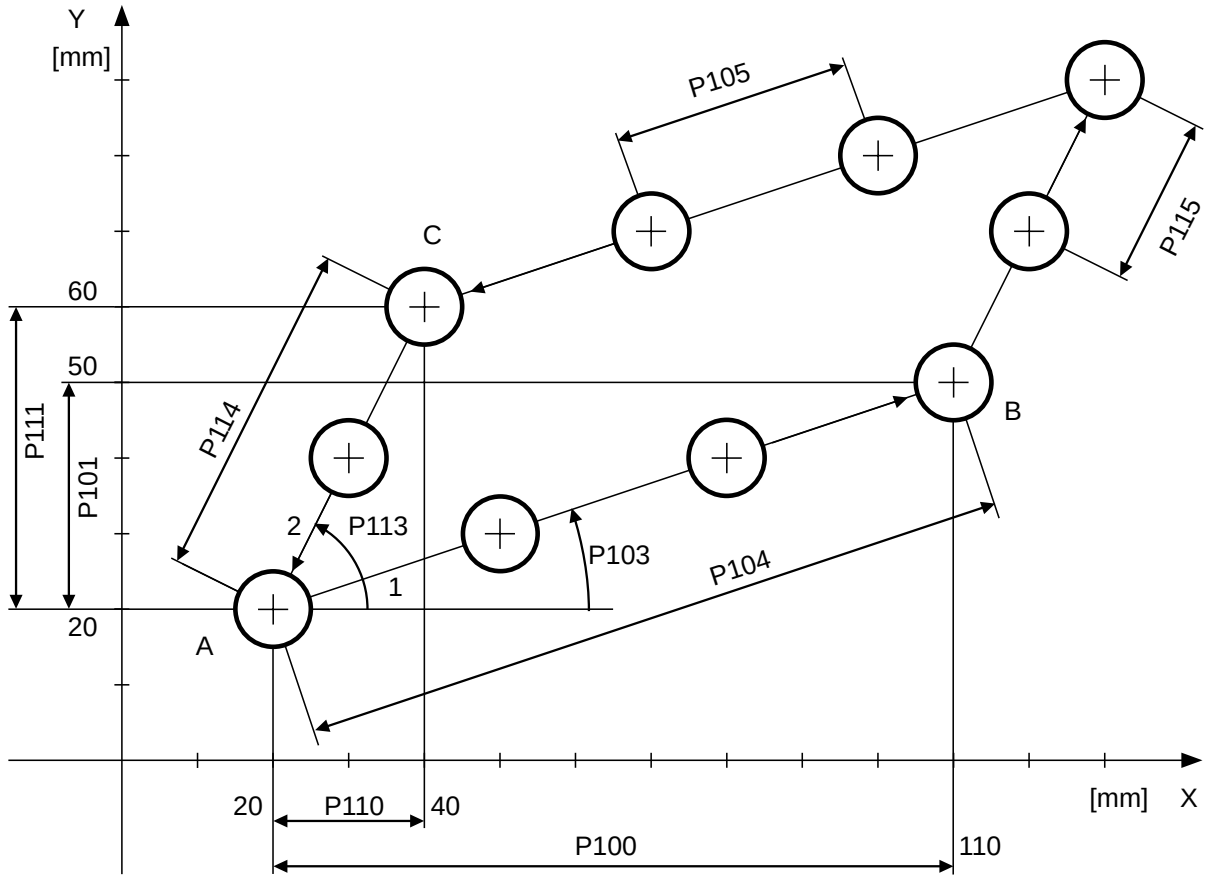



Figure 5-25

### Meaning of the parameters

| Vector 1 | Vector 2 | |
|---|---|---|
| P100 | P110 | coordinate of the 1. axis (X) |
| P101 | P111 | coordinate of the 2. axis (Y) |
| P103 | P113 | ector bracket related to the 1. axis (X) |
| P104 | P114 | vector length |
| P105 | P115 | vector part |
| P106 | P116 | number of positioning points |

## 5.4.2 G87 Parallelogram type processing (continued)

**Example 1:** **Programming with AB coordinates P100, P101 and P110, P111 and number of positioning points**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | **P100:90**<br>P114:– | **P101:30**<br>P105:– | **P110:20**<br>P115:– | **P111:40**<br>**P106:4** | P103:–<br>**P116:3** | P113:– | P104:– | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G87** | G81 | | | | | | |

**Example 2:** **Programming with vector brackets P103, P113 and vector length P104, P114 and number of positioning points**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | P100:–<br>**P114:46** | P101:–<br>P105:– | P110:–<br>P115:– | P111:–<br>**P106:4** | **P103:20**<br>**P116:3** | **P113:60** | **P104:96** | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G87** | G81 | | | | | | |

**Example 3:** **Programming with vector brackets P103, P113 and vector splitting P105, P115 and number of positioning points**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | P100:–<br>P114:– | P101:–<br>**P105:32** | P110:–<br>**P115:23** | P111:–<br>**P106:4** | **P103:20**<br>**P116:3** | **P113:60** | P104:– | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G87** | G81 | | | | | | |

## 5.4.2 G87 Parallelogram type processing (continued)

**Process**

N10 programming of the start point with X and Y

N20 programming of the target point with the parameters
P100, P110 and P101, P111 or P103, P113 and P104, P114 or P103, P113 and P105, P115

N30 programming of the parameters of the process cycle

N40 calls of the cycle pattern and the process cycle

Sequence of the operation: first position and then process.

Sequence of processing: for and return trip always
first vector 1 and then vector 2

Note: not used parameters are to be reset

## 5.4.2 G87 Parallelogram type processing (continued)

### Programming of the start point A

The start point A is determined by programming the coordinates X, Y..
If the coordinates are not programmed, the coordinates of the machine location are used as start coordinates.

### Programming of the target points B and C

### Programming mode 1

The target points B and C are determined by programming the coordinates X (AB) P100 / Y (AB) P101 and X (AC) P110 / Y (AC) P111.

| | | | |
|---|---|---|---|
| Target point B | Bx = Ax + X(AB)<br>By = Ay + Y(AB) | Target point C | Cx = Ax + X(AC)<br>Cy = Ay + Y(AC) |

### Programming mode 2

The target points B and C are determined by programming the angles P103 / P113 and vector length P104 / P114.

| | | | |
|---|---|---|---|
| Target point B | X(AB) = P104 * cosP103<br>Y(AB) = P104 * sinP103 | Target point C | X(AC) = P114 * cosP113<br>Y(AC) = P114 * sinP113 |

### Programming mode 3

The target points B and C are determined by programming the angles P103 / P113, the vector parts P105 / P115 and number of positioning points P106 / P116.

For P106 / P116 >= 2:

| | | | |
|---|---|---|---|
| Point B | X(AB) = P105 * (P106-1) * cosP103<br>Y(AB) = P105 * (P106-1) * sinP103 | Point C | X(AC) = P115 * (P116-1) * cosP113<br>Y(AC) = P115 * (P116-1) * sinP113 |

For P106 / P116 = 0 and P106 / P116 = 1 :

| | | | |
|---|---|---|---|
| Point B | X(AB) = P105 * P106 * cosP103<br>Y(AB) = P105 * P106 * sinP103 | Point C | X(AC) = P115 * P116 * cosP113<br>Y(AC) = P115 * P116 * sinP113 |

## 5.4.2 G87 Parallelogram type processing (continued)

### Data evaluation

### Angle P103, P113

≥ 0°: angle in positive mathematical sense (left-handed rotation) referred on the positive vector of the x-axis

< 0°: angle in negative mathematical sense (right-handed rotation) referred on the positive vector of the x-axis

≥ 360°: reduction of the angle on smaller 360°

### Influence of the plane that is switched on:

The sizes X and Y and the angle P103, P113 are plane-oriented.

| Plane | Axis | P103, P113 referred on the positive vector of the axis |
|---|---|---|
| G17 (XY) | X<br>Y | X |
| G18 (ZX) | Z<br>X | Z |
| G19 (YZ) | Y<br>Z | Y |

### Vector length P104, P114 and vector part P105, P115

Negative values are changed into positive values without indication.

## 5.4.2 G87 Parallelogram type processing (continued)

**Number of positioning points P106, P116**

Negative values are changed into positive values.
Non-integer values are round down to the next smaller integer value.

Number of positioning points P106, P116 = 0
The target point B / C (from A to B / C) are approached directly; eventually activated cycles are not executed.

Number of positioning points P106, P116 = 1
The target points B / C (from A to B / C) are approached directly and an eventually activated cycle is executed in the target point.

**Number of positioning points P106, P116 and vector part P105, P115**

Further identifications for the programming modes 1 and 2 could be the number of drilling holes P106, P116 or the vector part P105, P115.

When indicating the vector part P105, P115, the number of drilling holes is determined:

P106, P116 = (AB / P105, P115) + 1

After this, the vector part is calculated:

P105', P115' = AB / (P106, P116 - 1)

If the calculated number P106, P116 is an integer number:

P105', P115' = P105, P115

If the calculated number P106, P116 is not an integer number:

P105', P115' unequal to P105, P115

The drilling pattern is executed with the value P105', P115'.

## 5.4.3 G88 Grid type processing

### Start and target point at G88

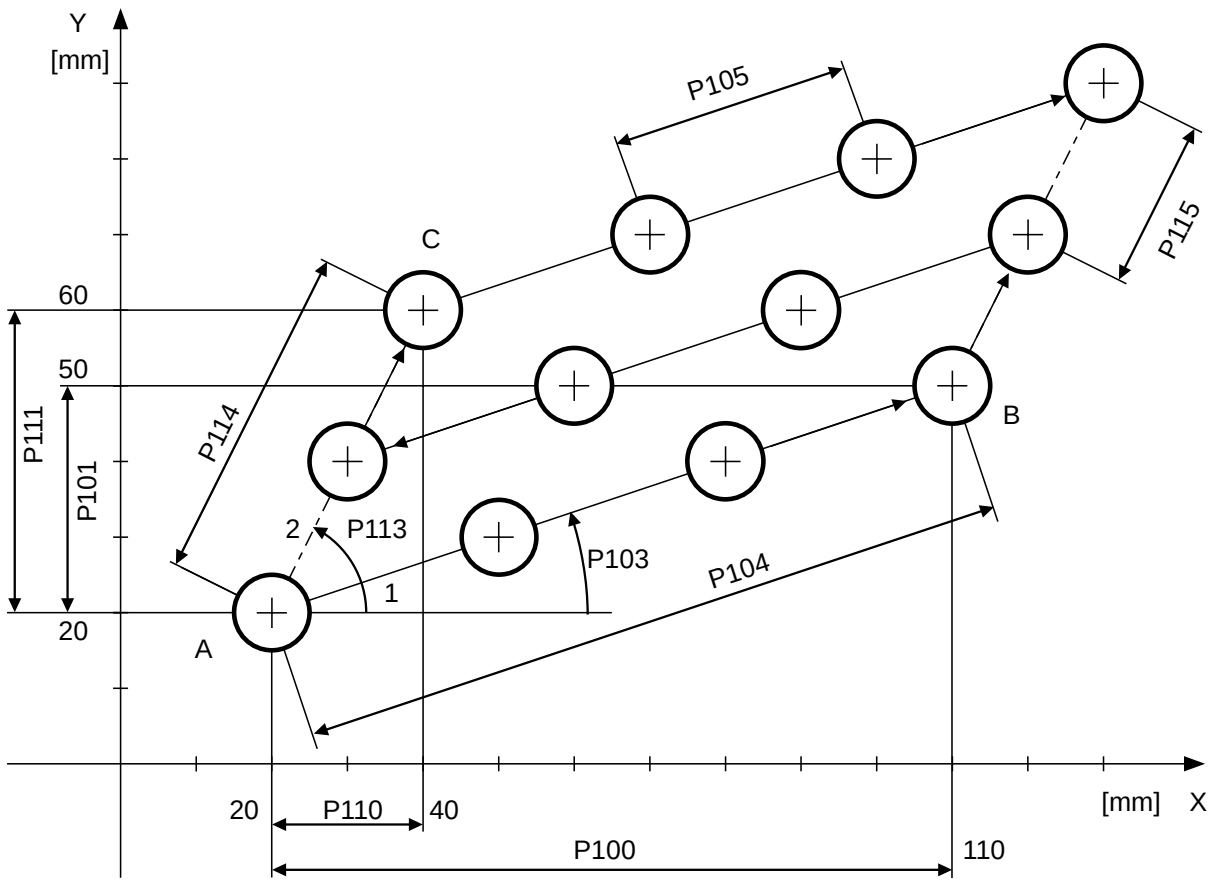



Figure 5-26

### Meaning of the parameters

| Vector 1 | Vector 2 | |
|---|---|---|
| P100 | P110 | coordinate of the 1. axis (X) |
| P101 | P111 | coordinate of the 2. axis (Y) |
| P103 | P113 | ector bracket related to the 1. axis (X) |
| P104 | P114 | vector length |
| P105 | P115 | vector part |
| P106 | P116 | number of positioning points |

## 5.4.3 G88 Grid type processing (continued)

**Example 1:** **Programming with AB coordinates P100, P110 und P101, P111 and number of positioning points**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | **P100:90**<br>P114:– | **P101:30**<br>P105:– | **P110:20**<br>P115:– | **P111:40**<br>**P106:4** | P103:–<br>**P116:3** | P113:– | P104:– | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G88** | G81 | | | | | | |

**Example 2:** **Programming with vector brackets P103, P113 and vector length P104, P114 and number of positioning points**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | P100:–<br>**P114:46** | P101:–<br>P105:– | P110:–<br>P115:– | P111:–<br>**P106:4** | **P103:20**<br>**P116:3** | **P113:60** | **P104:96** | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G88** | G81 | | | | | | |

**Example 3:** **Programming with vector brackets P103, P113 and vector splitting P105, P115 and number of positioning points**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N10 | G00 | **X20** | **Y20** | Z100 | S500 | M03 | T01 | M16 |
| N20 | P100:–<br>P114:– | P101:–<br>**P105:32** | P110:–<br>**P115:23** | P111:–<br>**P106:4** | **P103:20**<br>**P116:3** | **P113:60** | P104:– | |
| N30 | P32:800 | P33:0 | P34:32 | | | | | |
| N40 | **G88** | G81 | | | | | | |

## 5.4.3 G88 Grid type processing (continued)

**Process**

N10 programming of the start point with X and Y

N20 programming of the target point with the parameters
P100, P110 and P101, P111 or P103, P113 and P104, P114 or P103, P113 and P105, P115

N30 programming of the parameters of the process cycle

N40 calls of the cycle pattern and the process cycle

Sequence of the operation: first position and then process.

Sequence of processing: first with journey there first vector 1 completely
and afterwards the first position on vector 2,

then with return trip vector 1 completely
and afterwards the next position on vector 2,

then again with journey there vector 1 completely etc.
until the final position on vector 2 achieves
and the processing of vector 1 is executed

thereafter the initial position is started.

Note: not used parameters are to be reset

## 5.4.3 G88 Grid type processing (continued)

### Programming the start point A

The start point A is determined by programming the coordinates X, Y...
If the coordinates are not programmed, the coordinates of the machine location are used as starting coordinates.

### Programming of the target points B and C

### Programming mode 1

The target points B and C are determined by programming the coordinates X (AB) P100, Y (AB) P101 and X (AC) P110, Y (AC) P111.

| | | | |
|---|---|---|---|
| Target point B | Bx = Ax + X(AB)<br>By = Ay + Y(AB) | Target point C | Cx = Ax + X(AC)<br>Cy = Ay + Y(AC) |

### Programming mode 2

The target points B and C are determined by programming the angles P103, P113 and vector length P104, P114.

| | | | |
|---|---|---|---|
| Target point B | X(AB) = P104 * cosP103<br>Y(AB) = P104 * sinP103 | Target point C | X(AC) = P114 * cosP113<br>Y(AC) = P114 * sinP113 |

### Programming mode 3

The target points B and C are determined by programming the angles E1 / E2, the vector parts T1 / T2 and number of drilling holes N1 / N2.

For N >= 2:

| | | | |
|---|---|---|---|
| Point B | X(AB) = P105 * (P106-1) * cosP103<br>Y(AB) = P105 * (P106-1) * sinP103 | Point C | X(AC) = P115 * (P116-1) * cosP113<br>Y(AC) = P115 * (P116-1) * sinP113 |

For P106, P116 = 0 and P106, P116 = 1:

| | | | |
|---|---|---|---|
| Point B | X(AB) = P105 * P106 * cosP103<br>Y(AB) = P105 * P106 * sinP103 | Point C | X(AC) = P115 * P116 * cosP113<br>Y(AC) = P115 * P116 * sinP113 |

## 5.4.3 G88 Grid type processing (continued)

### Data evaluation

### Angle P103, P113

≥ 0°: angle in positive mathematical sense (left-handed rotation) referred on the positive vector of the x-axis

< 0°: angle in negative mathematical sense (right-handed rotation) referred on the positive vector of the x-axis

≥ 360°: reduction of the angle on smaller 360°

### Influence of the plane that is switched on:

The sizes X and Y and the angle P103, P113 are plane-oriented.

| Plane | Axis | P103, P113 referred on the positive vector of the axis |
|---|---|---|
| G17 (XY) | X<br>Y | X |
| G18 (ZX) | Z<br>X | Z |
| G19 (YZ) | Y<br>Z | Y |

### Vector length P104, P114 and vector part P105, P115

Negative values are changed into positive values without indication.

## 5.4.3 G88 Grid type processing (continued)

**Number of drilling holes P106, P116**

Negative values are changed into positive values.
Non-integer values are round down to the next smaller integer value.

Number of drilling holes P106, P116 = 0
The target points B / C (from A to B / C) are approached directly; eventually activated cycles are not executed.

Number of drilling holes P106, P116 = 1
The target points B / C (from A to B / C) are approached directly and an eventually activated cycle is executed in the target point.

**Number of drilling holes P106, P116 and vector part P105, P115**

Further identifications for the programming modes 1 and 2 could be the number of drilling holes P106, P116 or the vector part P105, P115.

When indicating the vector part P105, P115, the number of drilling holes is determined:

P106, P116 = (AB / P105, P115) + 1

After this, the vector part P105, P115 is calculated:

P105', P115' = AB / (P106, P116 - 1)

If the calculated number P106, P116 is an integer number:

P105', P115' = P105, P115

If the calculated number P106, P116 is not an integer number:

P105', P115' unequal to P105, P115

The drilling pattern is executed with the value P105', P115'.

## 5.4.4 G89 Circle type processing

### Start and target point at G88

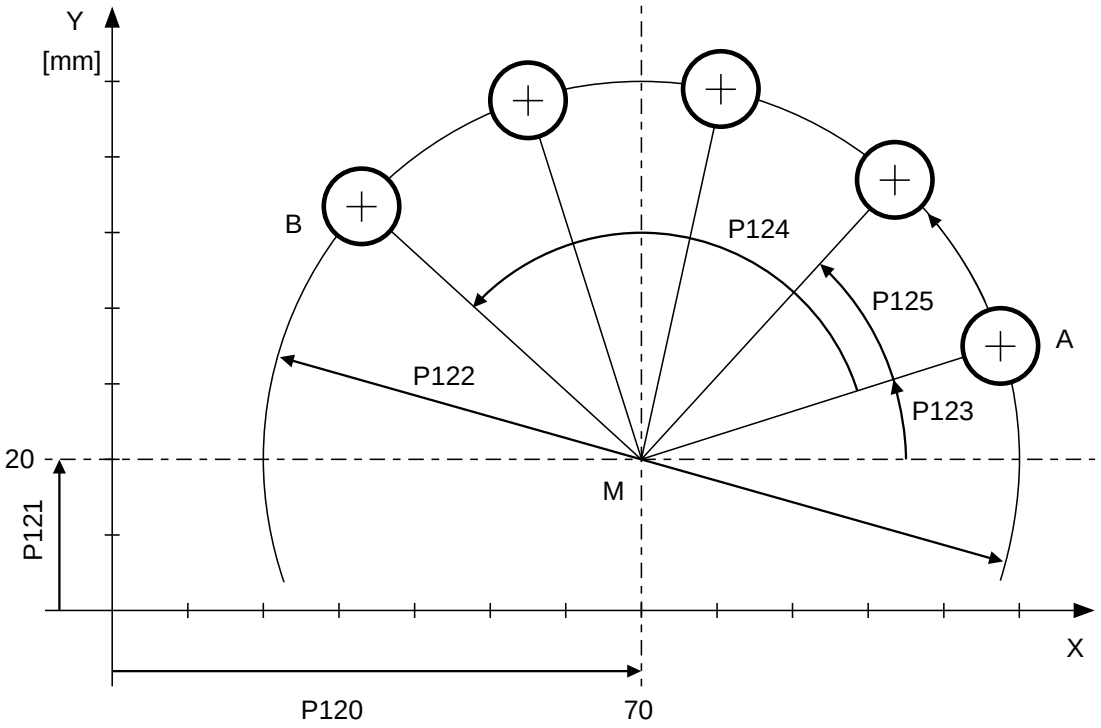



Figure 5-27

### Meaning of the parameters

| | |
|---|---|
| P120 | Coordinate of the 1. axis (X) of the positioning points |
| P121 | Coordinate of the 2. axis (Y) of the positioning points |
| P122 | Pitch circle diameter |
| P123 | Start angle |
| P124 | Travel angle |
| P125 | Vector part |
| P126 | Number of positioning points |

## 5.4.4 G89 Circle type processing (continued)

**Example 1:** **Programming with centre coordinates P120, P121, circle diameter P122, start brackets P123 and travel bracket P124 and number of positioning points**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| N10 | G00<br>M03 | Z100<br>T01 | S500<br>M16 | | | | |
| N20 | **P120:70** | **P121:20** | **P122:100** | **P123:18** | **P124:120** | P125:-- | **P126:5** |
| N30 | P32:800 | P33:0 | P34:32 | | | | |
| N40 | **G89** | G81 | | | | | |

**Example 2:** **Programming with centre coordinates P120, P121, circle diameter P122, start brackets P123 and vector part P125 and number of positioning points**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| N10 | G00<br>M03 | Z100<br>T01 | S500<br>M16 | | | | |
| N20 | **P120:70** | **P121:20** | **P122:100** | **P123:18** | P124:-- | **P125:30** | P126:-- |
| N30 | P32:800 | P33:0 | P34:32 | | | | |
| N40 | **G89** | G81 | | | | | |

## 5.4.4 G89 Circle type processing (continued)

**process**

N10 programming of the start point with P120, P121, P122 and P123

N20 programming of the target point with the parameters
P120, P121, P122, P123 and P124 or P120, P121, P122, P123 and P125

N30 programming of the parameters of the process cycle

N40 calls of the cycle pattern and the process cycle

Sequence of the operation: first position and then process.

Sequence of processing: dependent on the programmed type of interpolation G00, G01 or G02, G03 become the particulars positions straight linear or circular interpolates started.

Note: not used parameters are to be reset

## 5.4.4 G89 Circle type processing (continued)

### Programming the start point A

The starting point A always has to be determined by programming identifications at G89, i.e. the pitch circle centre point P120, P121, the pitch circle radius P122/2 and the starting angle P123.

### Programming the target point B

### Programming mode 1

The target point B is determined by programming the travel angle P124.
Bx = P120 + (P122/2) * cos(P123+P124)
By = P121 + (P122/2) * sin(P123+P124)

### Programming mode 2

The target point is determined by programming the number of positioning points P126 and the vector part P125.
Bx = P120 + (P122/2) * cos(P123 + (P126-1) * P125)
By = P121 + (P122/2) * sin(P123 + (P126-1) * P125)

P124 = (P126-1) * P125

## 5.4.4 G89 Circle type processing (continued)

### Data evaluation

### Angle P123

≥ 0°: angle in positive mathematical sense (left-handed rotation) referred on the positive vector of the x-axis

< 0°: angle in negative mathematical sense (right-handed rotation) referred on the positive vector of the x-axis

≥ 360°: reduction of the angle on smaller 360°

### Influence of the plane that is switched on:

The sizes X and Y and the angle P123 are plane-oriented.

| Plane | Axis | P123 referred on the positive vector of the axis |
|---|---|---|
| G17 (XY) | X<br>Y | X |
| G18 (ZX) | Z<br>X | Z |
| G19 (YZ) | Y<br>Z | Y |

### Vector part P125

Negative values are changed into positive values without indication.

## 5.4.4 G89 Circle type processing (continued)

### Number of positioning points P126

Negative values are changed into positive values.
Non-integer values are round down to the next smaller integer value.

Number of positioning points P126 = 0
The target point B (from A to B) is approached directly; eventually activated cycles are not executed.

Number of positioning points P126 = 1
The target point B (from A to B) is approached directly and an eventually activated cycle is executed in the target point.

### Number of positioning points P126 and vector part P125

Further identifications for the programming modes 1 and 2 could be the number of positioning points P126 or the vector part P125.

When indicating the vector part P125, the number of positioning points P126 is determined:

P126 = (P124 / P125) + 1

After this, the vector part is calculated:

P125' = P124 / (P126-1)

If the calculated number P126 is an integer number:

P125' = P125

If the calculated number N is not an integer number:

P125' unequal to P125

The drilling pattern is executed with the value P125'.

## 5.4.4 G89 Circle type processing (continued)

### Starting the points of positioning (G89)

Starting of the points of positioning depends on the programmed type of interpolation.

### G00 or G01 actively

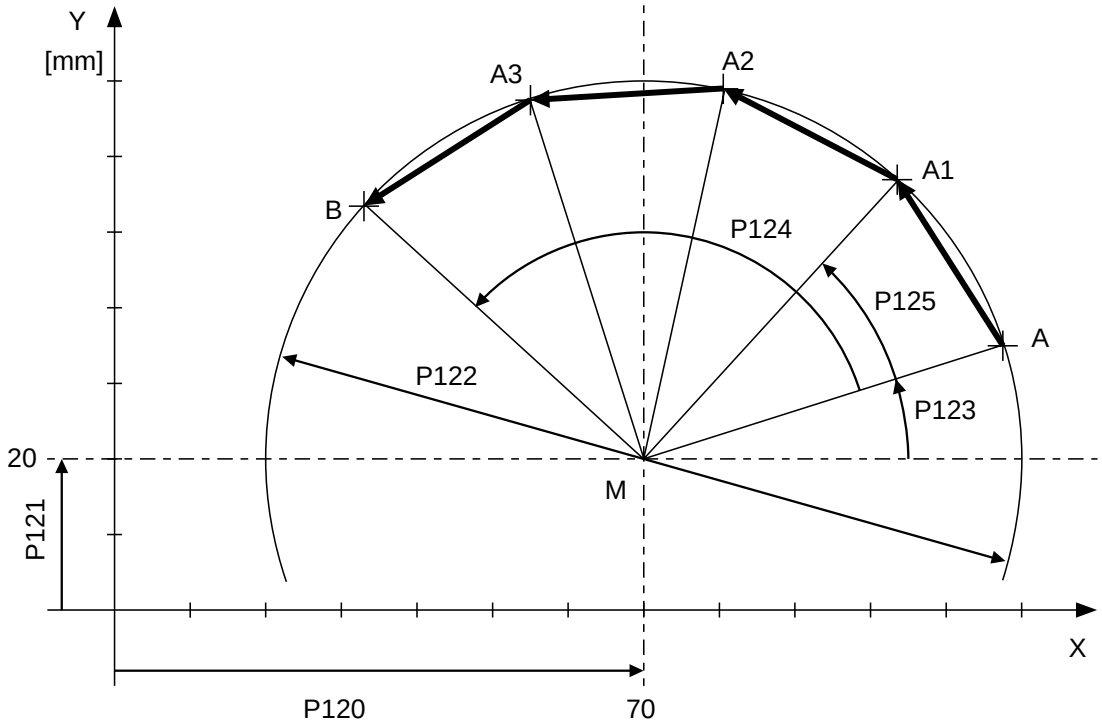



Figure 5-28

The positions (A1, A2, A3 and B) are started with G00.
The sign of the travel bracket P124 or, if this does not indicated, the sign of the vector part P125 determines, whether the circle is anti-clockwise rotation or is clockwise rotation processed:

| | |
|---|---|
| Positive sign of the bracket: | anti-clockwise rotation, |
| Minus sign of the bracket: | clockwise rotation. |

## 5.4.4 G89 Circle type processing (continued)

**G02 or G03 actively**

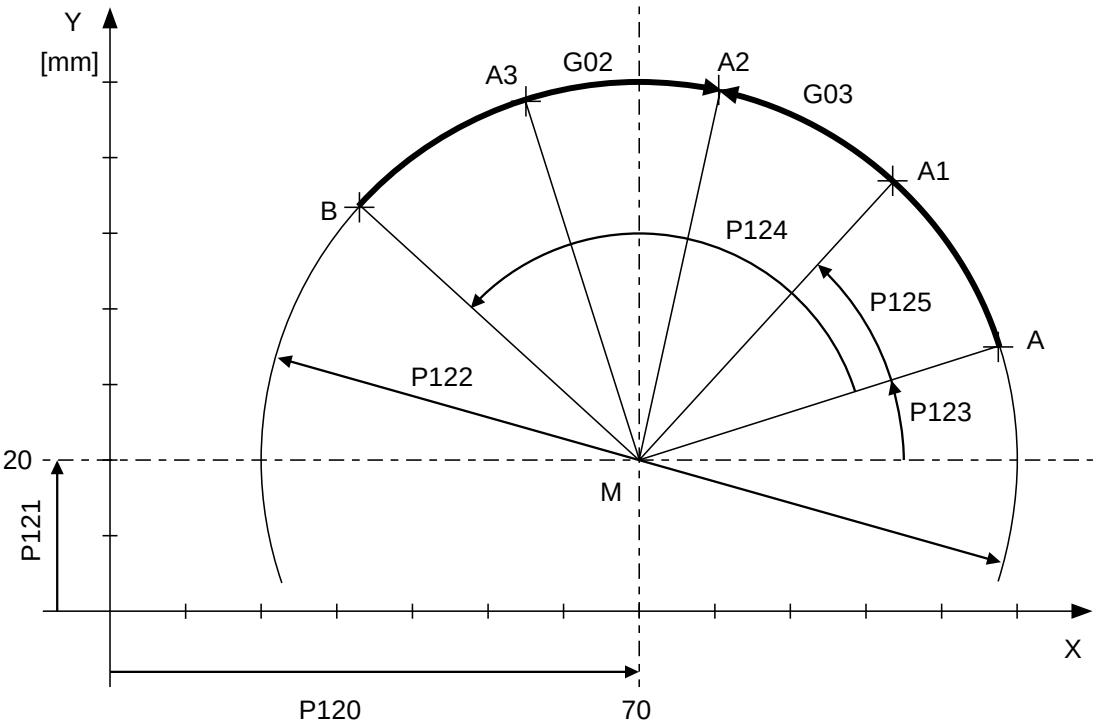



Figure 5-29

The positioning points are started with G02 or G03 and max. programmable feed speed.

Two cases are to be differentiated:

**The travel bracket is positive (anti-clockwise rotating)**

With G03 also the positioning direction is positive.
With G02 the positioning direction is negative (moving in opposite directions to the travel bracket).

**The travel bracket is negative (clockwise rotatingly)**

With G02 also the positioning direction is positive.
With G03 the positioning direction is negative (moving in opposite directions to the travel bracket).

## 5.5 Customer specific cycles

A cycle is a program that generates certain repeated sequences.

For user-specific cycles, these sequences are defined in a Z-program.

Example:
```
Z1001
N10  ...
.
.
N40  P500 : P500+1
.
.
N60  M30
```

The defined cycle can be started then in a machining program with a G-function.
The G-function must have the same number as the Z-program.

Example:
```
P2000

N10  ...
.
.
N60  P500 : 2    G1001
.
.
N90  M30
```

The G-function numbers can be selected arbitrarily except those numbers that are already reserved for other functions.

Input variables can be transmitted to the Z-program with parameters. The parameter numbers P500 to P4999 are free for the user. P0 to P499 is reserved for BWO-cycles.
If the BWO-cycles are not used, they are also free for the user.

Addtional functions to the operating system
Additional functions could be implemented with a DLL (Dynamic Link Library) that is written in programming language C.

# 6. Supplementary functions

## 6.1 Program controlling supplementary functions

M00 Measuring stop

M01 Synchronization

M02 Sub-routine skip back

M06 / M16 Tool functions

M23 Unconditional skip with statement of block number

M24 / M25 Program loops

M26 Supervision ‘clear remaining travel’

M28 Unconditional skip in sub-routine

M29 End of program with program repetition

M30 End of program

If parameter skips are programmed in the NC block, they are treated with priority!

### 6.1.1 M00 Measuring stop

Program run is shut down and spindle stop becomes effective after completion of the block in which M00 is programmed. Automatic mode is possible after Auto-Stop.

With pressing the key ‘Start’ the NC program continues and the spindle is switched on.

Example: X37,95 Y12,76 M00

After approaching the coordinates X and Y the program sequence is interrupted.

The function operates block by block.

M00 may only be programmed when the tool-radius-contour correction (G40) is switched off.

### 6.1.2 M01 Synchronization

The function M01 causes a synchronization of program analysis and real time machining.
M01 operates block by block and is executed after the path machining.

When processing a program the block analysis of the real time runs some blocks ahead.

Example:

```
N10  G01  F1000     X10  Y10
N20                 X20
N30                 X100
N40                 X50
N50  P100:20
```

In this NC program the axes traverse in the current block N10, while the block analysis is already executing the parameter instruction of block N50.

This running ahead of the block analysis can be stopped through programming M01. IF M01 is programmed in a block, the block analysis at the block end is waiting until this block is really worked.

### 6.1.3 M02 Sub-routine skip back

After processing the block in which M02 is programmed, a skip back into the calling programm is executed in a sub-routine in the calling program (after traverses, without stop).

### 6.1.4 M06 / M16 Tool functions

**M06** **Tool change**

**M16** **Tool data call**

see paragraph 7.1 Tool functions

### 6.1.5 M23 Unconditional skip

With M23 the program is continued at the indicated program - and block number.

The function operates block-by-block.

The skip is programmed with M23 and indicating program - and block number, e.g.

M23.110 skip to block 110 or

M23.10.110 skip in program 10 to block 110 .

### 6.1.6 M24 / M25 Program loop

**M24 Program loop start**

With loop programming program parts of the same kind can be repeated.

The program loop start is programmed with M24 and indicating the runs, e.g. M24.07 (7 runs of the loop). The loop number is to be found in P8840.

It has to be considered, that the block, in which the program loop stard is to be found (M24.. .), does not belong to the program loop.

The function M24 operates block-by-block.

**M25 Program loop end**

This function marks the end the program loop. After processing the block in which M25 is programmed, the program skips back to the loop start. If all runs are worked, the program is continued with the block following on M25.

The function operates block-by-block.

### 6.1.7 M26 Supervision ‘Clear remaining travel’

The supervision ‘clear remaining travel’ is active.

The function operates block-by-block and effective before axes movements.

From M26 on the interpolator supervises the signal ‘clear remaining travel’ from the PLC and executes the command. If the signal lines up already, the travel is cleared immediately.

### 6.1.8 M28 Unconditional skip in sub-routine

Program parts, which are repeated in a program, can be written as sub-routine. Also each arbitrary program can be called up as sub-routine, e.g.

M28.300 starts program 300 .

The control remembers the skip address and continues the calling program at the block following on M28, if the sub-routine is finished.

The sub-routine skip back can be programmed with M02.

A nesting of the sub-routines is possible four times.

The function M28 operates block-by-block.

### 6.1.9 M29 End of program and program repetition

After processing the block in which M29 is programmed, the program is finished, executed a skip at the beginning of the program and the program is restarted automatically.
The preset G - functions become effective again.

IF M29 stands at the end of a program, which was called up as sub-routine, a sub-routine skip back is executed.

The function operates block-by-block.

### 6.1.10 M30 End of program and skip to program start

After processing the block in which M30 is programmed, the program is finished and a skip to the beginning of the program is executed (after traverse, with stop).
The preset G - functions become effective again. Besides that Spindle Stop and Coolants off become active.

The function operates block-by-block.

## 6.2 Machine controlling supplementary functions

Area : 0 .. 999

There may be programmed 8 M-functions per NC block.

The M-functions can be defined as
- before traverse
- after traverse
- with stop
- with skip

(Skip-M-functions are always before traverse with stop, see q1050 .. 1099.)

At M-functions with skip, the skip target can exist either only of the block number or of program number and block number

e.g.:

| | |
|---|---|
| M41.2.10 | If M-function confirmed, skip to program 2 block number 10 |
| M41.10 | If M-function confirmed, skip to block number 10 |

If the M-function is confirmed, it is skiped to the indicated block number and/or in the indicated program with indicated block number.
At a skip impending ways are deleted and the NC block buffer is cleared.

With no confirmation the NC block interpreter switches over to the next NC block.

# 7. Tool

## 7.1 Tool functions

### General to the tool data

- The tool length in the offsetting record is always taken into consideration in autooperation (according to G17 / G18 / G19 in 3. defined axis).

- In the case of NC program end or NC program abort the spindle tool data becomes theorem into the offsetting record copies.
  Thus tool offset compensations of the NC program (M16) become ineffective.
  When starting of the next NC program is immediately the length of the spindle tool actively (offsetting data).

- The tool length works as shift.
  The indicator position is the programmed position from the NC program.
  The tool length adds itself in the sum shift parameter (P12155).

- The who things radius works as correction.
  The indicator position is smaller or larger than the programmed position from that NC program.

## 7.1 Tool functions (continued)

### T Selection of the group of tools in the NC program

The tool number T is identified and treated with in the analysis. In the tool data array a browsing is started after the suitable group of tools.
When finding the programmed group of tools this record is copied into the PLC tool data array (P8050) and transferred thus to the PLC.

A transfer to the PLC finds however only,

- the first T call in the NC program or
- a modification of the T number.

**Special case**
If a tool is called, which already is in the spindle (P8100), then the PLC tool data array is filled not from the tool data pool, but the spindle tool record is only copied into the PLC tool record.

Example N10 T5

**T extension**
For special customer adaptations the T function permits a covered subroutine reference. With each analyzed T, the NC memory is scanned for a Z5. If Z5 exists, then this cycle is covered called. With the call of Z5 the PLC Interface (P8050...) with the new data is described.

## 7.1 Tool functions (continued)

### Tool definitions t...

Existed in the system no tool tools, then can over the identifier, ‘t:’, ‘tr:’, ‘tq:’, ‘tl:’ tool data to be set, with which a radius correction (G41/42) activated afterwards operates. These tool definition can be combined at will in a NC block.
With all functions the tool offsetting record is described (P8150...); i.e. there is temporary tool datas, which are overwritten at a Tx M6 or Tx M1 or at the program end.

For activating everything of these tool tools is not necessary M16.

### ‘ t: ‘ - Tool radius correction

With the programming of ‘ t: ‘ in the offsetting record only the radius correction of the tool (P8162) is described and activated.
A G41/42 programmed afterwards uses the total of P8160 and P8162 as correction radius!
The quadrant and other tool datas remain unchanged!
This function is practical, in order to correct past tool radius.

Example:

```
N10  ...
N20  t:0.5                    {modification of the past tool radius }
N30  G1 X100 Y100 G42
N40  ...
```

### ‘ tr: ‘ - Tool radius

With the programming of ‘ tr: ‘ in the offsetting record the radius correction of the tool (P8162) is set to zero and the tool radius (P8160) with the programmed value is described.
The quadrant and other tool data remain unchanged!

Example:

```
N10  ...
N20  tr:50                    { setting the tool radius }
N30  G1 X100 Y100 G42
N40  ...
```

## 7.1 Tool functions (continued)

### Tool definitions t...

#### ‘ tl: ‘ - Tool length

With the programming of ‘ tl: ‘ in the offsetting record the length correction of the tool (P8163) is set to zero and the tool length (P8161) with the programmed value is described.
The quadrant and other tool datas remain unchanged!

Example:

```
N10  ...
N20  tl:80                    { setting the tool length }
N30  G1 X100 Y100
N40  ...
```

#### ‘ tq: ‘ - Tool quadrant

With the programming of ‘ tq: ‘ in the offsetting record the tool quadrant (P8164) is set or modified.
Other tool datas remain unchanged!

Example:

```
N10  ...
N20  tr:5   tq:4              {setting a tool radius with quadrant }
N30  G1 X100 Y100 G42
N40        ...
```

## 7.1 Tool functions (continued)

### M06 Tool change

With M06 the tool change is started up. M06 with synchronisation and stop must be defined (see P11051 or P8351).

2 possibilities the tool change consist to execute:

- 1. Tool change in the cycle
- 2. Tool change completely in the PLC implements.

to 1. If the theorem analysis a M06 identifies, it is checked whether the cycle 6 (Z6) exists. There is Z6, then this sub-routine is called, in that the tool change one handles. The actual tool change may not then in the PLC any more with M06 to be executed. But other M function numbers must be used. At the program end of Z6 from the system synchronized and following will become the tool datas taken into consideration (M16).

to 2. If Z6 does not exist, then this means that the PLC with the reception of M06 that Tool change executes. After acknowledgement of M06 the tool datas become taken into consideration (M16).

## 7.1 Tool functions (continued)

**Process of a tool change over PLC** (M06 with stop and synchronisation defines):

PLC receives M06

- If a tool is in the spindle, old tools placing.
  This is closed, as P8047 with the tool place is described.

- Subsequently, the tool (T) is changed.
  (tool number and tool place were transferred in the tool data theorem).
  If the change is final, this is acknowledged with the M function-acknowledgement.
  Beforehand P8045 must be however still described.

## 7.1 Tool functions (continued)

### Course of a tool change with Z6

Z6 is called up as sub-routine with M06.

Example:

```
Z6
N10  P8047:1      store tool data
N20  P8045:1      activate tool data
N30  M30
```

N10 P8047:1 Store tool data

The tool data theorem in the spindle tool data theorem (P8100) is retransferred into the tool data array. If the spindle tool datas are from T0, one does not retransfer.

N20 P8045:1 Activate tool data

The tool data theorem (P8050...) becomes into the spindle tool data theorem (P8100...) and the offsetting record (P8150...) copies.

N30 M30

With the program end of Z6 the tool data are activated (M16).

## 7.1 Tool functions

**Example for course of a tool change with Z6**

NC main program
N...
N...
N100 T3 M6 Call up tool change
N..
N...

When calling up Z6, the parameter area P8050..8099 is actualized with the new tool data of T3.

Z6

| | |
|---|---|
| N10 _wzwxl_x_pos := 1000; _wzwxl_y_pos:= 300; | Definition of the position for laying down / picking up |
| N30 P8100=P8050.200 | Check if tool-old = tool-new |
| N40 P8100=0.100 | Check if a tool is in the spindle<br>If not: do not store tool data |
| N50 G00 X:_wzwxl_x_pos Y:_wzwxl_y_pos M01 | Approach position for lay down P8120: |
| N60 P8047:1 | Store tool data (Trigger) |
| N100 P8050=0.200 | Check if tool should be picked up.<br>No tool picking up at T0. |
| N120 G00 X:_wzwxl_x_pos Y:_wzwxl_y_pos M01 | Approach position for picking up |
| N140 P8045:1 | Activate tool data |
| N200 M30 | |

#

## 7.1 Tool functions (continued)

### M16 Tool data call up

M16 with T in the NC block e.g.: N10 T1 M16

During pre-analysis time the corresponding tool data block from the tool data block array is loaded into the actual settlement data block with M16 according to the programmed T-number.
At T0 the settlement data block is cleared.

M16 without T in the NC block e.g.: N10 M16

The settlement data block is activated with M16.

The current spindle tool data block is not changed through M16. M16 can be transmitted to the PLC, if desired. This is not necessary for the function of the tool data call up.
The tool radius is activated with calling up G41 / G42 (tool radius path correciton left / right). The tool - length becomes active at the block end.

e.g.: N100 T2 M16 tool data call up
:
N120 X100 Y100 G42 call up tool radius path correction

## 7.2 Tool correction

The workpiece programming with tool correction enables the application of tools with different dimensions (example: regrinding of tools).
The dimensions of the tools are indicated with the corresponding T-address. The tool data are calculated by the control on the target path.

This enables the programming of graphically determined workpiece correction and results that the time-costly calculation of base for the cutter center point path is discontinued.

The correction method used for the BWO-control is composed of a combination between intersection - and blending radius correction.

The tool correction is only accomplished in blocks, in which the traverse to be proceeded is unequal to zero (travel differences unequal to zero at straights, radius unequal to zero at circles). The blocks with travels equal to zero are executed at the intersection point or at the end of the inserted transition circle. The amount of one after another lying blocks with travels equal to zero is limited on 12.

Outer contour

Completion of the tool correction
at the beginning of the transition circle

Inner contour

completion of the tool correction at
the intersection point

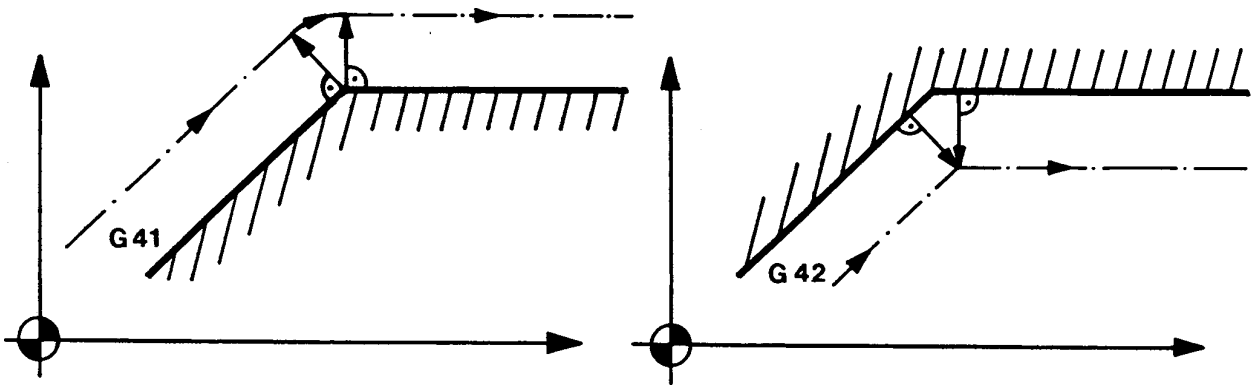



Figure 7-1 Completion of the tool correction

## 7.2 Tool correction (continued)

### Tool dimensions

With M06 / M16 the stored tool dimensions are activated and the tool correction is accomplished.

The tool dimensions of the active tool data are calculated into the position display.
Thereby the position display of the tool axis is the same like the programmed target position, if the axis is driven in position.

The tool axis is determined by the active plane selection of the interpolation main plane. See also G17, G18, G19.

### Tool radius

With the traverse conditions G40, G41 and G42 is determined, whether and how the tool radius correction has to be calculated.

Any correction is stopped with G40.
A preceded G41 or G42 is cancelled.

G41 means, that the tool is found on the left side of the programmed path (seen in feed direction).
G42 means, that the tool is found on the right side of the programmed path (seen in feed direction).

The tool radius can be entered positive or negative.
At a positive tool radius the programmed tool correction is calculated.
At a negative tool radius the programmed tool correction is changed: G41 becomes G42 and G42 becomes G41.

The tool radius correction is executed in the indicated interpolation plane. Before changing the interpolation plane correction must be cancelled with G40.

The tool correction can calculate different tool radius, which can be called up with different T-functions.

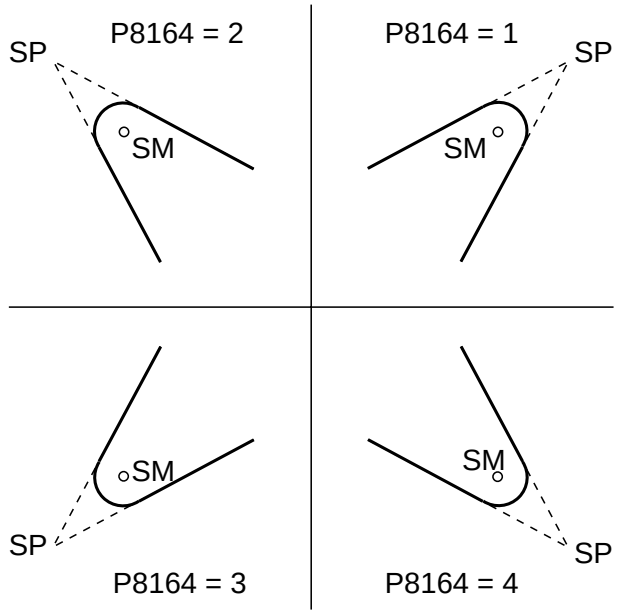
## 7.2 Tool correction (continued)

### Position of the tool

The relative position (quadrant) between tool and workpiece is indicated in P8164.

Definition of the quadrants

| | |
|---|---|
| P8164 = 1 to 8 | quadrant 1 to 8 |
| P8164 = 0 = 9 | no quadrant correction<br>SP = SM |
| SP | theoretical tool peak |
| SM | radius center point ot the tool |



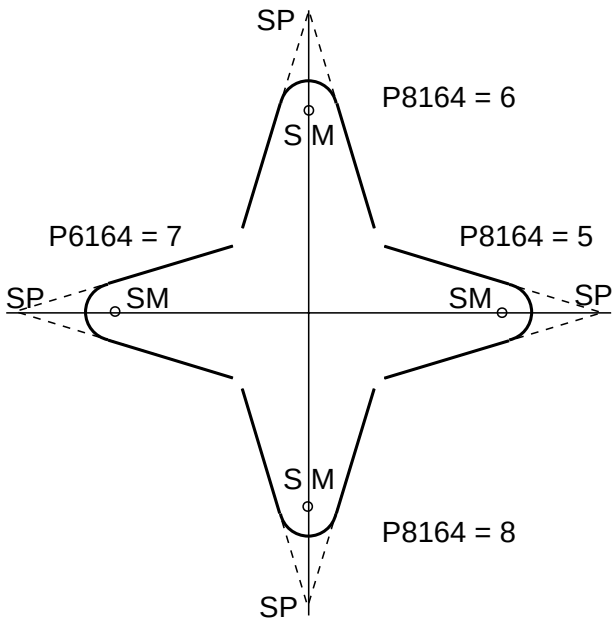




Figure 7-2

## 7.2 Tool correction (continued)

**Special case: Switch off the correction with changing the plane**

The switching off of the correction (G40) in a block with travel equal to zero followed by a block with changing plane (G17, G18, G19) leads to wrong positioning of the axes.

| | |
|---|---|
| Example: N200 G40 Z100 | switching off of the correction in plane G17 and travel equal to zero. |
| G18 X20 Y50 | position is approached wrong. |
| Solution: N200 G40 X40 Y100 Z100 | switching off of the correction in plane G17 and travel unequal to zero. |
| N210 G18 X20 Y50 | position is approached right. |

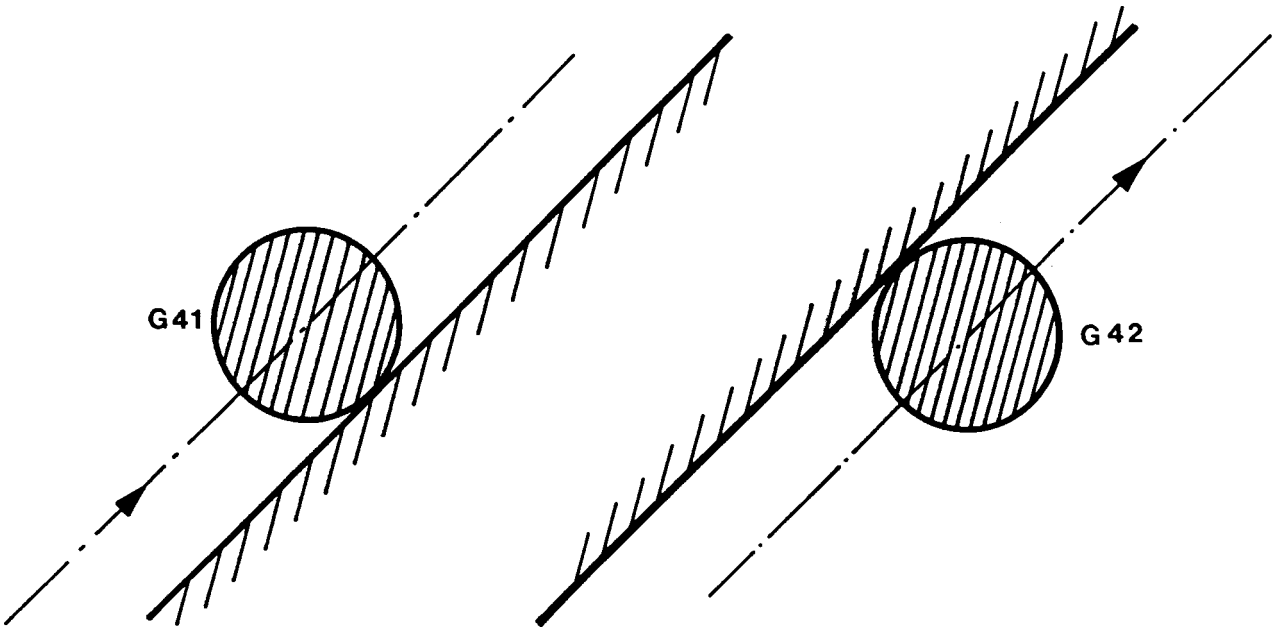



Figure 7-3 Definition of G41 and G42

## 7.3 Correction principle

If the correction is switched on, the path correction is always accomplished with the same principle:

The corrected path is displaced for the amount of the indicated radius value in reference to the programmed path. The thereby emerging path end points are determined by the cutting of the corrected path elements.

At the outer contour and at changing the correction a transition radius is inserted. At the inner contour the intersection is calculated.

The principle of the correction is explained in the following sketches:

Transition straight - straight

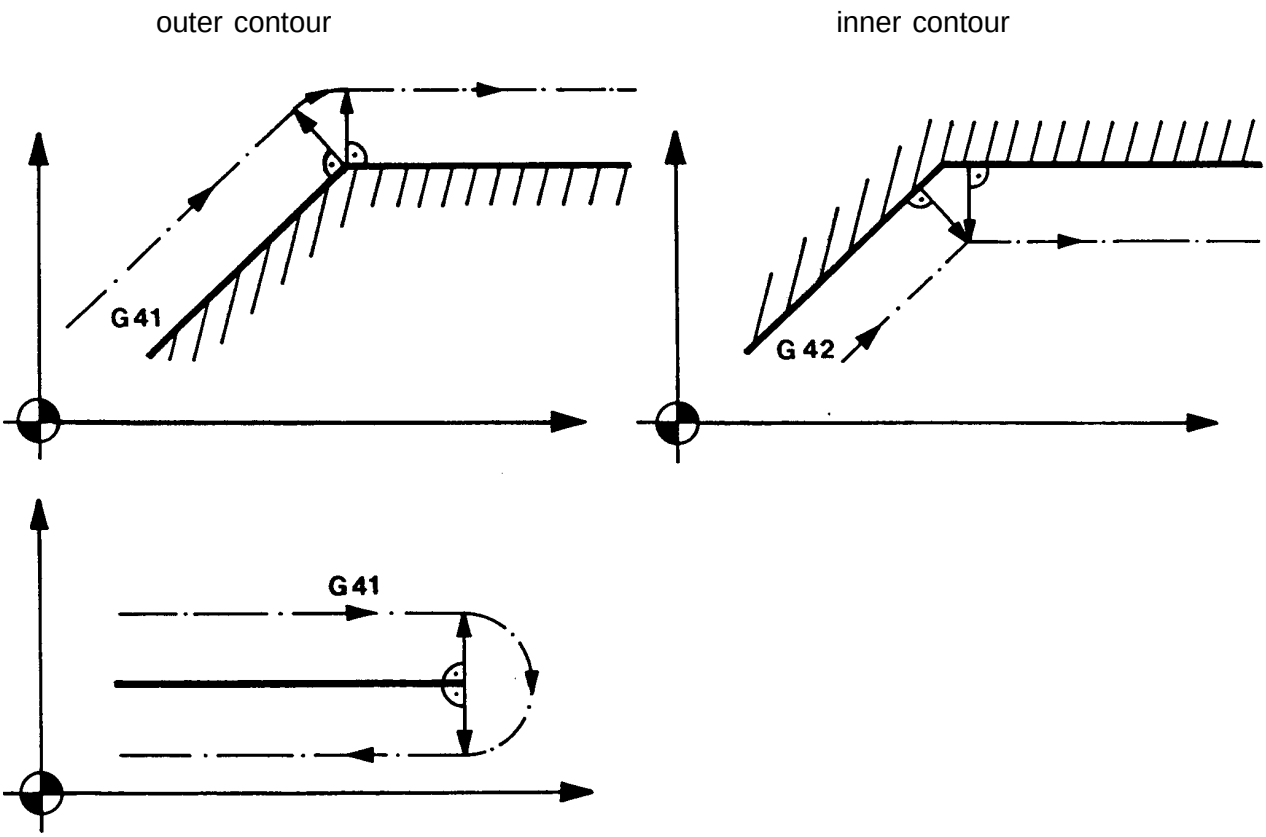
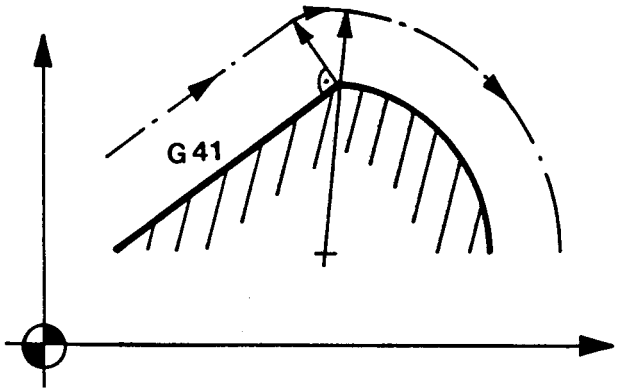



Figure 7-4

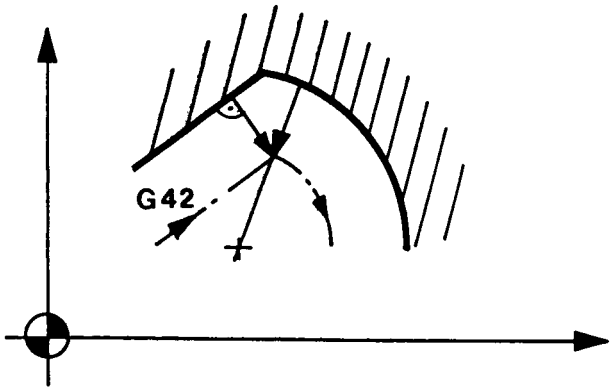
## 7.3 Correction principle (continued)

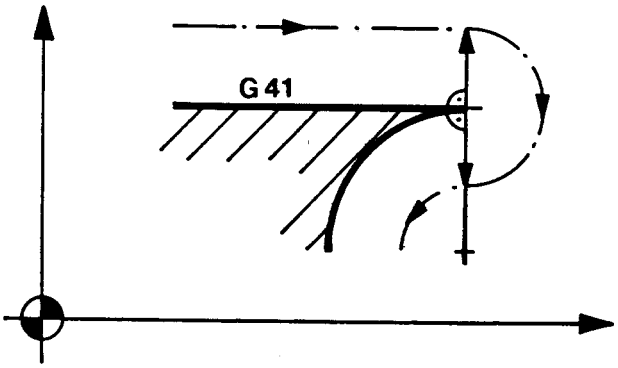
Transition straight - circle (also for circle - straight)

outer contour

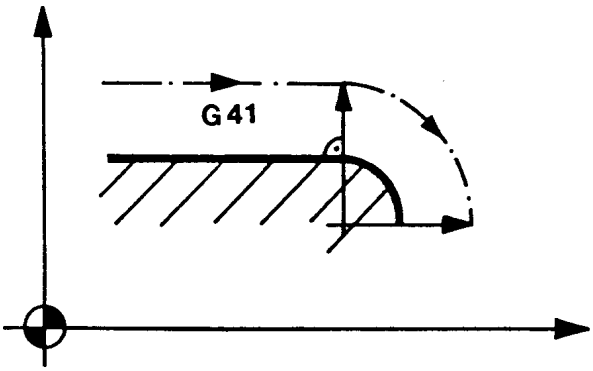



inner contour




Tangential transitions



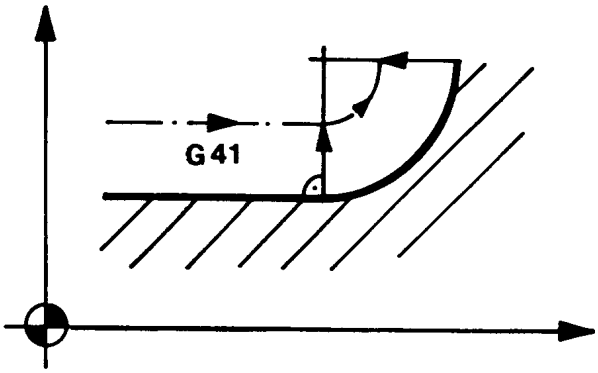
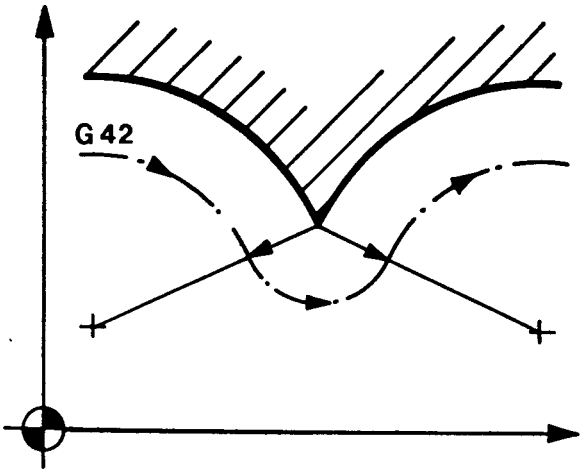




Figure 7-5

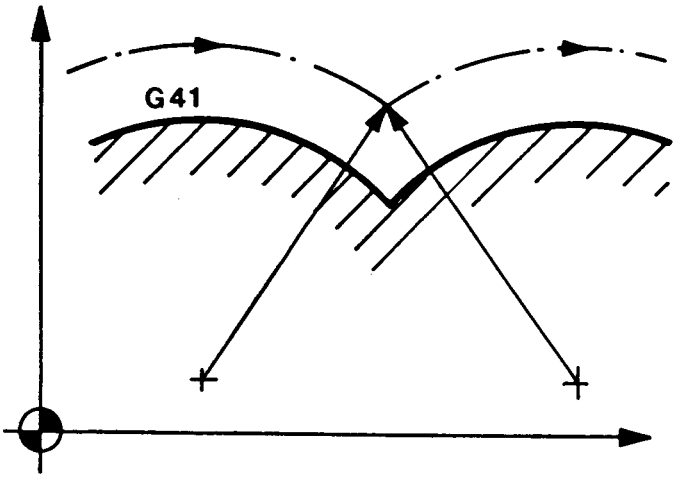
## 7.3 Correction principle (continued)

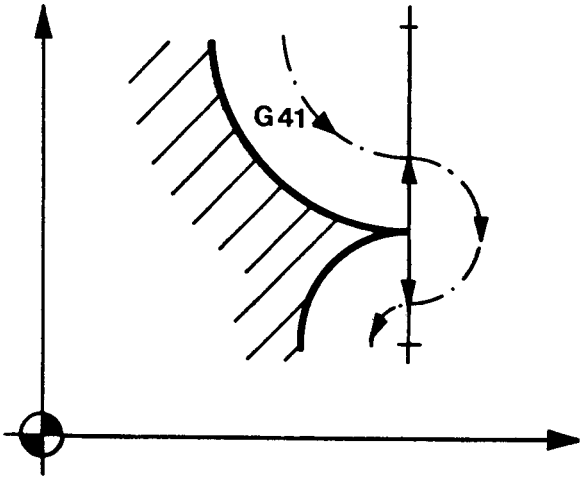
Transition circle - circle

outer contour




inner contour




Tangential transition

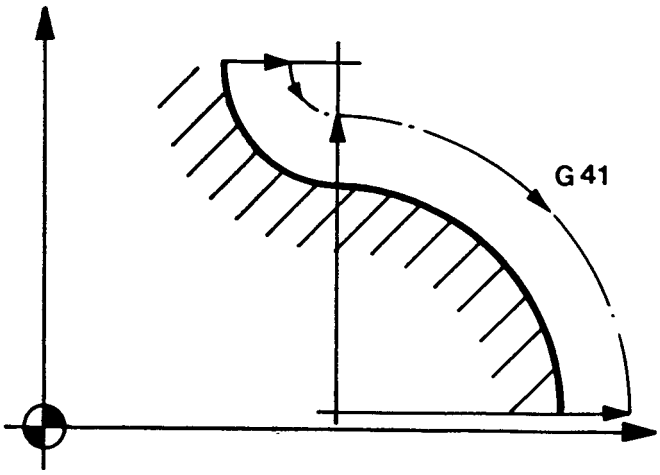



Figure 7-6

## 7.4 Change of the tool radius

When changing the tool radius, the intersections and transition circles are calculated first with the old radius.
The starting point (old radius) and the end point (new radius) of the corrected path do no more havethe same distance to the programmed path. This is valid for straights and circles.

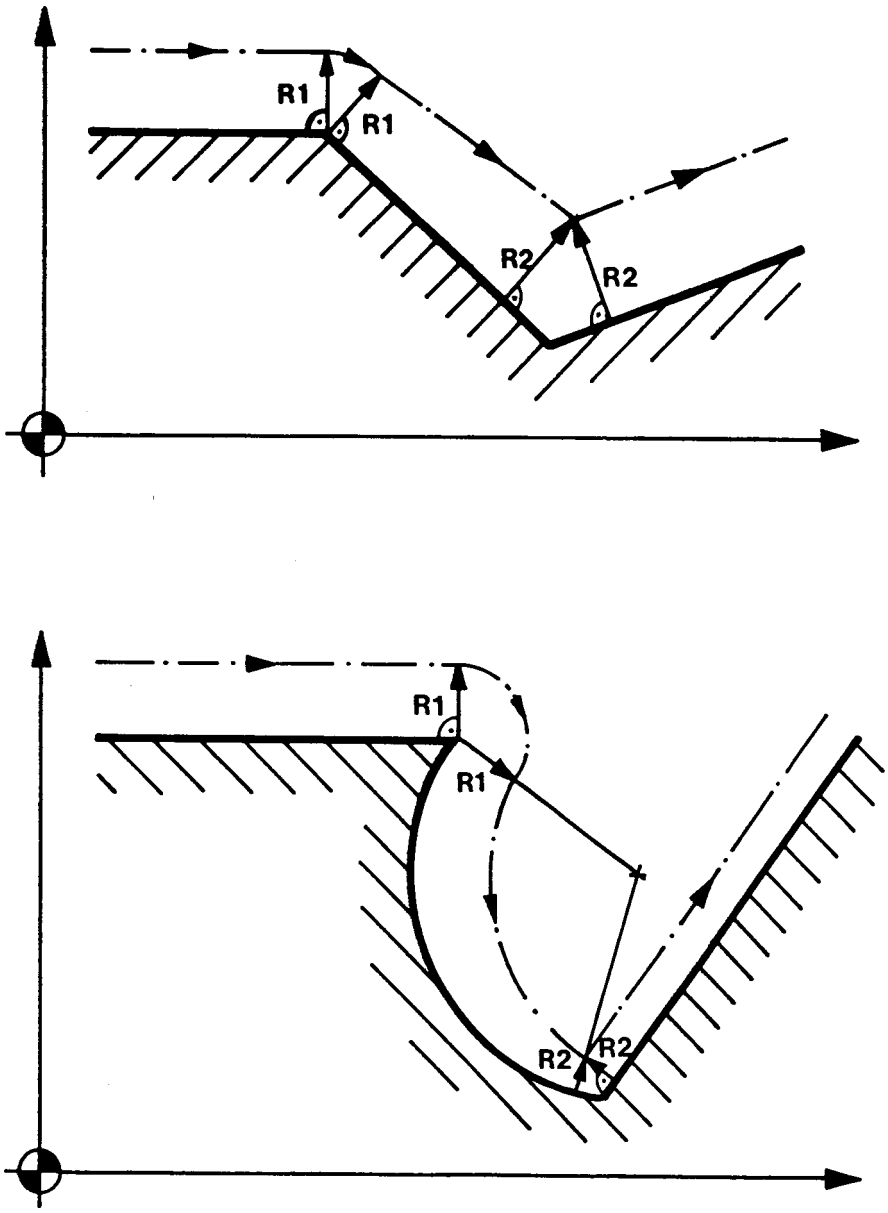



Figure 7-7

## 7.5 Switching on the correction

The programmed correction is clculated in each block.

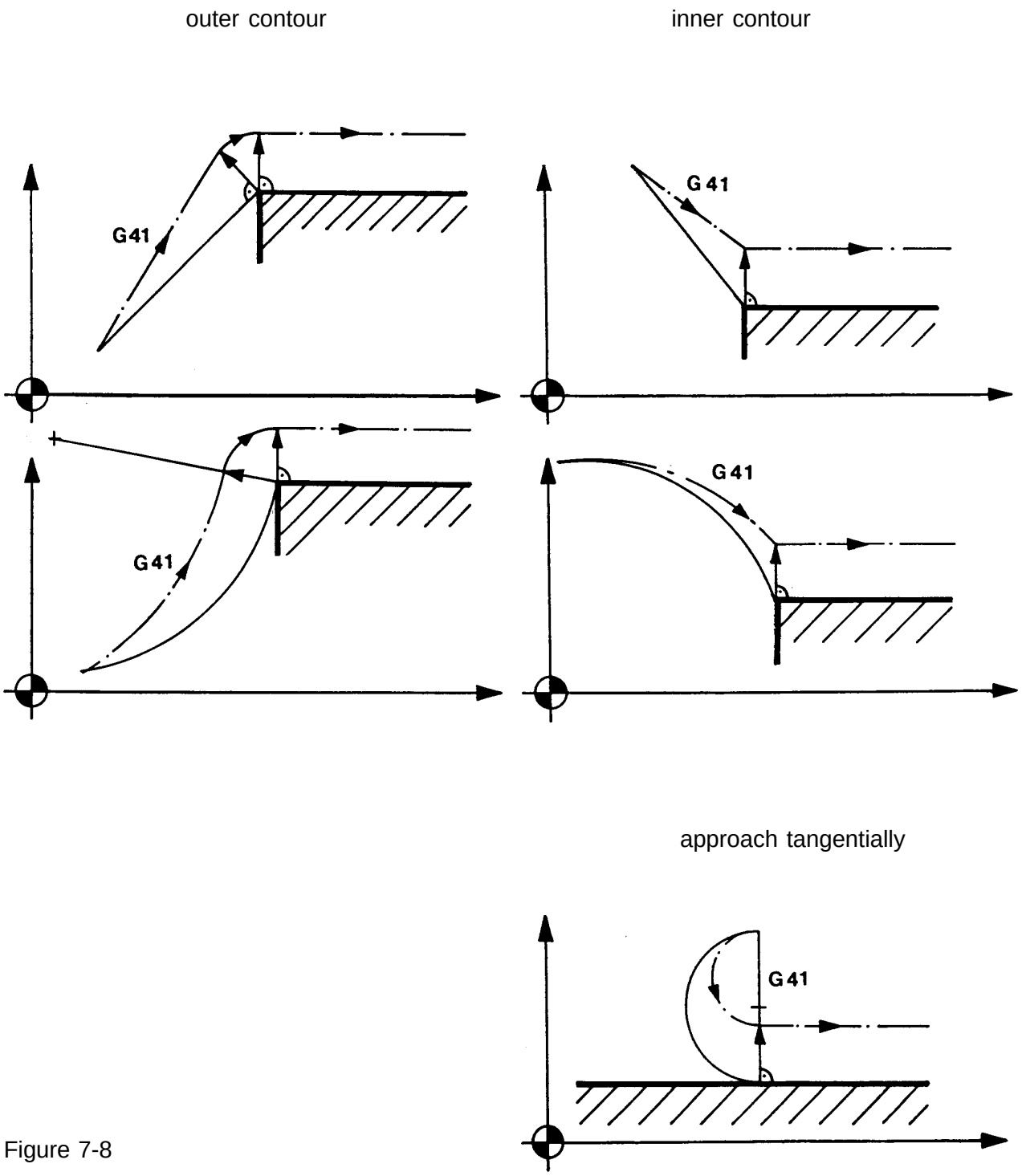
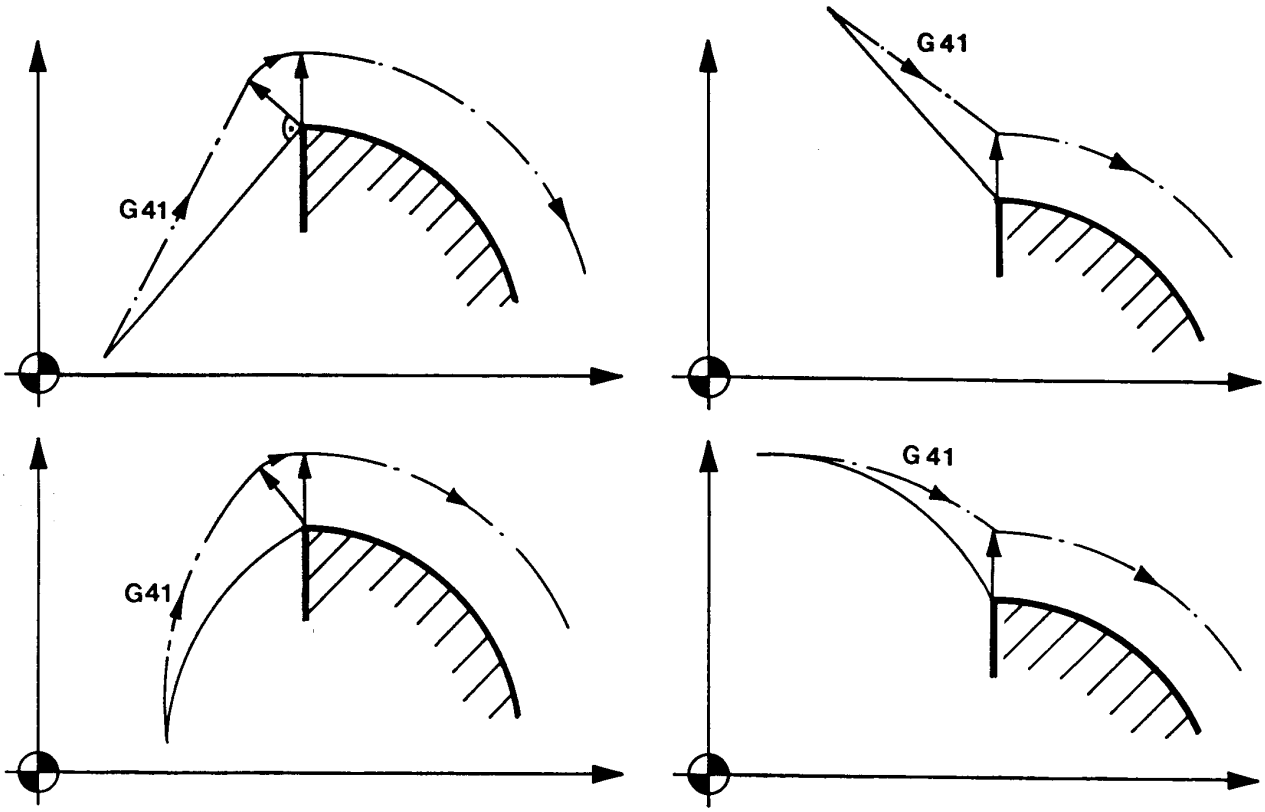



Figure 7-8

## 7.5 Switching on the correction (continued)

outer contour

inner contour




approach tangentially

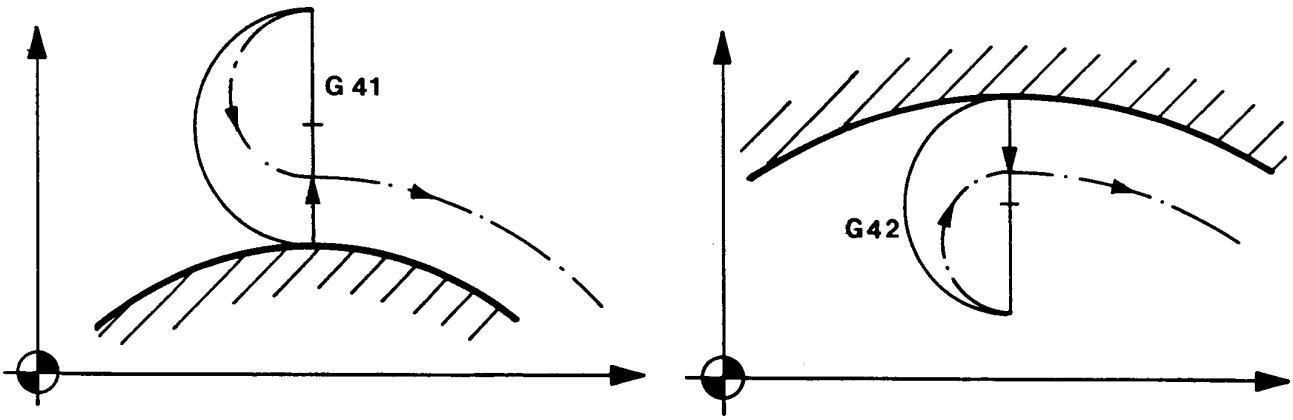



Figure 7-9

## 7.6 Switching off the correction

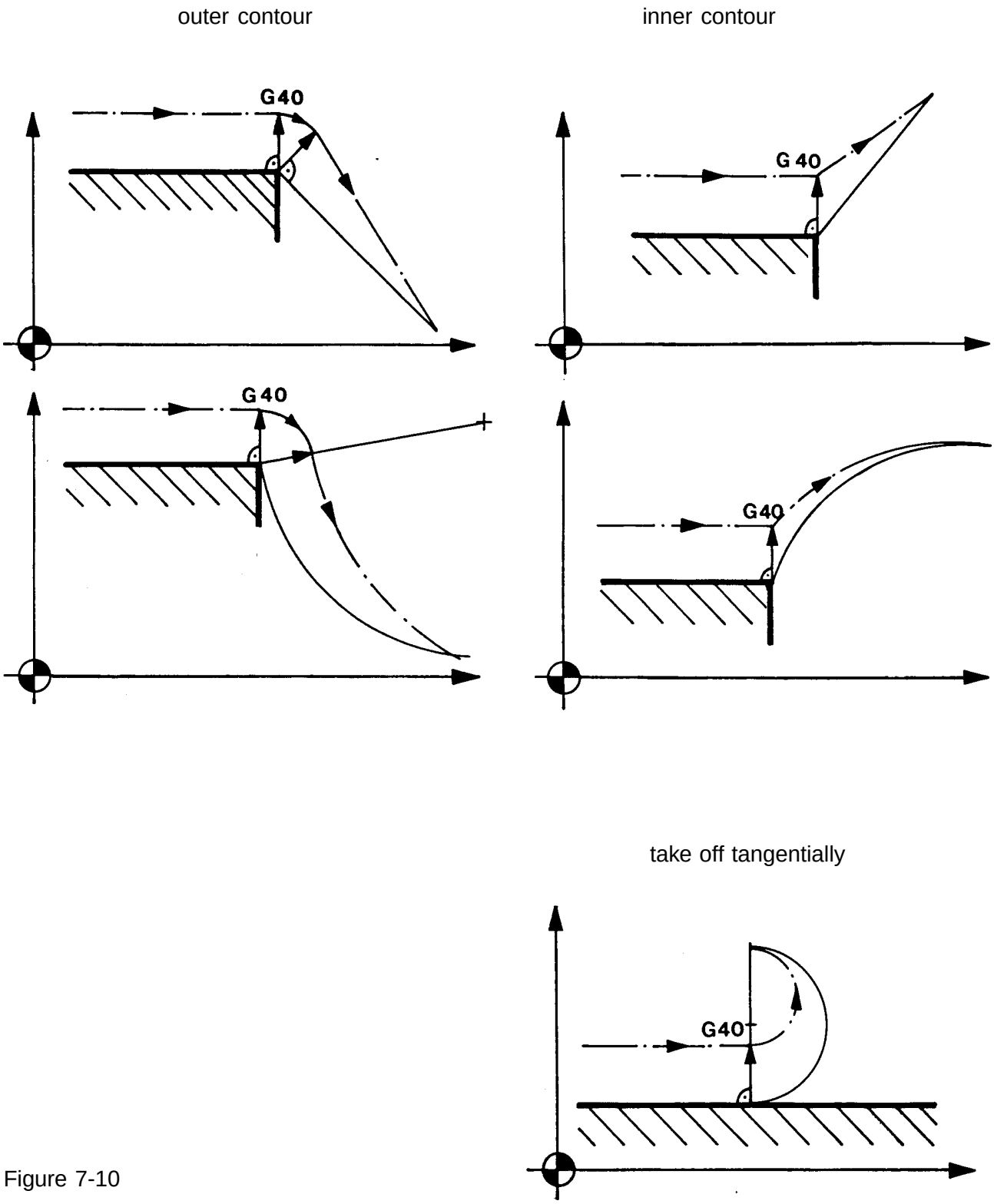



Figure 7-10

## 7.6 Switching off the correction (continued)

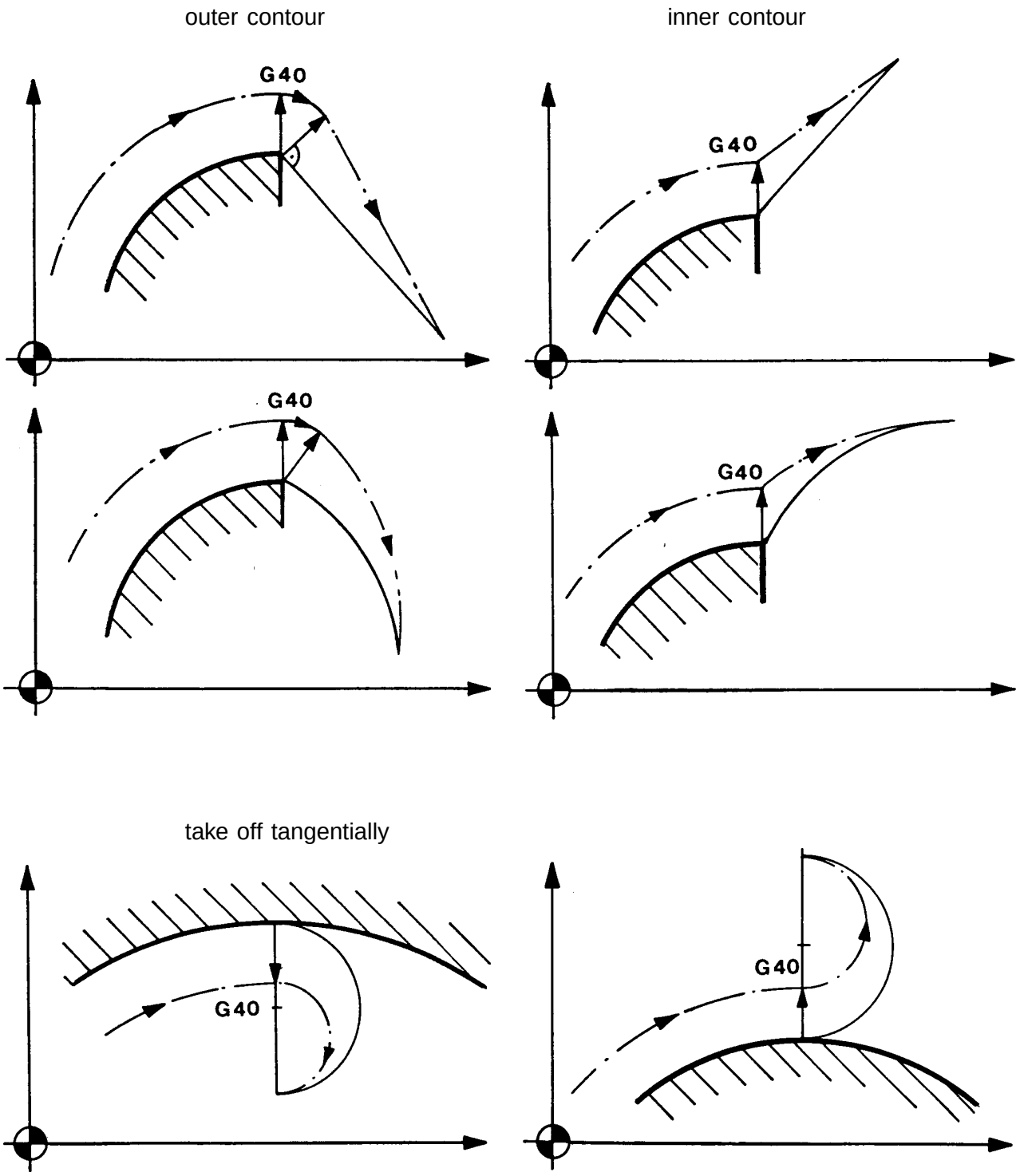



Figure 7-11

## 7.7 Special cases at inner contours

At inner contours undesirable contour errors can appear. In these cases the messages 1416 and 1420 are given out. The program is not interrupted.

The causes of these errors are:

1416 Too short travels in comparison with the dimension of the tool radius.
1420 Intersection not possible.

In the following figures the response of the control is illustrated for different cases.

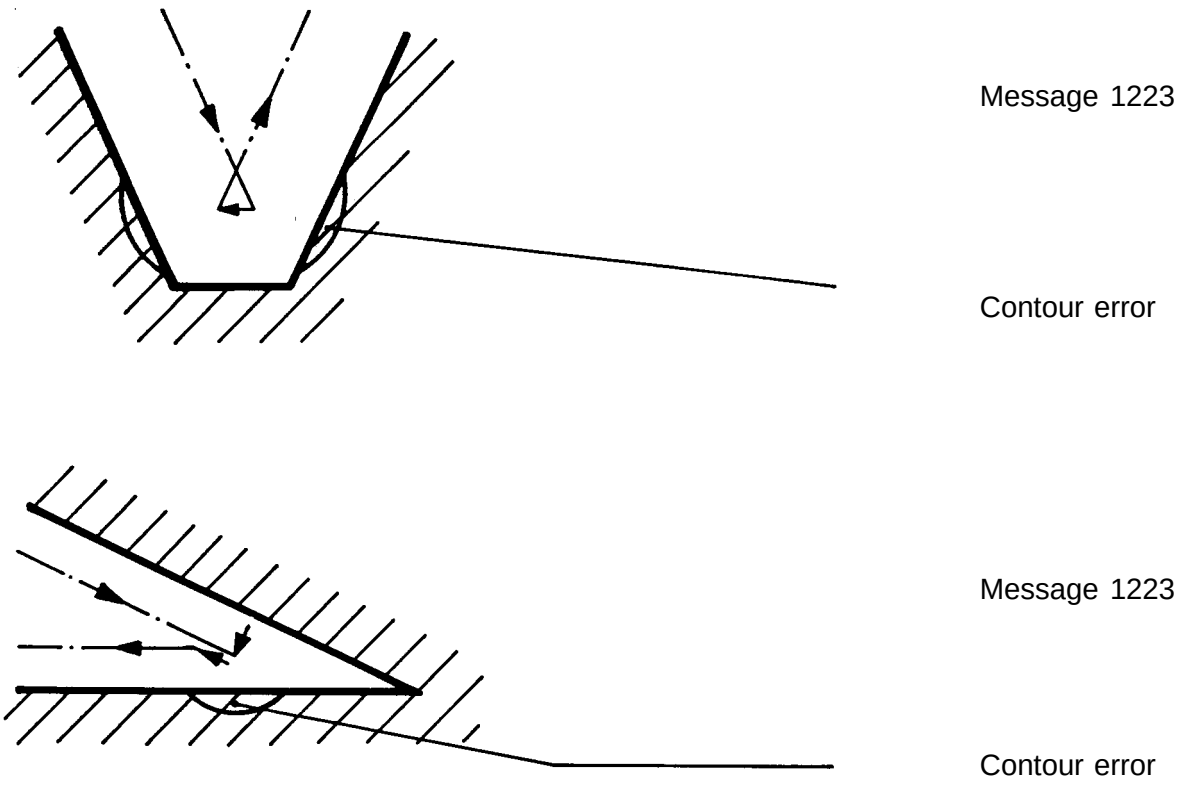
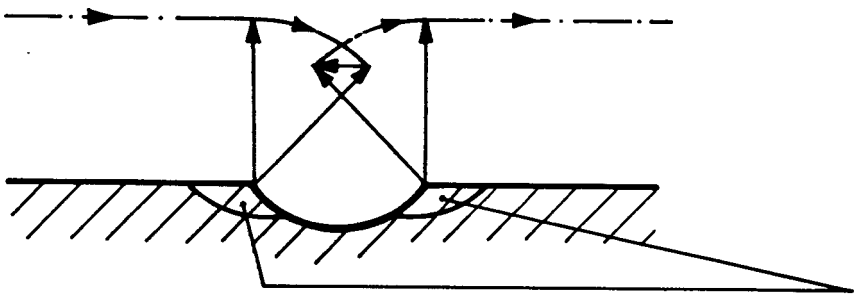


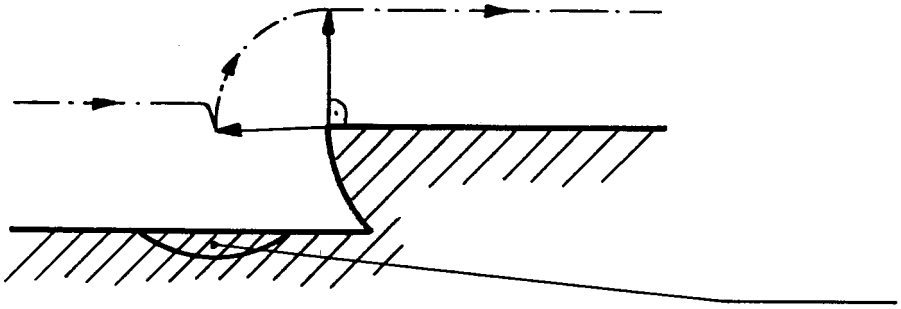

Figure 7-12

## 7.7 Special cases (continued)



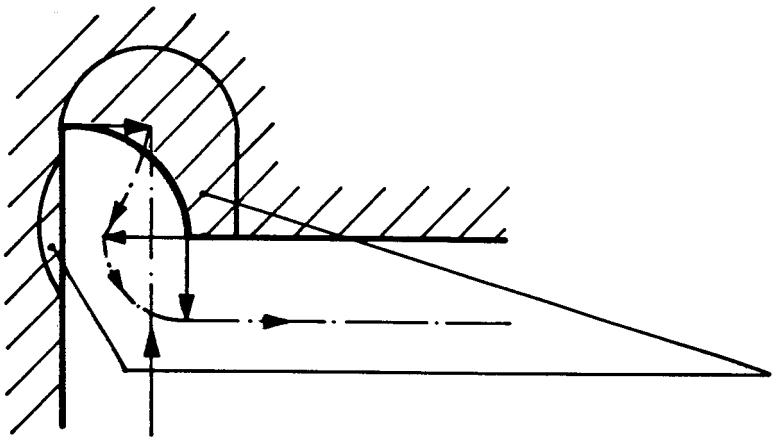
Message 1223

Contour error



Message 1223

Contour error



Message 1223

Contour error

Figure 7-13

# 8. Parameters

## 8. Parameters

## 8.1 General

The **System 900** puts 10000 to 50000 parameters at the users disposal, depending on the system size.
It is distinguished between two kinds of parameters:

System - Parameter q

Channel - Parameter P

**System - Parameter q**

This is a linear array, which is generally accessible, from q0 .. q (max. parameter).

The area of q is subdivided in function blocks:

| | |
|---|---|
| 0 . .. 99 | General system-configuration |
| 100 . .. 999 | Definition channel-descriptor |
| 1000 . .. 1999 | System-setups, system overlapping data |
| 2000 . .. 9999 | Axis data |
| 10000 . .. | Channel - Parameter |

Notes:

| | |
|---|---|
| Input 0 or — | means 0 or reset |
| Counting method byte | 1... 4 |
| Counting method bit | 0... 7 |

## 8.1 General (continued)

### Channel - Parameter P

When programming a channel - parameter, a system parameter is always accessed in dependence on the channel - descriptor.
That means channel - parameters are actually system - parameters, whereby the channel - descriptor defines, which channel - parameter accesses on which system - parameter.

The assignment between channel - parameter and system - parameter is not linear.
This assignment is defined in the channel - descriptor.

Channel - Parameter are virtual parameters, which show on a system - parameter. Therefore, the channel-parameter-number can be bigger than the maximum number of the parameters.

The area of P is subdivided into function - blocks:

| | |
|---|---|
| 0 . .. 6999 | User block 1<br>free user - parameter, real number definable in q103<br>Standard setup: 5000 parameters,<br>subdivided in |
| 0 . .. 499 | Reserved for BWO standard - cycles |
| 0 . .. 299 | Cycles - transmission - area for (cycles - interface) |
| 300 . .. 399 | Area reserved for cycles<br>Area for filing statical, modal data |
| 400 . .. 499 | Area reserved for cycles<br>Temporary data area<br>Calculation fields, Scratch etc. |
| 500 . .. 6999 | Free area for the user |
| 7000 . .. 9999 | Fixed defined channel - parameter |
| 11000 . .. 11999 | System - setup, system overlapping data,<br>common area of all channels |
| 12000 . .. 18399 | Axis data |
| 20000 . .. 29999 | User block 2 |
| 30000 . .. 39999 | User block 3 |

## 8.1 General (continued)

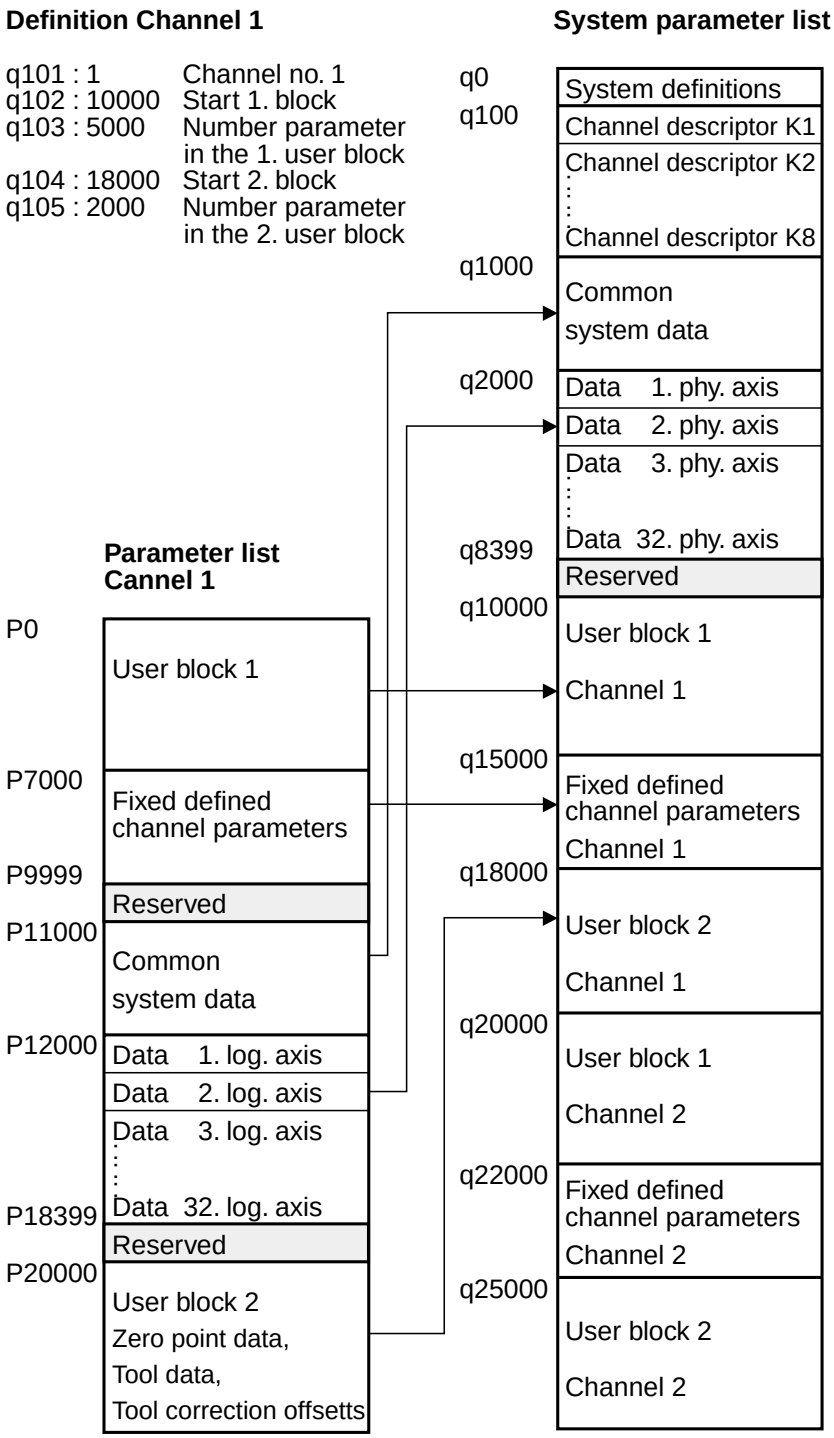
**Each physical axis occupies a parameter block of 200 parameters.**

| In the system has physical axis | the area | in the channel has logical axis | the area |
|---|---|---|---|
| 1. | q2000 ... q2199, | 1. | P12000 ... P12199, |
| 2. | q2200 ... q2399, | 2. | P12200 ... P12399, |
| 3. | q2400 ... q2599, | 3. | P12400 ... P12599, |
| 4. | q2600 ... q2799, | 4. | P12600 ... P12799, |
| 5. | q2800 ... q2999, | 5. | P12800 ... P12999, |
| 6. | q3000 ... q3199, | 6. | P13000 ... P13199, |
| 7. | q3200 ... q3399, | 7. | P13200 ... P13399, |
| 8. | q3400 ... q3599, | 8. | P13400 ... P13599, |
| 9. | q3600 ... q3799, | 9. | P13600 ... P13799, |
| 10. | q3800 ... q3999, | 10. | P13800 ... P13999, |
| 11. | q4000 ... q4199, | 11. | P14000 ... P14199, |
| 12. | q4200 ... q4399, | 12. | P14200 ... P14399, |
| 13. | q4400 ... q4599, | 13. | P14400 ... P14599, |
| 14. | q4600 ... q4799, | 14. | P14600 ... P14799, |
| 15. | q4800 ... q4999, | 15. | P14800 ... P14999, |
| 16. | q5000 ... q5199, | 16. | P15000 ... P15199, |
| 17. | q5200 ... q5399, | 17. | P15200 ... P15399, |
| 18. | q5400 ... q5599, | 18. | P15400 ... P15599, |
| 19. | q5600 ... q5799, | 19. | P15600 ... P15799, |
| 20. | q5800 ... q5999, | 20. | P15800 ... P15999, |
| 21. | q6000 ... q6199, | 21. | P16000 ... P16199, |
| 22. | q6200 ... q6399, | 22. | P16200 ... P16399, |
| 23. | q6400 ... q6599, | 23. | P16400 ... P16599, |
| 24. | q6600 ... q6799, | 24. | P16600 ... P16799, |
| 25. | q6800 ... q6999, | 25. | P16800 ... P16999, |
| 26. | q7000 ... q7199, | 26. | P17000 ... P17199, |
| 27. | q7200 ... q7399, | 27. | P17200 ... P17399, |
| 28. | q7400 ... q7599, | 28. | P17400 ... P17599, |
| 29. | q7600 ... q7799, | 29. | P17600 ... P17799, |
| 30. | q7800 ... q7999, | 30. | P17800 ... P17999, |
| 31. | q8000 ... q8199, | 31. | P18000 ... P18199, |
| 32. | q8200 ... q8399 | 32. | P18200 ... P18399 |

In the channel descriptor physical axes are assigned to the channel axes (q110 ... q141, Byte 3).

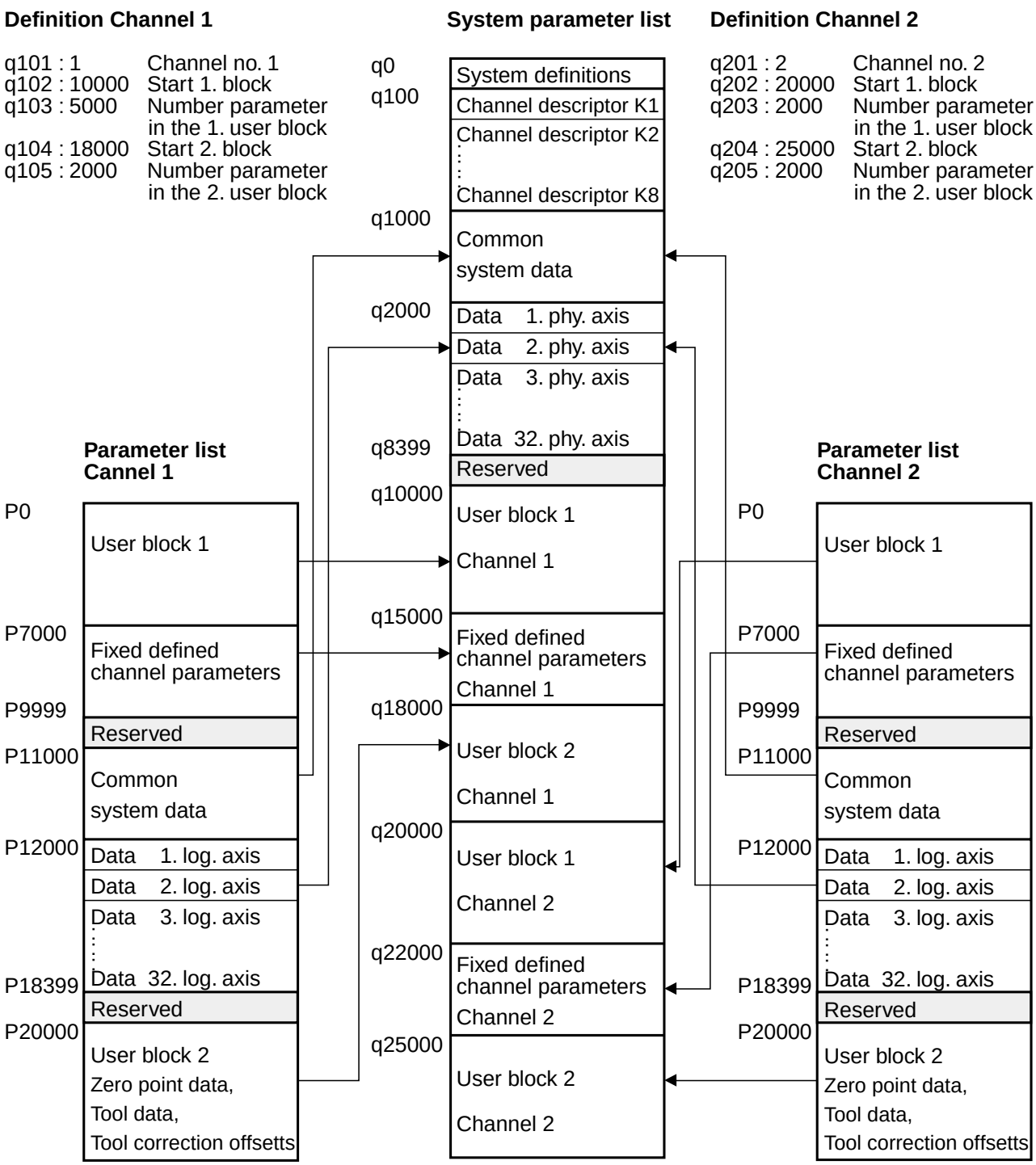
## 8.1 General (continued)

**Configuration example** for system with one channel (q2:1)



## 8.1 General (continued)

**Configuration example** for system with two channels (q2:2)



## 8.1 General (continued)

### General to the Decimal / Hexadecimal and Binary format

| display and input in the controller<br><br>Representation in **Decimal** / **Hexa** format | | allocation of the Byte's and Bit's<br><br>Representation in **Binar**y format (half byte format) | |
|---|---|---|---|
| 0 | $ 0 | 0 0 0 0 | 0 0 0 0 |
| 1 | $ 1 | 0 0 0 1 | 0 0 0 1 |
| 2 | $ 2 | 0 0 1 0 | 0 0 1 0 |
| 3 | $ 3 | 0 0 1 1 | 0 0 1 1 |
| 4 | $ 4 | 0 1 0 0 | 0 1 0 0 |
| 5 | $ 5 | 0 1 0 1 | 0 1 0 1 |
| 6 | $ 6 | 0 1 1 0 | 0 1 1 0 |
| 7 | $ 7 | 0 1 1 1 | 0 1 1 1 |
| 8 | $ 8 | 1 0 0 0 | 1 0 0 0 |
| 9 | $ 9 | 1 0 0 1 | 1 0 0 1 |
| 10 | $ A | 1 0 1 0 | 1 0 1 0 |
| 11 | $ B | 1 0 1 1 | 1 0 1 1 |
| 12 | $ C | 1 1 0 0 | 1 1 0 0 |
| 13 | $ D | 1 1 0 1 | 1 1 0 1 |
| 14 | $ E | 1 1 1 0 | 1 1 1 0 |
| 15 | $ F | 1 1 1 1 | 1 1 1 1 |

input in the **Hexa** format

with key ± clocks to $ in display appears.

Now the digits know A, B, C, D, E, F over the following keys to be input :

A key ‘ modifying ‘
B key ' pos 1 '
C key ‘ picture up ‘
D key ‘ resetting ‘
E key ' end '
F key ‘ picture down ‘

With the operate of the input key ↵ those become original functions modifying, pos 1 etc. again adjusted.

| Bytes | Byte 4 | Byte 3 | Byte 2 | Byte 1 |
|---|---|---|---|---|
| Bit number in the Byte | 7 6 5 4 3 2 1 0 | 7 6 5 4 3 2 1 0 | 7 6 5 4 3 2 1 0 | 7 6 5 4 3 2 1 0 |
| Bit number in 4 Byte | 31 30 29 28 27 26 25 24 | 23 22 21 20 19 18 17 16 | 15 14 13 12 11 10 9 8 | 7 6 5 4 3 2 1 0 |

To meaning see display and input with parameter status, M functions etc.

## 8.1 General (continued)

### Parameter status

Each parameter possesses 4 status bytes, in which additional information is contained. The parameter status is displayed in the menu parameter editor.

Example:

| Parameter NR. | Status indication | Meaning |
|---|---|---|
| P1000 | $ 30 02 04 01 | |
| | | byte 1 parameter loaded |
| | | byte 2 parameter is transferred to the operating panel |
| | | byte 3 parameter closed, if barrier 2 is settinged |
| | | byte 4 hexadecimal format / parameter in the EEPROM store |

| | | | |
|---|---|---|---|
| Status byte 1 | bit 0 | 0 | Parameter is reset. |
| | | 1 | Parameter is loaded. |
| | bit 1 | | - |
| | bit 2 | 1 | Parameter is loaded to the real time.<br>This identifier works only in the AUTOMATIK operation when processing a NC program. Real time parameters do not become with an interpreting of the NC block (advance) described, but only if this NC block is actually processed. Real time parameters become from the Interpoator before the pre path M functional module described. |
| | bit 3 | 1 | Parameter with synchronisation.<br>This identifier works only in the AUTOMATIK operation when processing a NC program. Becomes from a NC program if parameters with this identifier described, becomes at the NC end of record synchronizes. (the advance of the theorem interpreter disassembled). |
| | bit 4 | | Inch bit. |
| | | 0 | Parameter is not influenced by input system. |
| | | 1 | After switching the system of units of inch - > metric or metric - > inch becomes this parameter in each case into that different one system of units converted (see also P11308). |
| | bit 5 - 6 | | - |
| | bit 7 | 1 | FAST parameter.<br>Parameter is transferred over fast SMMS channel.<br>(system internal information). |

## 8.1 General (continued)

### Parameter status

| | | | |
|---|---|---|---|
| Status byte 2 | bit 0 | 1 | Parameter is transferred when describing to the Interpolator. |
| | bit 1 | 1 | Parameter is transferred when describing to the PLC.<br>All parameters with settinged PLC bit become of the CNC transfer automatically after each switching on routine to the PLC. |
| | bit 2 | 1 | Parameter is transferred when describing to the operating panel.<br>With each run of the switching on routine this bit becomes with all parameters reset. |
| | bit 3 | 1 | Identifier procedure parameter.<br>(SMMS chain is passed through when describing). |
| | bit 4 - 5 | | - |
| | bit 6 | 1 | Parameter is transferred when each describing to the operating panel. (speed Par function) |
| | bit 7 | 0 | Parameter sample identifier not settinged |
| | | 1 | Parameter sample identifier settinged,<br>i.e. if P11271..=4 becomes, describing this parameter in the sample buffer logs. |

## 8.1 General (continued)

### Parameter status

Status byte 3 With activated parameter barrier
- is the parameter status nevertheless to be described
- can the PLC nevertheless the parameter value change

| | | |
|---|---|---|
| Bit 0 | 1 | Parameters closed, if parameter barrier 1 is settinged |
| Bit 1 | 1 | Parameters closed, if parameter barrier 2 is settinged |
| Bit 2 | 1 | Parameters closed, if parameter barrier 3 is settinged |
| Bit 3 | 1 | Parameters closed, if parameter barrier 4 is settinged |
| Bit 4 - 7 | | - |

Status byte 4 Bit 0 - 3 Format for display: Number of post-decimal positions

| | | |
|---|---|---|
| Bit 4 | 0 | Decimal notation |
| | 1 | Hex notation |
| Bit 5 | 0 | Parameters do not store |
| | 1 | Parameters in the EEPROM store |
| Bit 6 - 7 | | - |

## 8.2 System Initializing

If a parameter in the area of q0 . .. q9 is changed, the control must be reset with ‘Clear parameter’.

q1 Number of axes
Is written at the end of the starting routine by the system. The number of axes is calculated according to the definitions in the channel descriptors (q110..).
q1 is transmitted to the PLC.

q2 Number of valid channel - descriptors.
Corresponds to the number of channels started when initializing.

q3 Number of q-parameters, minimum 30000.
Attention: When making a change, the NC - memory is formated.

q4 -

q5 Pointer on system data enlargement

q6 -

q7 -

q8 CPU clock
One describes by the system

q9 Version of the operating system of the operating panel
Parameter is written from the operating panel after the starting routine.
Enable new operating panel commands
0
1 new actual position display

## 8.2 System - Initializing (continued)

q10 FLASH Functions / special functions

So long a FLASH function actively is, should not the system not switched off become! For processing a q10-Funktion itself the machine must in operating mode HAND to find.

99 Activate channel descriptors (function 99 is effective only with EA import)
Application:
With this function defined channel descriptors (q100.., q200.., q300..) become in accordance with q2 (number of valid channel descriptors) activates.
Channels are however not started!
This function is helpful while the loading of the machine data, even if here channel parameters must be described by channels, which not yet actively are.

Example:

```
q       2 :  x
q     100 :  ...
:
q     200 :  ...
:
q     300 :  ...
:
:
q    1000 :  ...
:
q    2000 :  ...
:
q      10 :  99        Activate channel descriptors
:
K1:P8250 :  ...
:
K2:P8250 :  ...
:
K3:P8250 :  ...
:
```

## 8.2 System - Initializing (continued)

q10 Functions:

120 Reset all parameters in the FLASH

125 Reset all NC programs in the FLASH

170 Store all marked parameters in the FLASH memory
(max. 14000 parameters).

Being supposed the parameter areas of several channels to be stored, the following is to be observed:
Channel descriptors that channels which can be stored must available / defined to be, i.e., q2 (number of channels) was changed, to start then the CNC is before memory again. Only with the passing through of the switching on routine become in the CNC, in accordance with q2, channels started.

In the machine data file with q10:99 if the channel descriptors was activated, so the parameters can to be stored immediately.

175 Store all visible NC programs / cycles from that NC memory in the FLASH (max. 262kBytes).
In the starting routine after the ‘ NC memory ‘ all will reset in the FLASH stored programs into the NC memory written back.

176 Store all cycles of the NC memory in the FLASH
In the starting routine after the ‘ NC memory ‘ all will reset in the FLASH stored programs into the NC memory written back.

190 Restore q0..q999 from the FLASH memory.

200 Restore all parameters (apart from q0..q999) from the FLASH memory.

205 Restore all NC programs / cycles from the FLASH.

## 8.2 System - Initializing (continued)

500 With the I/O picture in the CNC direktory of the NC memory one displays.

501 With the I/O picture in the CNC Direktory FLASH Contents are displayed.

510 The CNC DLL Left is removed
Caution: With the next start of the system, those is to CNC DLL not more for the order.
Function is executed only if in q11:510 one enters before.

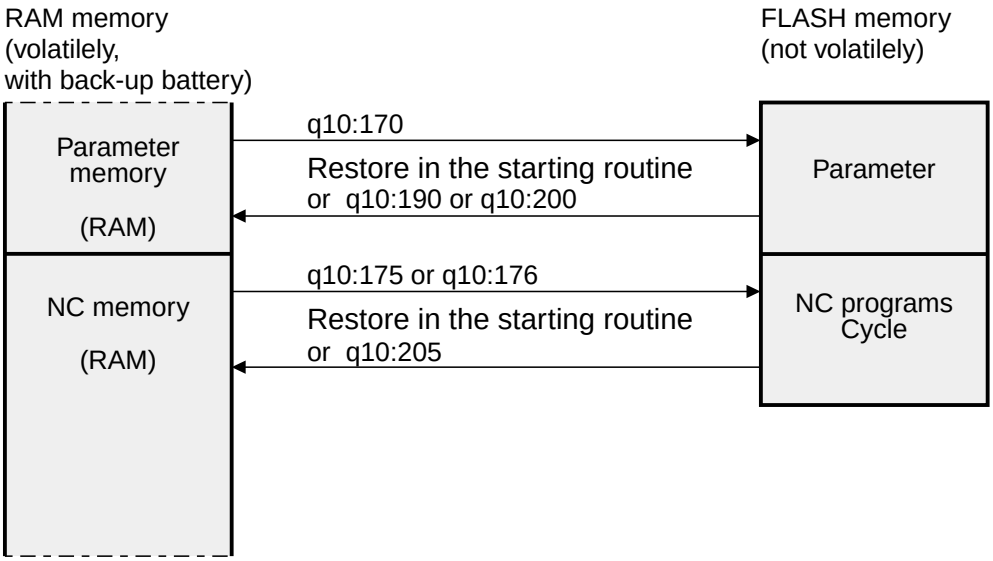
520 The switch ‘ NO_DMA ‘ is removed
Function is executed only if in q11:520 one enters before.

521 The switch ‘ NO_DMA ‘ is settinged
Function is executed only if in q11:521 one enters before.

530 The switch ‘ PLC_BIG ‘ is removed
Function is executed only if in q11:530 one enters before.

531 The switch ‘ PLC_BIG ‘ is settinged
Function is executed only if in q11:531 one enters before.

## 8.2 System - Initializing (continued)



## 8.2 System - Initializing (continued)

| | | |
|---|---|---|
| q12 | Operating system - version | |
| q13 | Operating system - check sum | |
| q14 | Operating system - time stamp day | |
| q15 | Operating system - time stamp month | |
| q16 | Operating system - time stamp year | |
| q17 | Operating system - time stamp hour | |
| q18 | Operating system - time stamp minute | |
| q19 | Operating system - time stamp second | |
| q22 | DLL version | |
| q23 | DLL check sum | |
| q24 | DLL time stamp day | |
| q25 | DLL time stamp month | |
| q26 | DLL time stamp year | |
| q27 | DLL time stamp hour | |
| q28 | DLL time stamp minute | |
| q29 | DLL time stamp second | |
| q32 | PLC version | (planned) |
| q33 | PLC check sum | (planned) |
| q34 | PLC time stamp day | (planned) |
| q35 | PLC time stamp month | (planned) |
| q36 | PLC time stamp year | (planned) |
| q37 | PLC time stamp hour | (planned) |
| q38 | PLC time stamp minute | (planned) |
| q39 | PLC time stamp second | (planned) |
| q42 | OP version | (planned) |
| q43 | OP check sum | (planned) |
| q44 | OP time stamp day | (planned) |
| q45 | OP time stamp month | (planned) |
| q46 | OP time stamp year | (planned) |
| q47 | OP time stamp hour | (planned) |
| q48 | OP time stamp minute | (planned) |
| q49 | OP time stamp second | (planned) |

## 8.2 System - Initializing (continued)

### ESR (starting routine) information

| | | | |
|---|---|---|---|
| q50 | Info | 1 | Parameters are deleted in ESR. |
| | | 0 | Parameters are not deleted in ESR.<br>Parameter shows information of the latest ESR. |
| q51 | Info | 1 | Parameters are deleted in ESR.<br>Parameter is waiting and has to be deleted by the user. |
| q52 | Info | 1 | NC program memory is deleted in ESR. |
| | | 0 | NC program memory is not deleted in ESR.<br>Parameter shows information of the latest ESR. |
| q53 | Info | 1 | NC program memory is deleted in ESR.<br>Parameter is waiting and has to be deleted by the user. |

q60 Password 1 (planned)
:
q68 Password 9 (planned)

q70 Priority PLC (planned)
q71 Priority channel 1 (planned)
:
q78 Priority channel 8 (planned)

## 8.2 System - Initializing (continued)

### Internal system parameter to the PLC

q97 Fatal error

| | |
|---|---|
| 0 or — | No error |
| < > 0 | Error number<br>a cause for fatal error (M1800) |

q98 Error message information for the display
q98 and q99 are set again at each channel changeover

Byte 1 Channel 1

Bit 0: System message
Bit 1: High priority message
Bit 2: Low priority message
Bit 3: Display message
Bit 4: PLC high priority message
Bit 5: PLC low priority message
Bit 6: free
Bit 7: free

Byte 2 Channel 2

Byte 3 Channel 3

Byte 4 Channel 4

q99 Error message informations
Byte 1 Channel 5

## 8.3 Channel - descriptor

The channel - descriptors are in the area of q100 . .. 899, that means:

Channel 1 q100 . .. q199
Channel 2 q200 . .. q299
Channel 3 q300 . .. q399
Channel 4 q400 . .. q499
Channel 5 q500 . .. q599
Channel 6 q600 . .. q699
Channel 7 q700 . .. q799
Channel 8 q800 . .. q899

If a parameter in the area of q100 . .. q899 is changed, the control must be restarted.

## 8.3 Channel - descriptor (continued)

**Parameters for channel - descriptor 1**

q101 Channel - No. 1 channel 1 fix defined

q102 Parameter - relocator
Here is defined, from which q on the channel starts, e.g. q102: 10000,
i.e. P0 shows on q10000

q103 Amount of channel - parameters in the 1st user block P0 . .. P6999
Here is defined, how many parameters actually should be reserved.
Input: 1 . .. 7000
The fixed defined channel-parameters succeed to the 1st user block
(3000 parameters).

q104 Parameter - relocator for 2nd user block P20000 . ..
Here is defined, from which q on this block starts, e.g. q104: 15000,
i.e. P20000 shows on q15000
The area for the fixed defined channel-parametes is between the 1st. and 2nd user block (3000 parameter).

q105 Amount of the channel - parameters in the 2nd. user block P20000 . .. P29999
Here is defined, how many parameters actually should be reserved.
Input: 1 . .. 10000

q106 Parameter - relocator for 3rd user block P30000 . ..
Here is defined, from which q on this block starts, e.g. q106: 10000
i.e. P30000 shows on q10000

q107 Amount of channel - parameters in the 3rd. user block P20000 . .. P39999
Here is defined how many parameters actually should be reserved.
Input: 1 . .. 10000

## 8.3 Channel - descriptor (continued)

### Parameters for channel - descriptor 1

q110 Axis name and axis assignment
Here is defined, with which name the axis is programed and which physical axis is addressed.
The Control determines with the system initialising the number of the axes available in the channel using this data.

1st. log. axis assignment -> to physical axis!
byte 1 Axis name (ASCII)

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASCII | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
| Hex | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 5A |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ASCII | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z |
| Hex | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 6A | 6B | 6C | 6D | 6E | 6F | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 7A |

Not certified axis identifiers are deposited with raster.

byte 2 Axis identifier extended 1... 8
e.g.: X1, X2 etc.
note: If byte 1 and byte 2 = 0,
there is no actual position display at the operating panel.
If byte 2 = 0, consists the axis identifier only of one character (byte 1).

byte 3 Physical axis number 1... 32
Defines, which physical axis is to be addressed.
To observe: Input in the hexadecimal system
e.g.: axis number 32 —> input: $20

byte 4 Key allocation
Defines, with which key in the operating panel axis block this axis one selects.
0 Axis is not selectable
1... 79 Key number
To observe: Input in the hexadecimal system
e.g.: key number 66 —> input: $42

## 8.3 Channel - descriptor (continued)

### Parameters for channel descriptor 1

### q110 Axis identifier and axis allocation (continuation)

Examples:

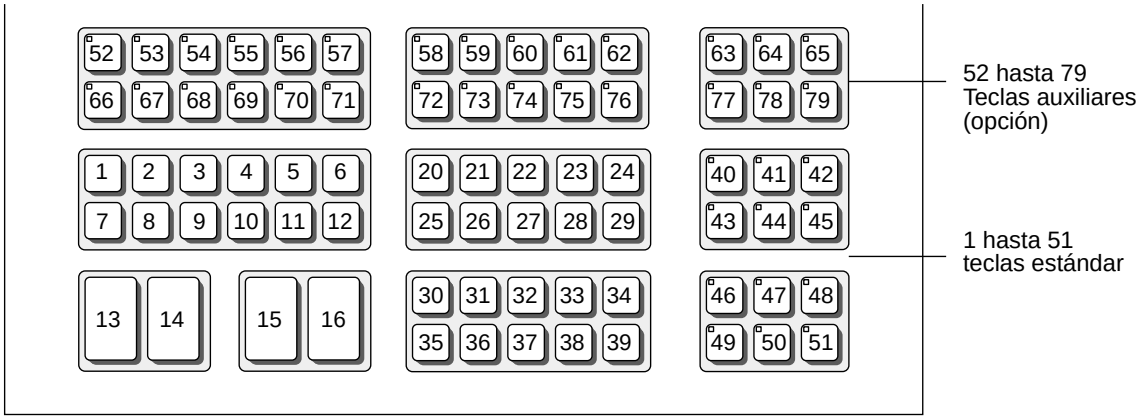
q 1 1 0 : $ 0 1 0 1 0 0 5 8

| | |
|---|---|
| axis identifier | 58 -> X |
| axis identifier extension | 00 -> keine |
| physical axis | 01 -> 1 |
| axis selectable over key | 01 -> 1 |

q 1 1 0 : $ 4 2 1 f 0 3 5 9

| | |
|---|---|
| axis identifier | 59 -> Y |
| axis identifier extension | 03 -> 3 (Y3) |
| physical axis | 1 f -> 31 |
| axis selectable over key | 42 -> 66 |

Key numbers




q111 2nd. log. Axis
q112 3rd. log. Axis
:
q141 32nd.log. Axis

## 8.3 Channel - descriptor (continued)

### Parameters for channel - descriptor 1

| | |
|---|---|
| q142<br>:<br>q149 | Spindel assignments<br>Assignment of the in the NC - program programmed spindle data to<br>the corresponding spindle blocks. Example: q143 : 4<br>When programming S2 in the NC - program, the number of revolutions in the 4th. spindle blockis changed. Input: 1...8 |
| q142 | Spindle block reference for S |
| q143 | Spindle block reference for S2 |
| q144 | Spindle block reference for S3 |
| q145 | Spindle block reference for S4 |
| q146 | Spindle block reference for S5 |
| q147 | Spindle block reference for S6 |
| q148 | Spindle block reference for S7 |
| q149 | Spindle block reference for S8 |
| q150 | Polar co-ordinate system : Name for radius (e.g. ‘x’) Input the ASCII - code |
| q151 | Polar co-ordinate system : Name for angles (e.g. ‘c’) Input the ASCII - code |

## 8.3 Channel - descriptor (continued)

### Parameters for channel - descriptor 1

q152 Definition of the coordinate system for G17

| | | |
|---|---|---|
| byte 1 | 1. logical axis number | abscissa (horizontal axis) |
| | 01 centre point identifier I | |
| byte 2 | 2. logical axis number | ordinate (vertically axis) |
| | 02 centre point identifier J | |
| byte 3 | 3. logical axis number | |
| | 03 vertically axis on the interpolation plane. | |
| default | $030201 | |

q153 Definition coordinate system for G18

| | | |
|---|---|---|
| byte 1 | 1. logical axis number | abscissa (horizontal axis) |
| | 03 centre point identifier K | |
| byte 2 | 2. logical axis number | ordinate (vertically axis) |
| | 01 centre point identifier I | |
| byte 3 | 3. logical axis number | |
| | 02 vertically axis on the interpolation plane. | |
| default | $020103 | |

q154 Definition coordinate system for G19

| | | |
|---|---|---|
| byte 1 | 1. logical axis number | abscissa (horizontal axis) |
| | 02 centre point identifier J | |
| byte 2 | 2. logical axis number | ordinate (vertically axis) |
| | 03 centre point identifier K | |
| byte 3 | 3. logical axis number | |
| | 01 vertically axis on the interpolation plane. | |
| default | $010302 | |

## 8.3 Channel - descriptor (continued)

### Parameters for channel - descriptor 1

q157 CNC error message Acknowledgement

0 or — The acknowledgement of pending CNC Error messages takes place with mode change after HAND (—> when describing P8683).
Additional is possible it to acknowledge over P8508 CNC Error messages.

1 The acknowledgement of pending CNC Error messages takes place only with describing P8508.
With the mode change after HAND NO CNC becomes error messages acknowledges.

q158 M function definition block from system or channel

0 or — M0..M199 are defined in the system block (i.e. P11050..P11099)
M200..M999 are defined in the channel block (i.e. P8300..P8499)

1 M0..M999 are defined in the channel block (i.e. P8250..P8499)

q159 Default of the number of post-decimal positions of the position parameters
After ‘ parameter = resetting ‘ (switching on routine) the following parameters become (in accordance with contents of q159 adjusted in the FLASH Memory) to post-decimal positions:
- axis displays P12150... 12169....
- null point record
- tool data theorem (starting from P10)

0 or — 3 post-decimal positions (standard adjustment)

q166 Definition of the Robot record (1... 2)

Robot record 1 (P11800..P11809)
Robot record 2 (P11810..P11819)

0 or — off
1 on

q167 Deinition of the polar record (1... 2)

Polar record 1 (P11820..P11824)
Polar record 2 (P11825..P11829)

0 or — off
1 on

## 8.3 Channel - descriptor (continued)

### Parameters for channel - descriptor 1

q171 Number zero point blocks work areas
Standard adjustment 1 (see P8555)

q172 Number of additional groups per zero point blocks
Defined, from many individual shifts itself the total shift together settings.
Standard adjustment 0

q173 Number of items (axes) per group
Number of entries per zero point. The zero point array always becomes for 7 points of zero created. Number of used parameters:

| | |
|---|---|
| Number zero point blocks | (q171 of work areas) |
| * (number of groups +1) | (q172 + 1) |
| * number of items per group | (q173 axes) |
| * 7 | (number of points of zero with q174 = 0, -) |

Number of used parameters for zero point array

q174 Number of usable, programmable points of zero
0 or — (preset)
7 available points of zero G53.. G59 (G153 always programmable)

1 G154.. G159 additionally programmable
altogether 13 points of zero available G53.. G59, G154.. G159
2 G254.. G259 additionally programmable
altogether 19 points of zero available G53.. G59, G154.. G159, G254.. G25
:
9 G954.. G959 additionally programmable
altogether 61 points of zero available G53.. G59, G154.. G159.... G954.. G959

The zero point array is increased at additional points of zero:
Number of used parameters:

| | |
|---|---|
| Number zero point-corrodes | (q171 of work areas) |
| * (number of groups + 1) | (q172+1) |
| * number of items per group | (q173 axes) |
| * number of points of zero | (q174*6 + 7) |

Number of used parameters for null point array

## 8.3 Channel - descriptor (continued)

### Zero point records q170... q174

Example: Zero point box with 2 work areas

| | | |
|---|---|---|
| q170 | 20000 | at the beginning of the zero point record |
| q171 | 2 | number of zero point blocks (work areas) |
| q172 | 2 | number of additional groups per zero point block (shift) |
| q173 | 3 | number of items (axes) per group |
| q174 | - | number of usable, programmable zero points: G53... G59 = 7 |

| Work area | | | sum shift | shift 1 | shift 2 |
|---|---|---|---|---|---|
| Work area 1 | G53 | 1. Achse | P20000 | P20021 | P20042 |
| | | 2. Achse | P20001 | P20022 | P20043 |
| | | 3. Achse | P20002 | P20023 | P20044 |
| | G54 | 1. Achse | P20003 | P20024 | P20045 |
| | | 2. Achse | P20004 | P20025 | P20046 |
| | | 3. Achse | P20005 | P20026 | P20047 |
| | G55 | 1. Achse | P20006 | P20027 | P20048 |
| | | 2. Achse | P20007 | P20028 | P20049 |
| | | 3. Achse | P20008 | P20029 | P20050 |
| | G56 | 1. Achse | P20009 | P20030 | P20051 |
| | | 2. Achse | P20010 | P20031 | P20052 |
| | | 3. Achse | P20011 | P20032 | P20053 |
| | G57 | 1. Achse | P20012 | P20033 | P20054 |
| | | 2. Achse | P20013 | P20034 | P20055 |
| | | 3. Achse | P20014 | P20035 | P20056 |
| | G58 | 1. Achse | P20015 | P20036 | P20057 |
| | | 2. Achse | P20016 | P20037 | P20058 |
| | | 3. Achse | P20017 | P20038 | P20059 |
| | G59 | 1. Achse | P20018 | P20039 | P20060 |
| | | 2. Achse | P20019 | P20040 | P20061 |
| | | 3. Achse | P20020 | P20041 | P20062 |
| Work area 2 | G53 | 1. Achse | P20063 | P20084 | P20105 |
| | | 2. Achse | P20064 | P20085 | P20106 |
| | | 3. Achse | P20065 | P20086 | P20107 |
| | G54 | 1. Achse | P20066 | P20087 | P20108 |
| | | 2. Achse | P20067 | P20088 | P20109 |
| | | 3. Achse | P20068 | P20089 | P20110 |
| | G55 | 1. Achse | P20069 | P20090 | P20111 |
| | | 2. Achse | P20070 | P20091 | P20112 |
| | | 3. Achse | P20071 | P20092 | P20113 |
| | G56 | 1. Achse | P20072 | P20093 | P20114 |
| | | 2. Achse | P20073 | P20094 | P20115 |
| | | 3. Achse | P20074 | P20095 | P20116 |
| | G57 | 1. Achse | P20075 | P20096 | P20117 |
| | | 2. Achse | P20076 | P20097 | P20118 |
| | | 3. Achse | P20077 | P20098 | P20119 |
| | G58 | 1. Achse | P20078 | P20099 | P20120 |
| | | 2. Achse | P20079 | P20100 | P20121 |
| | | 3. Achse | P20080 | P20101 | P20122 |
| | G59 | 1. Achse | P20081 | P20102 | P20123 |
| | | 2. Achse | P20082 | P20103 | P20124 |
| | | 3. Achse | P20083 | P20104 | P20125 |

## 8.3 Channel - descriptor (continued)

### Zero point records q170... q174

Example: Zero point box with extended zero points

| | | |
|---|---|---|
| q170 | 20000 | at the beginning of the zero point record |
| q171 | 1 | number of zero point blocks (work areas) |
| q172 | 3 | number of additional groups per zero point block (shift) |
| q173 | 4 | number of items (axes) per group |
| q174 | 1 | number of usable, programmable zero points: G53 ... G59 and G154 ... G159 = 13 |

| Work area 1 | | | sum shift | shift 1 | shift 2 | shift 3 |
|---|---|---|---|---|---|---|
| | G53 | 1. Achse | P20000 | P20052 | P20104 | P20156 |
| | | 2. Achse | P20001 | P20053 | P20105 | P20157 |
| | | 3. Achse | P20002 | P20054 | P20106 | P20158 |
| | | 4. Achse | P20003 | P20055 | P20107 | P20159 |
| | G54 | 1. Achse | P20004 | P20056 | P20108 | P20160 |
| | | 2. Achse | P20005 | P20057 | P20109 | P20161 |
| | | 3. Achse | P20006 | P20058 | P20110 | P20162 |
| | | 4. Achse | P20007 | P20059 | P20111 | P20163 |
| | G55 | 1. Achse | P20008 | P20060 | P20112 | P20164 |
| | | 2. Achse | P20009 | P20061 | P20113 | P20165 |
| | | 3. Achse | P20010 | P20062 | P20114 | P20166 |
| | | 4. Achse | P20011 | P20063 | P20115 | P20167 |
| | G56 | 1. Achse | P20012 | P20064 | P20116 | P20168 |
| | | 2. Achse | P20013 | P20065 | P20117 | P20169 |
| | | 3. Achse | P20014 | P20066 | P20118 | P20170 |
| | | 4. Achse | P20015 | P20067 | P20119 | P20171 |
| | G57 | 1. Achse | P20016 | P20068 | P20120 | P20172 |
| | | 2. Achse | P20017 | P20069 | P20121 | P20173 |
| | | 3. Achse | P20018 | P20070 | P20122 | P20174 |
| | | 4. Achse | P20019 | P20071 | P20123 | P20175 |
| | G58 | 1. Achse | P20020 | P20072 | P20124 | P20176 |
| | | 2. Achse | P20021 | P20073 | P20125 | P20177 |
| | | 3. Achse | P20022 | P20074 | P20126 | P20178 |
| | | 4. Achse | P20023 | P20075 | P20127 | P20179 |
| | G59 | 1. Achse | P20024 | P20076 | P20128 | P20180 |
| | | 2. Achse | P20025 | P20077 | P20129 | P20181 |
| | | 3. Achse | P20026 | P20078 | P20130 | P20182 |
| | | 4. Achse | P20027 | P20079 | P20131 | P20183 |
| | G154 | 1. Achse | P20028 | P20080 | P20132 | P20184 |
| | | 2. Achse | P20029 | P20081 | P20133 | P20185 |
| | | 3. Achse | P20030 | P20082 | P20134 | P20186 |
| | | 4. Achse | P20031 | P20083 | P20135 | P20187 |
| | G155 | 1. Achse | P20032 | P20084 | P20136 | P20188 |
| | | 2. Achse | P20033 | P20085 | P20137 | P20189 |
| | | 3. Achse | P20034 | P20086 | P20138 | P20190 |
| | | 4. Achse | P20035 | P20087 | P20139 | P20191 |
| | G156 | 1. Achse | P20036 | P20088 | P20140 | P20192 |
| | | 2. Achse | P20037 | P20089 | P20141 | P20193 |
| | | 3. Achse | P20038 | P20090 | P20142 | P20194 |
| | | 4. Achse | P20039 | P20091 | P20143 | P20195 |
| | G157 | 1. Achse | P20040 | P20092 | P20144 | P20196 |
| | | 2. Achse | P20041 | P20093 | P20145 | P20197 |
| | | 3. Achse | P20042 | P20094 | P20146 | P20198 |
| | | 4. Achse | P20043 | P20095 | P20147 | P20199 |
| | G158 | 1. Achse | P20044 | P20096 | P20148 | P20200 |
| | | 2. Achse | P20045 | P20097 | P20149 | P20201 |
| | | 3. Achse | P20046 | P20098 | P20150 | P20202 |
| | | 4. Achse | P20047 | P20099 | P20151 | P20203 |
| | G159 | 1. Achse | P20048 | P20100 | P20152 | P20204 |
| | | 2. Achse | P20049 | P20101 | P20153 | P20205 |
| | | 3. Achse | P20050 | P20102 | P20154 | P20206 |
| | | 4. Achse | P20051 | P20103 | P20155 | P20207 |

## 8.3 Channel - descriptor (continued)

**Parameters for channel - descriptor 1**

q175 Beginning of the tool data blocks 1. parameter
Defines, from which parameter on the tool data array starts.

q176 Number of tool data blocks
Number of elements of the tool data arrays.

q177 Number of sub data blocks

q178 Number of parameters of a tool block
Total length of an element in the tool data array.

q179 Number of tool places available in the tool magazine

## 8.3 Channel - descriptor (continued)

### Configuration - Example

Example: Amount of channels : 1
Amount of axes : 3

| | | | |
|---|---|---|---|
| q2 | 1 | channels | |
| q101 | 1 | channel number | |
| q102 | 10000 | parameter - relocator user block 1 | (q number) |
| q103 | 5000 | number of channel parameters in the 1st. block | |
| q104 | 18000 | parameter - relocator user block 2 | (q number) |
| q105 | 2000 | number of channel parameters in the 2. block | |
| q110 | $010058 | 1st. logical axis = 1. physical axis, axis name ‘X’, key 1 | |
| q111 | $020059 | 2nd. logical axis = 2. physical axis, axis name ‘Y’, key 18 | |
| q112 | $03005A | 3rd. logical axis = 3. physical axis, axis name ‘Z’, key 3 | |
| q170 | 20000 | beginning of the zero point data block | |
| q171 | 1 | number of zero point blocks | |
| q172 | 0 | number of groups per zero point block | |
| q173 | 32 | number of elements per group | |
| q175 | 21000 | beginning of the tool data block | |
| q176 | 50 | number of tool data blocks | |
| q177 | 1 | number of sub data blocks | |
| q178 | 20 | number of elements per data block | |

Parameters for this example are lying for this example as follows:

| | | |
|---|---|---|
| | q0 . .. q99 | general system configuration |
| | q100 . .. q999 | definition channel descriptors |
| P11000 . .. P11999 | q1000 . .. q1999 | system overlapping data |
| P12000 . .. P13599 | q2000 . .. q3599 | axis data |
| P0 . .. P4999 | q10000 . .. q14999 | customer parameter block 1 |
| P7000 . .. P9999 | q15000 . .. q17999 | fix defined channel parameters |
| P20000 . .. P21999 | q18000 . .. q19999 | for zero pointes, tool data |

## 8.4 Modes of operation - groups

### Operating mode network 1

The following parameters contain bit information for suitable channel selection.

q903 Operating mode switching in the network
Bit information: bit 0 channel 1
bit 1 channel 2
:
e.g.: $00000003: Channel 1 & channel 2
(P8683 in the defined channels is simultaneous settinged)

With the describing of q903 operating mode switching in the network becomes changes immediately.

q904 Stop in the network (see q903)
Stop in the network works only for STOP key
i.e. if a channel over STOP key is stopped, become the remaining channels in network also stopped.
Stop in the network does not work with stop by messages, measuring stops, Program end etc.
With the describing of q904 stop in the network is changed immediately.

q905 Abort in the network (see q903)
With the describing of q905 abort in the network is changed immediately.

q908 Message display in the network
(messages of the CNC)
Byte 1 Messages system and channel-specific messages of the PLC
Byte 2 Messages High Prio.
Byte 3 Messages Low Prio.
Byte 4 Messages display and channel-specific messages of the PLC

All bytes contain the following
Bit information bit 0 channel 1
bit 1 channel 2
:
bit 7 channel 8

Example q908 $00030303
i.e.. Messages that priority system / High Prio. / Low Prio.
in both channels (K1 + K2) are displayed.
The display messages are displayed only in the selected channel (byte 4 = 0).

## 8.4 Modes of operation - groups (continued)

Operating mode network 1

q909 PLC message display in the network
(messages of the PLC)
Byte 1 PLC Messages High Prio.
Byte 2 PLC Messages Low Prio.

see further q908

q910 Operating mode network 2
:
q919

q920 Operating mode network 3
:
q929

q930 Operating mode network 4
:
q939

## 8.5 Standard channel parameters

**Milling cycles**
(only if the milling cycles G71 / G72 / G73 / G74 / G75 are used, otherwise freely available)

| | |
|---|---|
| P11 | Pocket dimension in x-direction |
| P12 | Pocket dimension in y-direction |
| P13 | Pocket depth in z-direction |
| P14 | Corner radius |
| P15 | Allowance on outline in x and y-direction |
| P16 | Setting measure in x or y-direction (sign + / -) |
| P17 | Setting measure in z-direction |
| P18 | Allowance on pocket depth in z-direction |
| P19 | Safety margin in z-direction |
| P21 | Feed in z-direction (when immersing into the material) |

## 8.5 Standard channel parameters (continued)

**Drill cycles**
(only if the drill cycles G81 / G83 / G84 / G85 are used, otherwise freely available)

| | | | |
|---|---|---|---|
| P30 | Free cutting time | | |
| P31 | Balance fodder | G84 | |
| | | P31: 3 | = thread cutting without balance fodder on the right |
| | | P31: 4 | = thread cutting without balance fodder links |
| | | P31: 0 or -- | = G84 standard cycle (with balance fodder) |
| P32 | Drill feed | | |
| P32 | Thread pitch | G84 | |
| P33 | Drilling depth | | |
| P33 | Hread depth | G84 | |
| P34 | Anticipation plane | | Safety margin of the processing upper edge |
| P35 | Retreat plane | | To running around obstacles in the setting axis |
| P36 | Stroke rate | | G83, constant setting depth = (P33 - P34) / P36 |
| P36 | Setting depth | | G83, degressive setting depth |
| P37 | 1. Stroke | | G83, degressive setting depth |
| P38 | Safety margin | | G83, default = 1mm |
| P39 | Gradual decrease | | G83, degressive setting depth |
| | | | P39: 1 = on |
| | | | P39: 0 or -- = off |

## 8.5 Standard channel parameters (continued)

**Cycle patterns**
(only if the cycle patterns G86 / G87 / G88 / G89 are used, otherwise freely available)

**G86 vector type processing**

| | |
|---|---|
| P100 | Coordinate of the 1. Axis (x) |
| P101 | Coordinate of the 2. Axis (y) |
| P103 | Vector bracket related to the 1.Achse (x) |
| P104 | Vector length |
| P105 | Vector splitting |
| P106 | Number of points of positioning |

G87 scope handling of a parallelogram

| Vector 1 | Vector 2 | |
|---|---|---|
| P100 | P110 | Coordinate of the 1. Axis (x) |
| P101 | P111 | Coordinate of the 2. Axis (y) |
| P103 | P113 | Vector bracket related to the 1.Achse (x) |
| P104 | P114 | Vector length |
| P105 | P115 | Vector splitting |
| P106 | P116 | Number of points of positioning |

G88 grid handling

| Vector 1 | Vector 2 | |
|---|---|---|
| P100 | P110 | Coordinate of the 1. Axis (x) |
| P101 | P111 | Coordinate of the 2. Axis (y) |
| P103 | P113 | Vector bracket related to the 1.Achse (x) |
| P104 | P114 | Vector length |
| P105 | P115 | Vector splitting |
| P106 | P116 | Number of points of positioning |

G89 circle handling

| | |
|---|---|
| P120 | Coordinate of the 1. Axis (x) of the pitch diameter centre point |
| P121 | Coordinate of the 2. Axis (y) of the pitch diameter centre point |
| P122 | Circle diameter |
| P123 | Start bracket |
| P124 | Travel bracket |
| P125 | Vector part |
| P126 | Number of points of positioning |

## 8.5 Standard channel parameters (continued)

**Measuring cycle**
(only if the measuring cycle G69 are used, otherwise freely available)

| | | |
|---|---|---|
| P140 | Cycle selection | |
| P141 | Safety margin | [ mm ] |
| P143 | Measuring rate | [ mm/min ] |
| P144 | Number of measurements at the same point (> 0) | [ n ] |
| P147 | Pointer on the measuring tolerance data | |
| (P147)+4 | Confidence interval | [ mm ] |
| P148 | Measuring axis in plane system (1... 3) | |
| P149 | Pointer on the data of point of trigger | |
| (P149)+0 | XN, point of trigger in negative direction 1. Axis | [ mm ] |
| (P149)+1 | XP, point of trigger in positive direction 1. Axis | [ mm ] |
| (P149)+2 | YN, point of trigger in negative direction 2. Axis | [ mm ] |
| (P149)+3 | YP, point of trigger in positive direction 2. Axis | [ mm ] |
| (P149)+4 | ZN, point of trigger in negative direction 3. Axis | [ mm ] |
| (P149)+5 | ZP, point of trigger in positive direction 3. Axis | [ mm ] |
| P150 | Pointer on the calibrationing drilling data | |
| (P150)+0 | Position of the calibrationing drilling centre point 1. Axis (i) | [ mm ] |
| (P150)+1 | Position of the calibrationing drilling centre point 2. Axis (j) | [ mm ] |
| (P150)+2 | Position of the calibrationing drilling centre point 3. Axis (k) | [ mm ] |
| (P150)+3 | Calibrationing drilling diameter | [ mm ] |
| P152 | Expected drilling diameter | [ mm ] |
| P154 | Pointer on the measuring data | |
| (P154)+0 | Measuring position 1. Axis | [ mm ] |
| (P154)+1 | Measuring position 2. Axis | [ mm ] |
| (P154)+2 | Measuring position 3. Axis | [ mm ] |

## 8.5 Standard channel parameters (continued)

### Channel parameters

| | | | |
|---|---|---|---|
| P70 | Graphical programming environment with phase<br>Input leg length | (G12) | <br>[mm] |
| P71 | Graphical programming environment with radius<br>Input radius | (G12) | <br>[mm] |
| P160 | $U_0$ Origin axis 1 of the system UV (Rotating 45)<br>Parameter is activated in the block with G45. | | [mm] |
| P161 | $V_0$ Origin axis 1 of the system UV (Rotating 45)<br>Parameter is activated in the block with G45. | | [mm] |
| P163 | E Rotating angle<br>Content is activated in the block with G45.<br>Conversion of the coordinates of the UV-system into coordinates of the XY-system<br>Xb = (U*cosE - V*sinE) + U0<br>Yb = (U*sinE + V*cosE) + V0<br>see also G45/G56 | | [degree] |
| P165 | U additive shift axis 1 (rotation G45 planned) | | [mm] |
| P166 | V additive shift axis 2 (rotation G45 planned) | | [mm] |
| P168 | E incrementing of the rotating angle (planned) | | [degree] |

## 8.5 Standard channel parameters (continued)

P7000 Parameter area is used by the system
.
.
P7999

| | Offset |
|---|---|
| - Measuring position | 0 ... 31 |
| - Display positions | 32 ... 63 |
| - Program positions | 64 ... 95 |
| - Delta positions | 96 ... 127 |
| - Display shifts | 128 ... 159 |

## 8.5 Standard channel parameters (continued)

### ZSM control parameter

P7950 ZSM command

0 in the case of current measurement, the measurement is aborted.

1 start ZSM measurement

- > P7960 to 1 is settinged
- > if P7960 = 10 measurement terminates error free.

Internal operational sequence with the measuring start:
With the ZSM command ‘ start ZSM measurement ‘ becomes with the suitable Measuring axis (P7951) the ZSM Messaufzeichnung activates.
In accordance with the defined measuring logic of this measuring axis (P12045, byte 4), becomes with the switch edge defined there the ZSM recording started. The first edge defines a gap/tooth change.

Example: P12045: $0 xx xx xx switch edge positively effectively
i.e.. The measured value recording starts with a positive switch edge at the sensor input (0/24V-Sprung).
A positive edge is detected as gap/tooth change —> beginning of the tooth.
A negative edge is detected as tooth/gap change —> beginning of the gap.

P7951 Axis number

Contents log. Axis number (1... 32)

P7952 Number of teeth which can be measured (max. 250)

P7954 Correction window

[ % ]

0... 100

Here the ZSM Korrekturalgorithmus can be influenced,

100 ZSM Korrekturalgorithmus ineffectivy.

0 ZSM Korrekturalgorithmus fully effectively

if 0 or -- 80

## 8.5 Standard channel parameters (continued)

### ZSM Statusparameter

P7960 ZSM status
Parameter may not be described.

| | |
|---|---|
| 1 | measured value recording runs |
| 5 | measuring analysis runs |
| 10 | measurement terminates, measured value error free valid (P7950 reaches 0) |
| > 10 | measurement incorrectly or aborted |
| 20 | measurement aborted |
| 21 | no edges were detected |
| 22 | division ?? 0 determines |
| 24 | measuring recording not correctly, missing measured values in the data array |
| 25 | measuring recording not correctly, measured values not continuously up/down-rising |
| 30 | incorrect input, P7951 / P7952 check |

P7961 Measured value 1 [ ° ]
Tooth center
Area 0... measured division

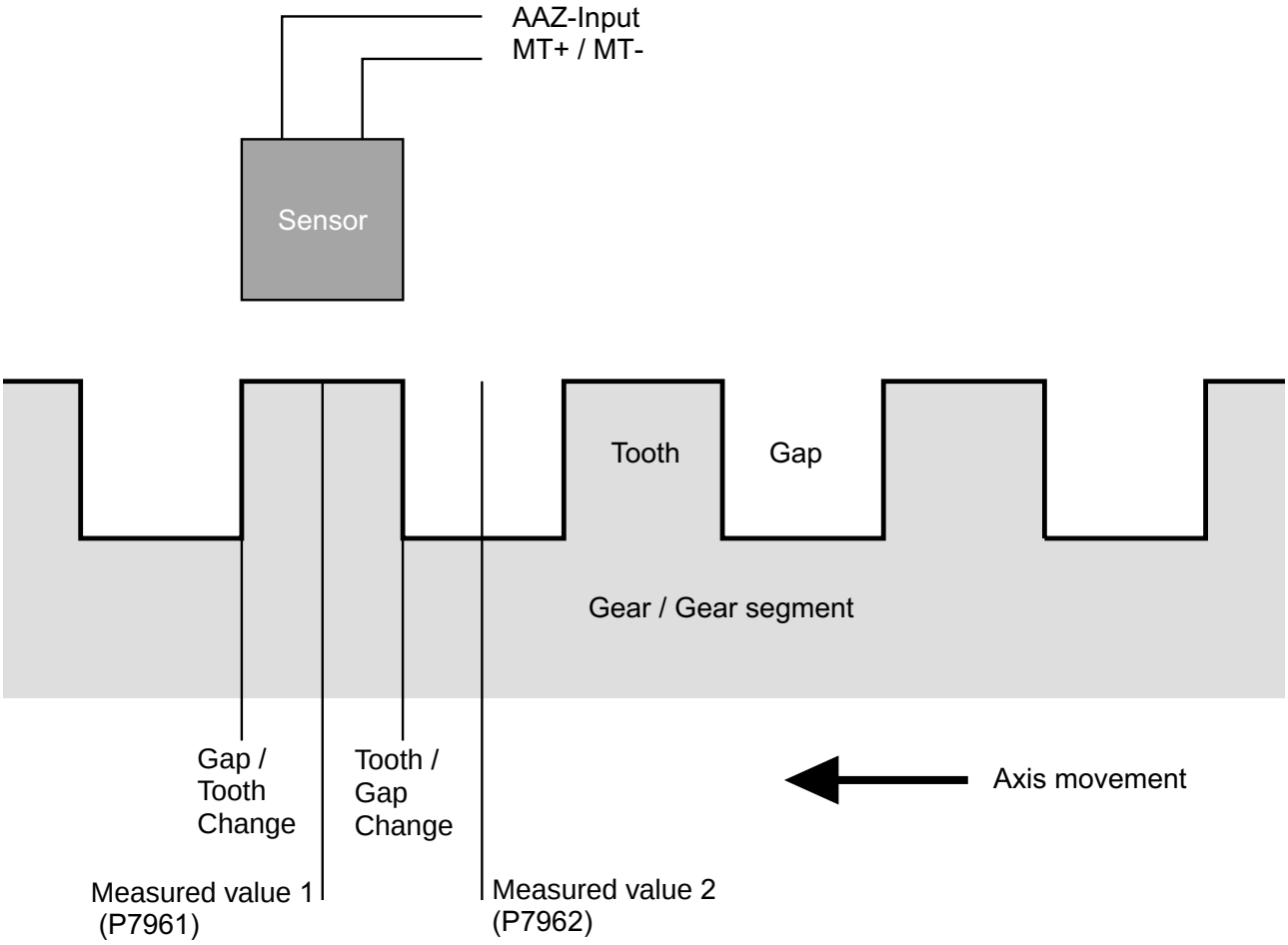
P7962 Measured value 2 [ ° ]
Gap center
Area: P7962 > P7961

## 8.5 Standard channel parameters (continued)

### ZSM Statusparameter

Example of a measuring flow in the NC program

```
N100 P7950:1          { start measurement }
N110 M1               { loop re-entry point
N120 P7960<10.110     { control room, to measurement terminates or aborted }
N130 P7960=10.200     { branch, if measurement of OK ONE }
N140...               { error handling, measurement aborted or errors }
:
N200...:P7961         { measured value process }
:
```



## 8.5 Standard channel parameters (continued)

### Channel parameters

P8000 Axis shifts
:
P8031

P8000 Shift axis 1
P8001 Shift axis 2
P8002 Shift axis 3
P8003 Shift axis 4
:
P8031 Shift axis 32

## 8.5 Standard channel parameters (continued)

### Tool - Data - Interface

P8040 T read in locking
0 or -- T read in locking is open
1 T read in locking is set
When a locking is set, it is prevented that the realtime data block (P8200...) is written by the system.

If the read in locking is set and 'T' is programmed in the NC block, the NC program run is stoped as long as the T read in locking is set.

T read in locking is reset:
- at a NC program start
- when copying the real time data block into the spindle data block (P8046 : 2).

P8043 Tool exchange in the manual mode
Loading the tool data block into the PLC tool data block (P8050 ... P8099) and into the real time data block (P8200...).
Example: P8043:1
The tool group number 1 is searched in the tool data array. If the search is successful, the corresponding data block is copied to P8050... and P8200.
At P 8043=0 the tool data are set to zero.
If the data block can not be found, a message appears.
Subsequently, it is switched to AUTO and Z6 is called up.
At the end of Z6, it is changed back to MANUAL.
If Z6 does not exist, M6 is sent to the PLC.

At DLL active tool change command 1 is sent to the DLL before Z6 is called up.

## 8.5 Standard channel parameters (continued)

### Tool - Data - Interface

P8045 Tool datas input

Byte 1 CMD
Byte 2 CMD Extention

CMD 1
Thus the PLC becomes tool record (P8050..) into the spindle tool record (P8100..) and the offsettings record (P8150..) copies.

CMD 2
Thus the real time record becomes (P8200...)
into the spindle tool record (P8100...) copies.
Additionally T read in barrier reset (P8040:0).
In the operating mode HAND becomes additional the spindle tools record (P8100...) in the offsettings record (P8150...) copies.

With CMD Extention: Channel number real time of the record.
0 or -- copy over within the channel
1...8 copy over channel-spreading
spindle tool record 1..8. channel becomes in
the spindle tool record (P8100...) copies.

In the tool record array becomes with the suitable tools that
Tool workstation zeroed.

P8046 Tool datas copy over
1 Thereby the spindle tools record (P8100..) becomes in offsetting record (P8150) copies.

2 Thereby the PLC becomes tool record (P8050...) into that offsetting record (P8150) copies.

## 8.5 Standard channel parameters (continued)

### Tool - Data - Interface

P8047 Tool datas placings

1 Thereby the spindle tool data block (P8100..) becomes in the suitable tool data block array back-stored and afterwards the actual spindle tool data block reset.

If P8100 = 0 or -- (no tools in the spindle) this procedure becomes leave immediately.
With active tool change DLL only command 2 is transmitted to the DLL.

P8048 Tool group number (t-paragraph from NC program)
(parameter to the real time is described)
The parameter is described only if ‘ T ‘ is programmed in the NC block

P8049 Info NC block contains tool-controlling m-function

| | |
|---|---|
| 0 | no tool-controlling m-function |
| 6 | M06 in the block |
| 16 | M16 in the block |

P8049 is described in the advance, if T is programmed in the NC block
P8049 is updated, before the parameter block P8050... is described.

## 8.5 Standard channel parameters (continued)

Tool - Data - Interface

Actual PLC tool data block

P8050 Actual PLC tool data (interface to the PLC).
: Here are the tool data, which were transmitted to the PLC.
P8099 Is loaded during block analysis with the tool data according to the T programmed in the NC - program (see also P8049).

Special case:
If the tool group number (T number) is the same like the tool group number of a spindle data block, the PLC tool data are not loaded from the tool data array, but the spindle data block is copied into the PLC tool data block.

P8050 Tool group number (T - number)
P8051 Tool number (e.g. continuous numbering)
P8052 Tool place in the magazine
P8053 Tool sub data block (selected)

P8058 Tool life status
0 or -- tool life o.k.
1 tool life run down

P8060 Tool radius
P8061 Tool length
P8062 Radius correction offset
P8063 Length correction offset
P8064 Tool type (active quadrant 0...9)
P8065 Customer data <— Here the customer specific area begins
:
P8099

## 8.5 Standard channel parameters (continued)

### Tool - Data - Interface

### Actual spindle tool data block

P8100 Actual spindle tool data block.
: The data block refers to the actual tool in the spindle.
P8149 This data block is loaded from the tool data array and when laying back the tool stored again into the array.

| | | |
|---|---|---|
| P8100 | Tool group number | (T - number) |
| P8101 | Tool number | (e.g. continuous numbering) |
| P8102 | Tool place in the magazine | |
| P8103 | Tool sub data block | (selected) |

P8108 Tool life status

| | | |
|---|---|---|
| 0 or -- | tool life | o.k. |
| 1 | tool life | run down |

P8110 Tool radius
P8111 Tool length
P8112 Radius correction offset
P8113 Length correction offset
P8114 Tool type (active quadrant 0...9)
P8115 Customer data <— Here the customer specific area begins
:
P8149

## 8.5 Standard channel parameters (continued)

### Tool - Data - Interface

### Actual data block

| | |
|---|---|
| P8150 | Actual data block. |
| : | This is the data block, which is calculated into the NC program. |
| P8199 | From this data block, it can not be stored back to the data array. |

| | | |
|---|---|---|
| P8150 | Tool group number | (T - number) |
| P8151 | Tool number | (e.g. continuous numbering) |
| P8152 | Tool place in the magazine | |
| P8153 | Tool sub data block | (selected) |

P8158 Tool life status

| | | |
|---|---|---|
| 0 or -- | tool life | o.k. |
| 1 | tool life | run down |

| | |
|---|---|
| P8160 | Tool radius |
| P8161 | Tool length |
| P8162 | Radius correction offset |
| P8163 | Length correction offset |
| P8164 | Tool type (active quadrant 0...9) |
| P8165 | Customer data <— Here the customer specific area begins |
| : | |
| P8199 | |

## 8.5 Standard channel parameters (continued)

### Tool - Data - Interface

### Real time data block

This is the data block that is loaded from the system to the real time:
- T programmed in the NC block
- T M6 programmed in the NC block (is not written at T M16)

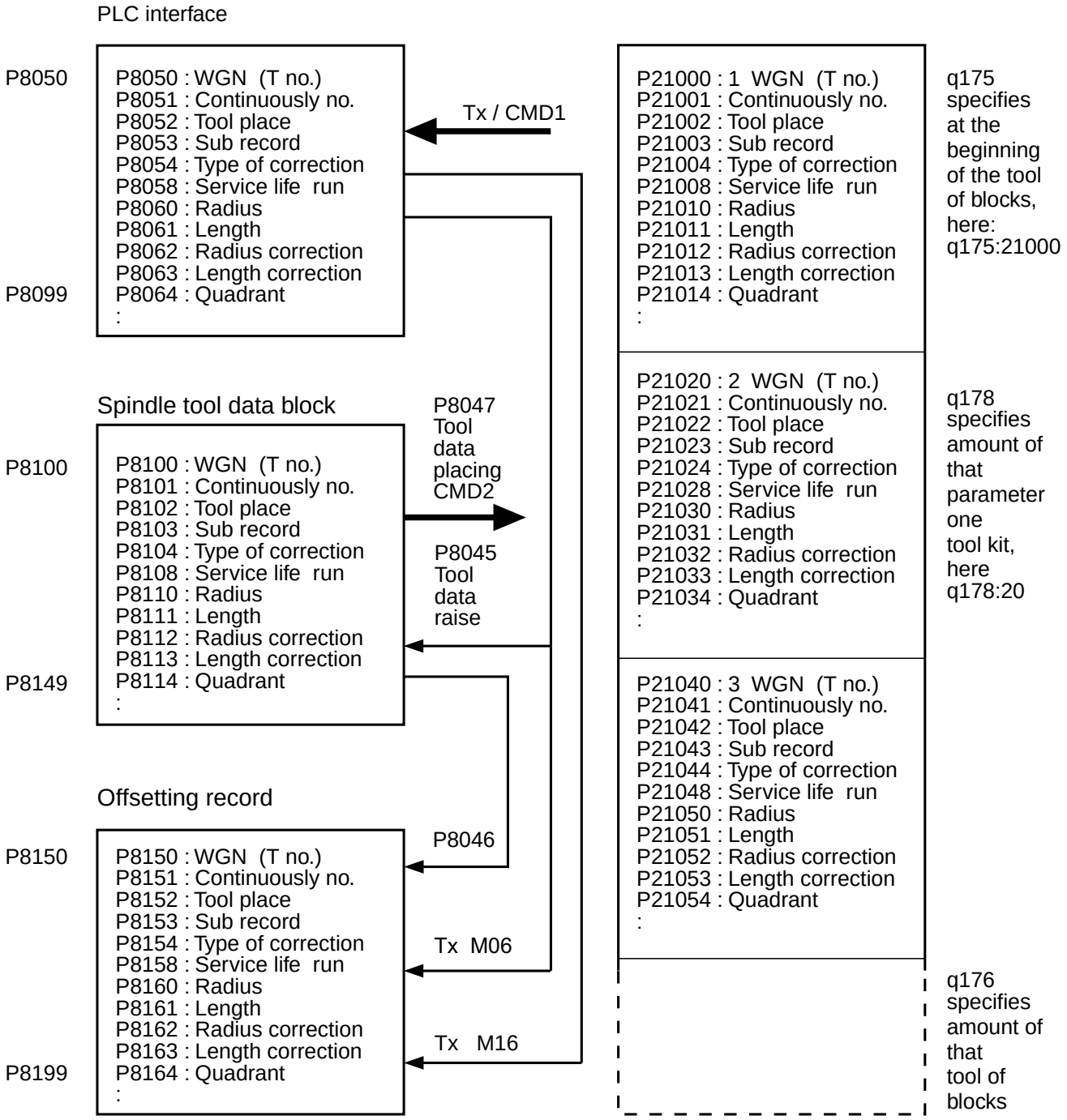
Special case:
If the tool group number (T number) is the same like the tool group number of a spindle data block, the PLC tool data are not loaded from the tool data array, but the spindle data block is copied into the PLC tool data block.
See also T read in locking P8040

With external tool administration, the real time data block is loaded with calling up command 3.

| | | |
|---|---|---|
| P8200 | Tool group number | (T number) |
| P8201 | Tool number | (e.g. continuous numbering) |
| P8202 | Tool place in the magazine | |
| P8203 | Tool sub data block | (selected) |
| P8208 | Tool life status | (-, 0 tool life o.k., 1 tool life over) |
| P8210 | Tool radius | |
| P8211 | Length of the tool | |
| P8212 | Radius correction | |
| P8213 | Length correction | |
| P8214 | Tool type | (acitve quadrant 0..9) |
| P8215 | Customer specific area | |
| . | | |
| . | | |
| P8249 | | |

## 8.5 Standard channel parameters (continued)

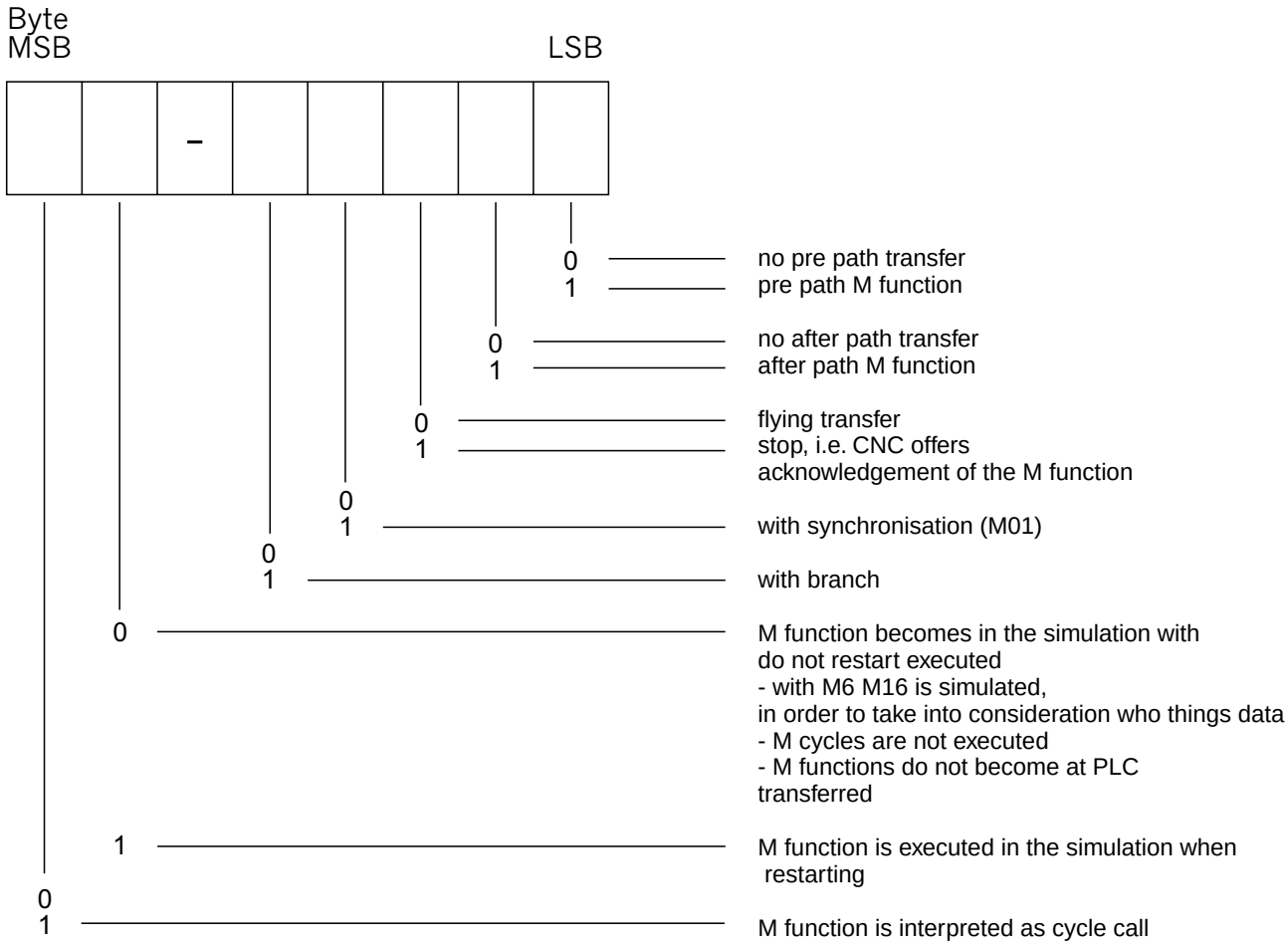
### Tool data blocks in the overview



## 8.5 Standard channel parameters (continued)

### Channel specific definition of the M functions

Information for a M - function




P8250 Channel-specific definition of the M functions
see table starting from P11050, see also q158
Here 1000 channel-specific M functions can be specified.
Note: A modification in P8250.. becomes with a operating modes changes by HAND after AUTO effectively.

## 8.5 Standard channel parameters (continued)

### Definition of the M functions

| | | | | | |
|---|---|---|---|---|---|
| P8250 | M | 03 | 02 | 01 | 00 |
| P8251 | M | 07 | 06 | 05 | 04 |
| P8252 | M | 11 | 10 | 09 | 08 |
| P8253 | M | 15 | 14 | 13 | 12 |
| P8254 | M | 19 | 18 | 17 | 16 |
| P8255 | M | 23 | 22 | 21 | 20 |
| P8256 | M | 27 | 26 | 25 | 24 |
| P8257 | M | 31 | 30 | 29 | 28 |
| P8258 | M | 35 | 34 | 33 | 32 |
| P8259 | M | 39 | 38 | 37 | 36 |
| P8260 | M | 43 | 42 | 41 | 40 |
| P8261 | M | 47 | 46 | 45 | 44 |
| P8262 | M | 51 | 50 | 49 | 48 |
| P8263 | M | 55 | 54 | 53 | 52 |
| P8264 | M | 59 | 58 | 57 | 56 |
| P8265 | M | 63 | 62 | 61 | 60 |
| P8266 | M | 67 | 66 | 65 | 64 |
| P8267 | M | 71 | 70 | 69 | 68 |
| P8268 | M | 75 | 74 | 73 | 72 |
| P8269 | M | 79 | 78 | 77 | 76 |
| P8270 | M | 83 | 82 | 81 | 80 |
| P8271 | M | 87 | 86 | 85 | 84 |
| P8272 | M | 91 | 90 | 89 | 88 |
| P8273 | M | 95 | 94 | 93 | 92 |
| P8274 | M | 99 | 98 | 97 | 96 |
| P8275 | M | 103 | 102 | 101 | 100 |
| P8276 | M | 107 | 106 | 105 | 104 |
| P8277 | M | 111 | 110 | 109 | 108 |
| P8278 | M | 115 | 114 | 113 | 112 |
| P8279 | M | 119 | 118 | 117 | 116 |
| P8280 | M | 123 | 122 | 121 | 120 |
| P8281 | M | 127 | 126 | 125 | 124 |
| P8282 | M | 131 | 130 | 129 | 128 |
| P8283 | M | 135 | 134 | 133 | 132 |
| P8284 | M | 139 | 138 | 137 | 136 |
| P8285 | M | 143 | 142 | 141 | 140 |
| P8286 | M | 147 | 146 | 145 | 144 |
| P8287 | M | 151 | 150 | 149 | 148 |
| P8288 | M | 155 | 154 | 153 | 152 |
| P8289 | M | 159 | 158 | 157 | 156 |
| P8290 | M | 163 | 162 | 161 | 160 |
| P8291 | M | 167 | 166 | 165 | 164 |
| P8292 | M | 171 | 170 | 169 | 168 |
| P8293 | M | 175 | 174 | 173 | 172 |
| P8294 | M | 179 | 178 | 177 | 176 |
| P8295 | M | 183 | 182 | 181 | 180 |
| P8296 | M | 187 | 186 | 185 | 184 |
| P8297 | M | 191 | 190 | 189 | 188 |
| P8298 | M | 195 | 194 | 193 | 192 |
| P8299 | M | 199 | 198 | 197 | 196 |

| | | | | | |
|---|---|---|---|---|---|
| P8300 | M | 203 | 202 | 201 | 200 |
| P8301 | M | 207 | 206 | 205 | 204 |
| P8302 | M | 211 | 210 | 209 | 208 |
| P8303 | M | 215 | 214 | 213 | 212 |
| P8304 | M | 219 | 218 | 217 | 216 |
| P8305 | M | 223 | 222 | 221 | 220 |
| P8306 | M | 227 | 226 | 225 | 224 |
| P8307 | M | 231 | 230 | 229 | 228 |
| P8308 | M | 235 | 234 | 233 | 232 |
| P8309 | M | 239 | 238 | 237 | 236 |
| P8310 | M | 243 | 242 | 241 | 240 |
| P8311 | M | 247 | 246 | 245 | 244 |
| P8312 | M | 251 | 250 | 249 | 248 |
| P8313 | M | 255 | 254 | 253 | 252 |
| P8314 | M | 259 | 258 | 257 | 256 |
| P8315 | M | 263 | 262 | 261 | 260 |
| P8316 | M | 267 | 266 | 265 | 264 |
| P8317 | M | 271 | 270 | 269 | 268 |
| P8318 | M | 275 | 274 | 273 | 272 |
| P8319 | M | 279 | 278 | 277 | 276 |
| P8320 | M | 283 | 282 | 281 | 280 |
| P8321 | M | 287 | 286 | 285 | 284 |
| P8322 | M | 291 | 290 | 289 | 288 |
| P8323 | M | 295 | 294 | 293 | 292 |
| P8324 | M | 299 | 298 | 297 | 296 |
| P8325 | M | 303 | 302 | 301 | 300 |
| P8326 | M | 307 | 306 | 305 | 304 |
| P8327 | M | 311 | 310 | 309 | 308 |
| P8328 | M | 315 | 314 | 313 | 312 |
| P8329 | M | 319 | 318 | 317 | 316 |
| P8330 | M | 323 | 322 | 321 | 320 |
| P8331 | M | 327 | 326 | 325 | 324 |
| P8332 | M | 331 | 330 | 329 | 328 |
| P8333 | M | 335 | 334 | 333 | 332 |
| P8334 | M | 339 | 338 | 337 | 336 |
| P8335 | M | 343 | 342 | 341 | 340 |
| P8336 | M | 347 | 346 | 345 | 344 |
| P8337 | M | 351 | 350 | 349 | 348 |
| P8338 | M | 355 | 354 | 353 | 352 |
| P8339 | M | 359 | 358 | 357 | 356 |
| P8340 | M | 363 | 362 | 361 | 360 |
| P8341 | M | 367 | 366 | 365 | 364 |
| P8342 | M | 371 | 370 | 369 | 368 |
| P8343 | M | 375 | 374 | 373 | 372 |
| P8344 | M | 379 | 378 | 377 | 376 |
| P8345 | M | 383 | 382 | 381 | 380 |
| P8346 | M | 387 | 386 | 385 | 384 |
| P8347 | M | 391 | 390 | 389 | 388 |
| P8348 | M | 395 | 394 | 393 | 392 |
| P8349 | M | 399 | 398 | 397 | 396 |

## 8.5 Standard channel parameters (continued)

### Definition of the M functions

| | | | | | |
|---|---|---|---|---|---|
| P8350 | M | 403 | 402 | 401 | 400 |
| P8351 | M | 407 | 406 | 405 | 404 |
| P8352 | M | 411 | 410 | 409 | 408 |
| P8353 | M | 415 | 414 | 413 | 412 |
| P8354 | M | 419 | 418 | 417 | 416 |
| P8355 | M | 423 | 422 | 421 | 420 |
| P8356 | M | 427 | 426 | 425 | 424 |
| P8357 | M | 431 | 430 | 429 | 428 |
| P8358 | M | 435 | 434 | 433 | 432 |
| P8359 | M | 439 | 438 | 437 | 436 |
| P8360 | M | 443 | 442 | 441 | 440 |
| P8361 | M | 447 | 446 | 445 | 444 |
| P8362 | M | 451 | 450 | 449 | 448 |
| P8363 | M | 455 | 454 | 453 | 452 |
| P8364 | M | 459 | 458 | 457 | 456 |
| P8365 | M | 463 | 462 | 461 | 460 |
| P8366 | M | 467 | 466 | 465 | 464 |
| P8367 | M | 471 | 470 | 469 | 468 |
| P8368 | M | 475 | 474 | 473 | 472 |
| P8369 | M | 479 | 478 | 477 | 476 |
| P8370 | M | 483 | 482 | 481 | 480 |
| P8371 | M | 487 | 486 | 485 | 484 |
| P8372 | M | 491 | 490 | 489 | 488 |
| P8373 | M | 495 | 494 | 493 | 492 |
| P8374 | M | 499 | 498 | 497 | 496 |
| P8375 | M | 503 | 502 | 501 | 500 |
| P8376 | M | 507 | 506 | 505 | 504 |
| P8377 | M | 511 | 510 | 509 | 508 |
| P8378 | M | 515 | 514 | 513 | 512 |
| P8379 | M | 519 | 518 | 517 | 516 |
| P8380 | M | 523 | 522 | 521 | 520 |
| P8381 | M | 527 | 526 | 525 | 524 |
| P8382 | M | 531 | 530 | 529 | 528 |
| P8383 | M | 535 | 534 | 533 | 532 |
| P8384 | M | 539 | 538 | 537 | 536 |
| P8385 | M | 543 | 542 | 541 | 540 |
| P8386 | M | 547 | 546 | 545 | 544 |
| P8387 | M | 551 | 550 | 549 | 548 |
| P8388 | M | 555 | 554 | 553 | 552 |
| P8389 | M | 559 | 558 | 557 | 556 |
| P8390 | M | 563 | 562 | 561 | 560 |
| P8391 | M | 567 | 566 | 565 | 564 |
| P8392 | M | 571 | 570 | 569 | 568 |
| P8393 | M | 575 | 574 | 573 | 572 |
| P8394 | M | 579 | 578 | 577 | 576 |
| P8395 | M | 583 | 582 | 581 | 580 |
| P8396 | M | 587 | 586 | 585 | 584 |
| P8397 | M | 591 | 590 | 589 | 588 |
| P8398 | M | 595 | 594 | 593 | 592 |
| P8399 | M | 599 | 598 | 597 | 596 |

| | | | | | |
|---|---|---|---|---|---|
| P8400 | M | 603 | 602 | 601 | 600 |
| P8401 | M | 607 | 606 | 605 | 604 |
| P8402 | M | 611 | 610 | 609 | 608 |
| P8403 | M | 615 | 614 | 613 | 612 |
| P8404 | M | 619 | 618 | 617 | 616 |
| P8405 | M | 623 | 622 | 621 | 620 |
| P8406 | M | 627 | 626 | 625 | 624 |
| P8407 | M | 631 | 630 | 629 | 628 |
| P8408 | M | 635 | 634 | 633 | 632 |
| P8409 | M | 639 | 638 | 637 | 636 |
| P8410 | M | 643 | 642 | 641 | 640 |
| P8411 | M | 647 | 646 | 645 | 644 |
| P8412 | M | 651 | 650 | 649 | 648 |
| P8413 | M | 655 | 654 | 653 | 652 |
| P8414 | M | 659 | 658 | 657 | 656 |
| P8415 | M | 663 | 662 | 661 | 660 |
| P8416 | M | 667 | 666 | 665 | 664 |
| P8417 | M | 671 | 670 | 669 | 668 |
| P8418 | M | 675 | 674 | 673 | 672 |
| P8419 | M | 679 | 678 | 677 | 676 |
| P8420 | M | 683 | 682 | 681 | 680 |
| P8421 | M | 687 | 686 | 685 | 684 |
| P8422 | M | 691 | 690 | 689 | 688 |
| P8423 | M | 695 | 694 | 693 | 692 |
| P8424 | M | 699 | 698 | 697 | 696 |
| P8425 | M | 703 | 702 | 701 | 700 |
| P8426 | M | 707 | 706 | 705 | 704 |
| P8427 | M | 711 | 710 | 709 | 708 |
| P8428 | M | 715 | 714 | 713 | 712 |
| P8429 | M | 719 | 718 | 717 | 716 |
| P8430 | M | 723 | 722 | 721 | 720 |
| P8431 | M | 727 | 726 | 725 | 724 |
| P8432 | M | 731 | 730 | 729 | 728 |
| P8433 | M | 735 | 734 | 733 | 732 |
| P8434 | M | 739 | 738 | 737 | 736 |
| P8435 | M | 743 | 742 | 741 | 747 |
| P8436 | M | 747 | 746 | 745 | 744 |
| P8437 | M | 751 | 750 | 749 | 748 |
| P8438 | M | 755 | 754 | 753 | 752 |
| P8439 | M | 759 | 758 | 757 | 756 |
| P8440 | M | 763 | 762 | 761 | 760 |
| P8441 | M | 767 | 766 | 765 | 764 |
| P8442 | M | 771 | 770 | 769 | 768 |
| P8443 | M | 775 | 774 | 773 | 772 |
| P8444 | M | 779 | 778 | 777 | 776 |
| P8445 | M | 783 | 782 | 781 | 780 |
| P8446 | M | 787 | 786 | 785 | 784 |
| P8447 | M | 791 | 790 | 789 | 788 |
| P8448 | M | 795 | 794 | 793 | 792 |
| P8449 | M | 799 | 798 | 797 | 796 |

## 8.5 Standard channel parameters (continued)

### Definition of the M functions

| | | | | | |
|---|---|---|---|---|---|
| P8450 | M | 803 | 802 | 801 | 800 |
| P8451 | M | 807 | 806 | 805 | 804 |
| P8452 | M | 811 | 810 | 809 | 808 |
| P8453 | M | 815 | 814 | 813 | 812 |
| P8454 | M | 819 | 818 | 817 | 816 |
| P8455 | M | 823 | 822 | 821 | 820 |
| P8456 | M | 827 | 826 | 825 | 824 |
| P8457 | M | 831 | 830 | 829 | 828 |
| P8458 | M | 835 | 834 | 833 | 832 |
| P8459 | M | 839 | 838 | 837 | 836 |
| P8460 | M | 843 | 842 | 841 | 840 |
| P8461 | M | 847 | 846 | 845 | 844 |
| P8462 | M | 851 | 850 | 849 | 848 |
| P8463 | M | 855 | 854 | 853 | 852 |
| P8464 | M | 859 | 858 | 857 | 856 |
| P8465 | M | 863 | 862 | 861 | 860 |
| P8466 | M | 867 | 866 | 865 | 864 |
| P8467 | M | 871 | 870 | 869 | 868 |
| P8468 | M | 875 | 874 | 873 | 872 |
| P8469 | M | 879 | 878 | 877 | 876 |
| P8470 | M | 883 | 882 | 881 | 880 |
| P8471 | M | 887 | 886 | 885 | 884 |
| P8472 | M | 891 | 890 | 889 | 888 |
| P8473 | M | 895 | 894 | 893 | 892 |
| P8474 | M | 899 | 898 | 897 | 896 |
| P8475 | M | 903 | 902 | 901 | 900 |
| P8476 | M | 907 | 906 | 905 | 904 |
| P8477 | M | 911 | 910 | 909 | 908 |
| P8478 | M | 915 | 914 | 913 | 912 |
| P8479 | M | 919 | 918 | 917 | 916 |
| P8480 | M | 923 | 922 | 921 | 920 |
| P8481 | M | 927 | 926 | 925 | 924 |
| P8482 | M | 931 | 930 | 929 | 928 |
| P8483 | M | 935 | 934 | 933 | 932 |
| P8484 | M | 939 | 938 | 937 | 936 |
| P8485 | M | 943 | 942 | 941 | 940 |
| P8486 | M | 947 | 946 | 945 | 944 |
| P8487 | M | 951 | 950 | 949 | 948 |
| P8488 | M | 955 | 954 | 953 | 952 |
| P8489 | M | 959 | 958 | 957 | 956 |
| P8490 | M | 963 | 962 | 961 | 960 |
| P8491 | M | 967 | 966 | 965 | 964 |
| P8492 | M | 971 | 970 | 969 | 968 |
| P8493 | M | 975 | 974 | 973 | 972 |
| P8494 | M | 979 | 978 | 977 | 976 |
| P8495 | M | 983 | 982 | 981 | 980 |
| P8496 | M | 987 | 986 | 985 | 984 |
| P8497 | M | 991 | 990 | 989 | 988 |
| P8498 | M | 995 | 994 | 993 | 992 |
| P8499 | M | 999 | 998 | 997 | 996 |

## 8.5 Standard channel parameters (continued)

### Messages

| | | | | |
|---|---|---|---|---|
| P8500 | Message | system | causes abort of all channels | |
| P8501 | Message | high - priority | causes abort of the channel | |
| P8502 | Message | low - priority | causes stop of the channel | |
| P8503 | Message | only display | | |
| P8504 | Additional information | of axis | | |
| P8505 | Additional information 1 | for message | Info1 | in the picture with key ‘?’ |
| P8506 | Additional information 2 | for message | Info2 | in the picture with key ‘?’ |
| P8507 | Additional information 3 | | Info3 | in the picture with key ‘?’ |

P8508 Acknowledgement of pending CNC messages
(see also q157)

P8509 Actually displayed message (parameter of the PLC one describes)

| | |
|---|---|
| Byte 1 | Message paragraph |
| Byte 2 | Message paragraph |
| Byte 3 | Channel number (1... 8) |
| Byte 4 | Axis paragraph (1... 32) |

(see also parameter status byte 3)

**Channel locking**

P8510 Automatic transmission locking
The lockings that are defined here are activated in the AUTOMATIC mode.
Activating can be done with the mode of operation changeover (see also P11010 . ..)
Byte 0

| | | |
|---|---|---|
| Bit 0 | Parameter locking 1 | (see also parameter status byte 3) |
| Bit 1 | Parameter locking 2 | (see also parameter status byte 3) |
| Bit 2 | Parameter locking 3 | (see also parameter status byte 3) |
| Bit 3 | Parameter locking 4 | (see also parameter status byte 3) |

Byte 2

| | |
|---|---|
| Bit 0 | NC-memory locking |
| Bit 1 | Cycle-memory locking |

## 8.5 Standard channel parameters (continued)

### Channel informations

P8540 M function - interface diagnosis
Diagnostic parameter only described with active PLC< >CNC
P8549 interface diagnosis. (P11280 = 1)
Byte 1 M function paragraph
Byte 2 M function paragraph
Byte 3 M function definition

P8550 Channel number, is pre-allocated.

P8551 Number of axes of this channel, is obtained when the switching on routine.

P8552 Final axis in the channel (logical axis paragraph)
After the switching on routine one obtains.

P8553 Mapping test parameter
Mode of operation: P8553 is described with a p-paragraph, sees P8554.

P8554 Those obtains the Procedure called when describing the parameter P8553
q paragraph this parameter and this writes after P8554.

P8555 Actual work area, switches zero point blocks over
0 or -- Invalid work area
1 1. Record of the zero points actively
2 2. Record of the zero points actively
: :

P8559 Control rooms on end of block acknowledgement with M function with stop
0 or -- ok
1 Wait for acknowledgement (block release)
(CNC waits for the PLC Acknowledgement of a m-function with stop)

## 8.5 Standard channel parameters (continued)

### Channel informations

P8570 ... Actual reference point display

| | | | |
|---|---|---|---|
| P8570 | 1st display field | Content: | 1..32 logical axis number |
| : | | | 0 no display |
| P8577 | 8th display field | | |

P8578 Number of max. reference point displays in the status line,
if P8578 < axis number of the last channel axis, the reference point displays are showing the subsequent reference points.

P8679 All reference points taken

| | |
|---|---|
| 0 or -- | Not all reference points taken |
| 1 | All reference points in the channel taken |

## 8.5 Standard channel parameters (continued)

### Channel informations

P8580 Actual organization of the actual position display
: This parameter area is set by the operating system.
P8587 (may not be written).

P8580 Number of the display field
Content: 1..32 logical axis number
0 no axis display
Byte 1 display field 1
Byte 2 display field 2
Byte 3 display field 3
Byte 4 display field 4

P8581 Number of the display field
Byte 1 display field 5
Byte 2 display field 6
Byte 3 display field 7
Byte 4 display field 8
:
P8587 Number of the display field 29..32

P8588 Maximum number of actual display fields

## 8.5 Standard channel parameters (continued)

### Channel informations

P8590 : P8597 — Standard (customer specific) organization of the actual position display
At each operating mode change, the here defined actual position display is activated.

P8590 — Number of the display field

| | | |
|---|---|---|
| Content: | 1..32 | logical axis number |
| | 0 | no axis display |
| Byte 1 | display field 1 | |
| Byte 2 | display field 2 | |
| Byte 3 | display field 3 | |
| Byte 4 | display field 4 | |

Comment:
With the describing of P8590 the Istpositionsanzeige is again structured.
(trigger parameters)

P8591 — Paragraph of the indication area

| | |
|---|---|
| Byte 1 | display field 5 |
| Byte 2 | display field 6 |
| Byte 3 | display field 7 |
| Byte 4 | display field 8 |

P8597 — Paragraph of the indication area 29.. 32
Parameter with trigger function.
With each describing P8597 becomes into that
parameters P8590... activates p8597 specified Istpos display.

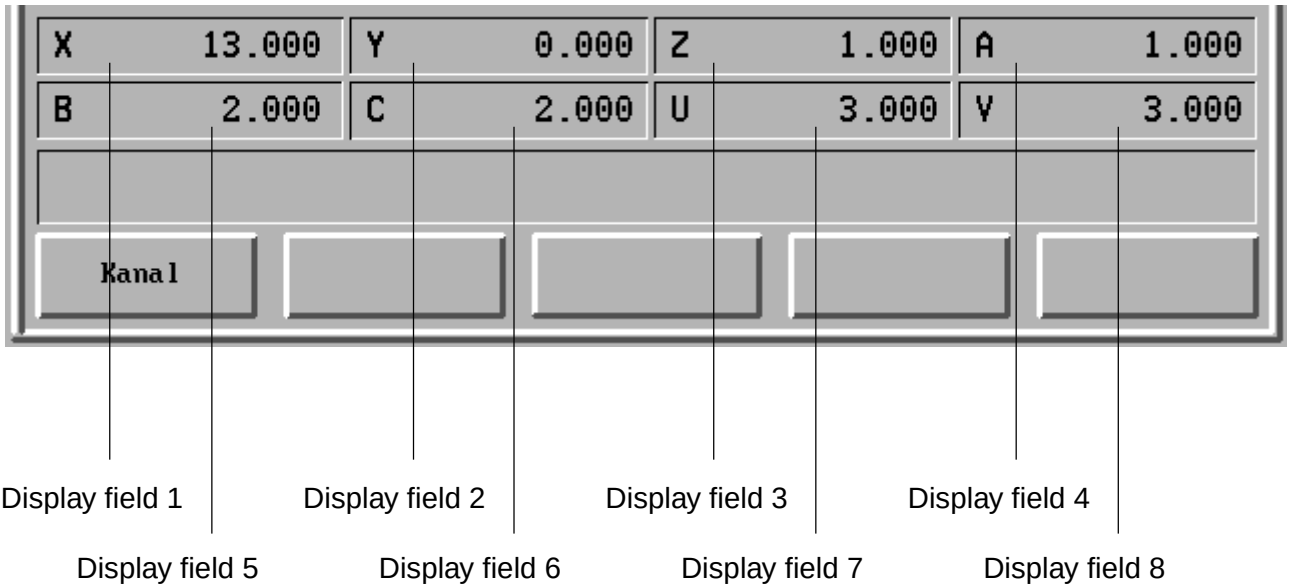
P8598 — Display mode of the actual position display

| | |
|---|---|
| 0 or -- | If the actual position display knows not all available axes at the same time to raise, if this becomes on the final indication area with the axis selection of an axis, which not at the moment to display comes, another axis to displace. |
| 1 | Actual position display does not change. |

## 8.5 Standard channel parameters (continued)

### Channel informations

Example actual position display



## 8.5 Standard channel parameters (continued)

**Presettings MANUAL** (planned)

P8600 Presetting axis position display
:
P8639

## 8.5 Standard channel parameters (continued)

**Presetting AUTO** (planned)

P8640 Presetting axis position display
:
P8679

## 8.5 Standard channel parameters (continued)

### Channel - Commands to PLC

P8681 Key Manual (to PLC) is written by the operating panel
0 Key released
1 Key pressed (PLC:THANDK1)
P8681 is written by the operating panel.

P8682 Key Start / Stop (to PLC) is written by the operating panel
0 Keys released
1 Key Stop pressed (PLC:TSTOPK1)
2 Key start pressed (PLC:TSTARK1)
When writing P8682, P8684 is written with AUTO Start /-Stop
and answered to the PLC.

P8683 Mode of operation change (to PLC)
1 Manual (PLC:BAWHAK1)
Pending CNC messages become with
mode change after hand reset.
2 Automatic sequential blovk (PLC:BAWAUK1)
3 Automatic single block (PLC:BAWAUK1)
8 Automatic positioning block (PLC:BAWAUK1)

## 8.5 Standard channel parameters (continued)

### Channel - Commands to PLC

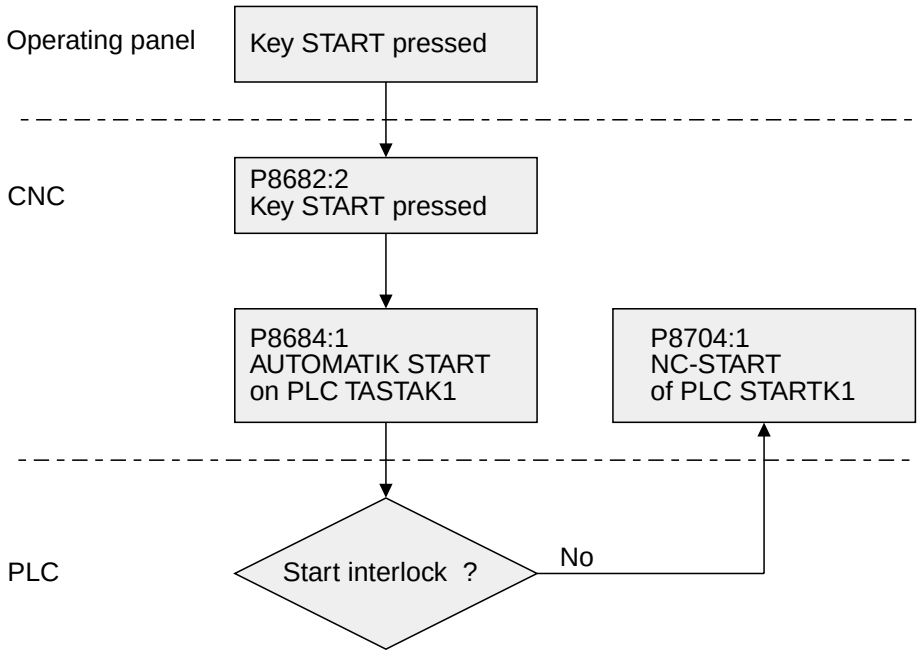
P8684 Automatic transmission Start/Stop (to PLC)

| | | |
|---|---|---|
| 0 | Stop | (PLC:TASTOK1) |
| 1 | Start | (PLC:TASTAK1) |

Example: NC Program start

When writing P8682, P8684 is written with AUTO- Start/Stop and answered to the PLC. If there are no start interlocking in the PLC, the Start/Stop command is answered to P8704. With P8704 the NC program (P8800) is started.

Example: Flow of a NC program start




P8685 Automatic program active (to PLC)

The CNC indicates here the actual condition.
The parameters may not be written. .

| | | |
|---|---|---|
| 0 | Program not yet active or finished. | (PLC:ANAK_K1) |
| 1 | Program active Stop | (PLC:AASP_K1) |
| 2 | Program active Start | (PLC:AAST_K1) |

## 8.5 Standard channel parameters (continued)

### Channel - Commands to PLC

P8686 Restarting info. at PLC
- 0 No restarting, normal railway company.
- 1 Restarting without axis movement, NC program is in the browsing.
- 2 Restarting at outline (axis movement), starting block was found.
  Outline on direct path started with rapid traverse feed (P8816).
  With achieving the outline P8686:0

P8689 Actual type of coordinate (see also P8759)
- 0 or -- Transformation out
- 15, 16 Polar transformation
- 47, 48, 49 Robot transformation

P8690 M function code at PLC
Transmit a m-code at PLC in the manual operation.

P8695 Acknowledgement for remainder path resetting
- 0 or -- With NC block with M26 a NC nC-Verfahrweg becomes over
  - hardware sensor input
  - P8715
  aborted,
  P8695 with the actual NC record number is described.

P8696 Acknowledgement for measuring position accommodation
- 0 or -- With start of a measuring travel P8717 measuring position raised over
  - hardware sensor input
  - P8716
  aborted,
  P8696 with the actual NC record number is described.

## 8.5 Standard channel parameters (continued)

### Channel commands of the PLC

| | | |
|---|---|---|
| P8700 | Enable regulator for channel | (PLC:REOK_K1) |
| | 0 no regulator enabling, i.e. command = actual of the axis | |
| | 1 enable regulator | |
| P8701 | Enable move of all axes in the channel | (PLC:KAFR_K1) |
| | 0 no channel enabling, i.e. stopping the axes without dynamics | |
| | 1 channel enabling | |
| P8702 | Security stop of all axes in the channel | (PLC:SICHAK1) |
| | 1 Stop, i.e. stopping the axes with dynamics | |
| P8703 | Mode of operation | (PLC:BA_K1) |
| | 1 MANUAL | (PLC:HAND_K1) |
| | 2 AUTO sequential block | (PLC:AUTF_K1) |
| | 4 AUTO single block | (PLC:AUTE_K1) |
| | 8 AUTOpositioning block | (PLC:AUTP_K1) |
| P8704 | AUTO Start / Stop | (PLC:STARTK1) |
| | Herewith a NC program is started (number is in P8800). | |
| | 0 Stop | |
| | 1 Start | |
| P8705 | NC program abort | (PLC:ABBRUK1) |
| | 1 Abort | |
| P8706 | Enable block | (PLC:SAFREK1) |
| | Sentence by sentence control of a NC program | |
| | 0 No block change | |
| | 1 Block change | |
| P8709 | Reference points taken | (PLC:REFALK1) |
| | 0 Reference points not yet taken | |
| | 1 All reference points taken | |

## 8.5 Standard channel parameters (continued)

### Channel command of PLC

P8710 Emergency programm call 1 (PLC:NPA1K1)
0 No call
1 Program call
Program - and block number according to P8820, P8821
Function:
When calling up an emergency program a running NC program is interrupted.
When activating a emergency program in manual mode, the operating mode AUTO sequential block is changed.
If operating mode change is locked, the message 1320 appears.
At the end of the emergency program the mode of operation AUTO sequential block remains. When starting the emergency program P8710 is loaded with 0.

P8711 Emergency program call 2 (PLC:NPA2K1)
0 No call
1 Program call
Program- and block number according to P8822, P8823
Function see P8710

P8714 Conditional block skip (M22) (PLC:BSP22K1)
0 no skip
1 skip after block number

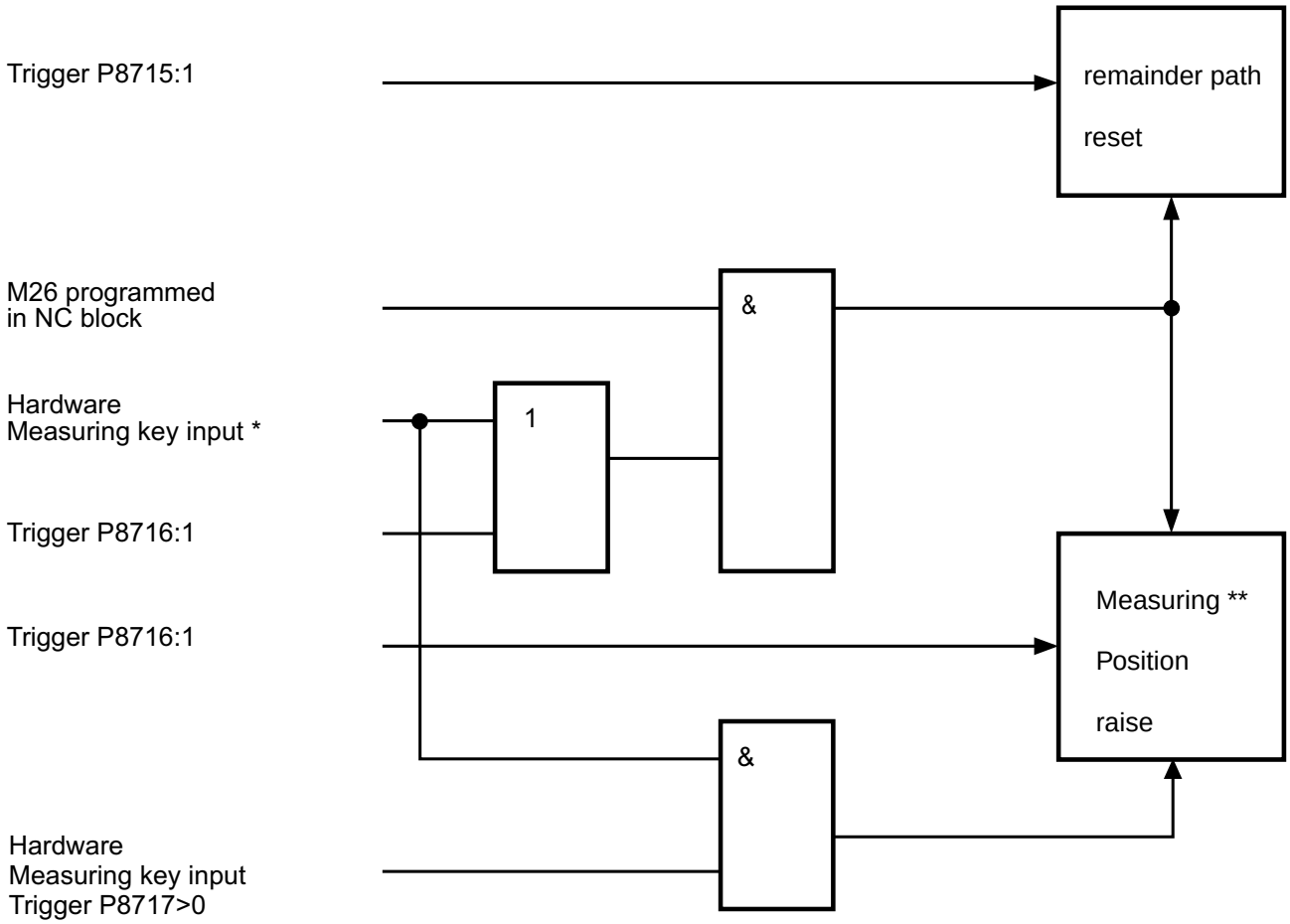
P8715 Trigger for clearing movement in progress (M26) (PLC:TRWLOK1)
1 trigger

P8716 Trigger for software-measuring key (PLC:TSWMTK1)
1 trigger

P8717 Measuring position release
1 Measuring position release over sensor input
unique release for measuring position accommodation
2 Measuring position release over sensor input
constant release for measuring position accommodation
(see P8696)

## 8.5 Standard channel parameters (continued)

**Clearing residual traverse (movement in progress)** **Measuring position logics**




note:

| | | |
|---|---|---|
| * see also | P12045 | measuring logic |
| ** see also | P12153 | measuring position |
| | P12181 | measuring position achieves |
| | P8855 | measuring position type of display |
| | P8655 | acknowledgement measuring position accommodation |

## 8.5 Standard channel parameter (continued)

### Teach-in

P8747 Axis selection at Teach-In

| | |
|---|---|
| 0 or -- | All existing axis positions are overtaken in the NC block at key target=actual |
| <>0 | Only axis positions according to selection are overtaken in the NC block |

Example:

P8747: 0FH At axis 1 to 4, the position is overtaken in the NC block.

P8748 Radius of the tool used in Teach-In.

P8749 Mode of coordinate for Teach - In

| | | |
|---|---|---|
| Input | 0 | off |
| | 48 | tool coordinate mode |
| | 49 | work piece coordinate mode |

## 8.5 Standard channel parameters (continued)

### Manual operation

| | | | | |
|---|---|---|---|---|
| P8750 | Traverse mode selection | | | |
| | 1 | Continuously | (relative) | (PLC:KONT_K1) |
| | 2 | Step | (relative) | (PLC:STEP_K1) |
| | 3 | Hand-wheel | | (PLC:HARA_K1) |
| | 4 | Divide | (absolute/relative) | (PLC:TEIL_K1) |
| | 5 | Home | (absolute/relative) | (PLC:HOME_K1) |
| P8751 | Axis selection<br>Logical axis number 1...32 | | | (PLC:RAGAWK1) |
| P8752 | Manual move + / - | | | |
| | 0 | stop | | |
| | 1 | + | | (PLC:HAND+K1) |
| | 2 | - | | (PLC:HAND-K1) |
| | With the describing of this parameter the technique becomes the axis (P8751) started in the suitable procedure mode (P8750). Parameter becomes of the system with depressing the key hand + / - described. | | | |
| P8753 | Relative-travel in manual mode<br>(internally used parameter) | | | |
| P8754 | max. programmable manual feed | | | [mm/min, degree/min] |
| P8755 | Programmed manual feed rate | | | [mm/min, degree/min] |
| P8756 | Actual manual feed rate | | | [mm/min, degree/min] |

## 8.5 Standard channel parameters (continued)

### Manual operation

P8757 Coordinate system in HAND

| | | |
|---|---|---|
| Input | -- , 0 , 17 | G17 |
| | 18, 19, 117, 118, 119 | Gxxx |

The tool length always affects the vertically axis of the interpolation plane.
Parameter wid after each passing through of the switching on routine reset.

P8758 Zero pointes in Manual
- display of the actual zero point in manual operation.
- When writing the corresponding zero point is activated.

Input 53 . .. 59
Parameter wid after each passing through of the switching on routine reset.

P8759 Coordinate mode in Manual
0 transformation off
Polar transformation
Input 15 off
16 on
Robot transformation
Input 47 off
48 Tool - coordinates
49 Workpiece - coordinates
4849 Automatic switch between 48 and 49
Parameter wid after each passing through of the switching on routine reset.

## 8.5 Standard channel parameters (continued)

### Step operation

| | | |
|---|---|---|
| P8760 | Actual step width | [mm] |
| P8761 | step width<br>1 h on step width | |
| P8762 | Pointer on selected step | |
| P8763<br>:<br>P8769 | Step width table | |
| P8763 | Step width 1<br>default 10 | |
| P8764 | Step width 2<br>default 1 | |
| P8765 | Step width 3<br>default 0,1 | |
| P8766 | Step width 4<br>default 0,01 | |
| P8767 | Step width 5<br>default 0,001 | |
| P8768 | Step width 6<br>default 0 | |
| P8769 | Step width 7<br>default 0 | |

## 8.5 Standard channel parameters (continued)

### Hand-wheel

P8770 Active hand-wheel
0 No hand-wheel switched on
1..8 Number of hand-wheel switched on

P8771 Hand-wheel 1
Bitinfo for axes, which may proceed with hand-wheel.
Example: 8771: 03
The 1st and 2nd axis can only be selected with the hand-wheel.
:
:
P8778 Hand-wheel 8

P8779 Hand-wheel definition
Byte 1 0 Hand-wheels are activated individually with the hand-wheel key.
Hand-wheel multiplicator is modified individually.
During hand-wheel far one circuit axis selection is not changed.

$10 All hand-wheels are always simultaneous activated.
Hand-wheel multiplicator is modified individually.
During the hand-wheel far circuit the former axis selection becomes this hand-wheel again activates.

## 8.5 Standard channel parameters (continued)

**Indexing** (planned)

P8780
:
P8789

## 8.5 Standard channel parameters (continued)

**Home** (planned)

P8790
:
P8799

## 8.5 Standard channel parameters (continued)

### Start data

P8800 Program number of the program to be started (see P8704)

P8801 Block number
Start from this block.

P8802 Program number in the case of the NC program abort
Parameter is described by the system
see function: Restart at outline

P8803 Record number in the case of the NC program abort
Parameter is described by the system
see function: Restart at outline

P8804 Restarting at outline

| | |
|---|---|
| 0 or -- | Restarting function not actively |
| 1 | Restarting function actively |

Mode of operation restarting at outline:

In the case of the abort of a current NC program (HAND abort, message) becomes of system the actual NC program position in the parameters P8802, P8803 and P8807 stored. A properly terminated NC program resets these information.

After an NC abort if the restarting mode is switched on and the NC program started, then if the NC program up to the restarting point is simulated,
i.e.. no axis movements egeben themselves.

In the restarting block the simulation is switched off. The restarting position on direct path one starts. With achieving the restarting position becomes P8804=0 settinged.

One restarts on the initial position of the aborted block.
If the NC program in a process cycle is aborted, then becomes to cycle start started.

When restarting become accordingly m-functions, M6 and m-cycles
M function definition (P11050..., P8250...) treats.

During the restarting simulation P8050 (advance t NR.) becomes to the PLC do not transfer.

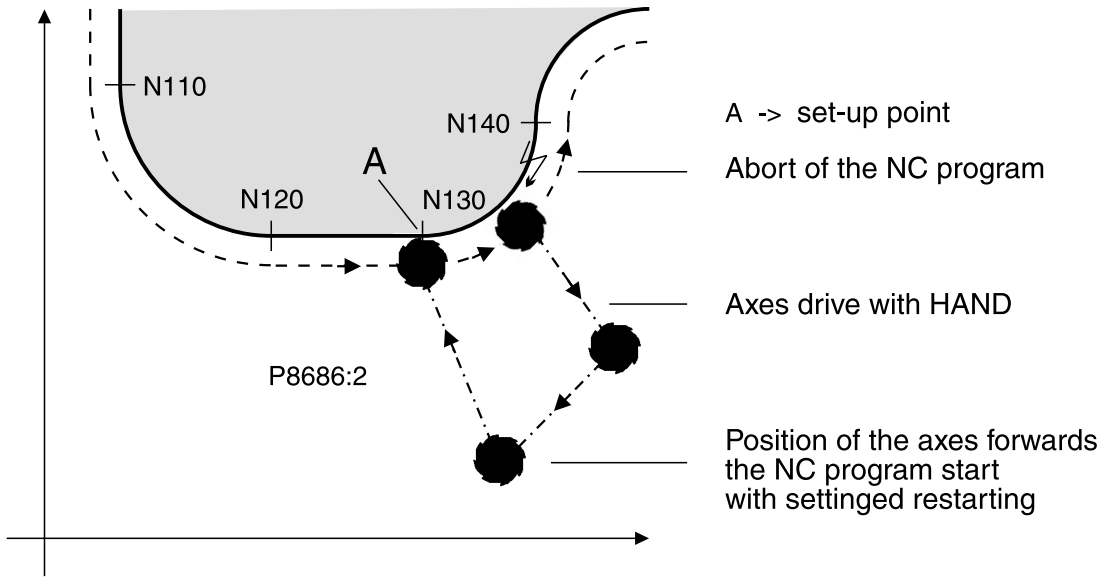
see also P8686

## 8.5 Standard channel parameters (continued)

### Start data

P8805 Restarting adjustments

Example:



## 8.5 Standard channel parameters (continued)

### Start data

P8806 Start data flag

| | | |
|---|---|---|
| Byte 1 bit 0 | 0 | No block display during cycle handling |
| | 1 | Block display runs during cycle handling |
| Byte 2 bits 0 | 0 | Increasing automatic file barrier actively, i.e. of the NC interpreter processed NC programs and cycles remain up to the program end (abort or M30) with the editing barrier provide (max. 250 entries). |
| | 1 | Increasing automatic file barrier not actively, now the editing barrier is only so long active, as the NC interpreter the NC program opened (interpreter operates in the advance). |
| Byte 3 bit 0 | 0 | Drill cycles do not pend to modal, G80 does not have effect. |
| | 1 | Drill cycle modality switched on, i.e. with the unique programming of a Bohrzykluses (G81, G83, G84, G85) becomes in the following NC blocks ‘ also path ‘ implicitly the drill cycle programmed first called. This Modalitaet is switched off with G80. |

P8807 Internal restarting information

P8809 Graphics on/off
- 0 Graphics off
- 1 Graphics on

P8810 Block skip
- 0 Block skip not switched on
- 1 Block skip switched on

P8811 Dripfeed operation
- 0 No Dripfeed operation
- 1 With Dripfeed operation

P8812 Without axis movement
- 1 NC program sequence without axis movement

## 8.5 Standard channel parameters (continued)

### Start data

P8813 Without M - function
1 NC program sequence without M-function
- M-functions at PLC are not transmitted
- program-controlling M-functions work unchanged
- branch M-functions do not branch

P8814 Single block mode with / without stop in intermediate blocks
0 or -- each main block is stopped in the single block mode
1 after each block end is stopped in the single block mode (at cycle blocks, insert block etc.)

P8815 Test feed rate [mm/min]
0 or -- switched off
<>0 at G01, G02 and G03 this programmed feed is used.

P8816 Rapid traverse G00 [mm/min]
0 or -- Manual feed rate active
max. Axis speed (P12004)
the axes available in the channel positions.
< > 0 with prog. Rapid traverse is positioned with this speed.

P8817 Asynchronous feed rate [mm/min]
The programmed feed rate of the active NC block is replaced until the block end by the feed rate of P8817

P8818 Percentage feed rate change [%]
The programmed feed rates in the NC program are changed with this percentage value.

## 8.5 Standard channel parameters (continued)

### Start data

| | | |
|---|---|---|
| P8820 | Program number | Emergency program 1 |
| P8821 | Block number | |
| | Emergency program call up see P8710 | |
| P8822 | Program number | Emergency program 2 |
| P8823 | Block number | |
| | Emergency program call up see P8711 | |
| P8824 | Program number | |
| P8825 | Block number | |
| | Emergency program call up see P8712 | |
| P8826 | Program number | |
| P8827 | Block number | |
| | Emergency program call up see P8713 | |
| P8830 | Zero point in AUTO | |
| | 0 or -- | NC program starts with G53 |
| | 53..59,153.. | NC program starts with the programmed zero point |

## 8.5 Standard channel parameters (continued)

### Program controlling parameters

P8840 Definition of the coordinate system for G117
(see also q152...)

Byte 1 1. logical axis paragraph
abscissa (horizontal axis)
centre point identifier I
Byte 2 2. logical axis paragraph
ordinate (vertically axis)
abscissa and ordinate specify the level, in which the circular interpolation takes place.
centre point identifier J
Byte 3 3. logical axis paragraph
definition of the vertically axis on the interpolation level

The definition of the sense of circle turning a right-angled coordinate system always becomes assumed.
The direction of rotation in the various levels is as follows determined:
One looks against the direction of the axis, which is vertically on the level.
(axis No. in byte 3).
With G02 now in the clockwise direction one interpolates.
With G03 against the clockwise direction one interpolates.

Programming example:
N100 G117 P8840:$00010302
byte: 4 3 2 1

P8841 Definition of the coordinate system for G118 (see also q153..)
Default, if
0 or -- $020103
Byte 1 03 (centre point identifier K)
Byte 2 01 (centre point identifier I )
Byte 3 02

P8842 Definition of the coordinate system for G119 (see also q154..)
Default, if
0 or -- $010302
Byte 1 02 (centre point identifier J)
Byte 2 03 (centre point identifier K)
Byte 3 01

## 8.5 Standard channel parameters (continued)

### Program controlling parameters

P8843 Max. one permitted radius error during centre point programming [ mm ]

| | | | |
|---|---|---|---|
| 0 or -- | Default | radius error | 0.003mm |
| | otherwise | error message | M1238 |
| < > 0 | Permitted error of the radius during centre point programming, starting from that the error message M1238 is output. | | |

P8844 Radius correction messages suppress

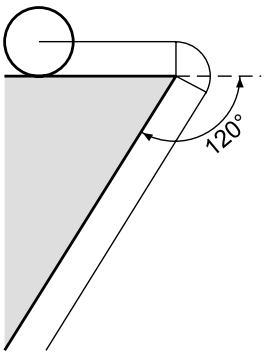
Byte 1

| | | |
|---|---|---|
| bit 0 | 0 | M1154 release |
| | 1 | M1154 is suppresses |
| bit 1 | 0 | M1155 release |
| | 1 | M1155 is suppresses |

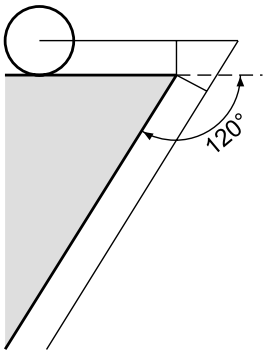
P8845 Inserting sets / intersections with werkzeugradius-Korrektur.

| | |
|---|---|
| -- | at outside edges sets are always inserted. |
| 0 | in the case of direction deviation over 120 degrees sets are inserted under 120 degrees intersections are calculated. |
| 0... 180 | [ degrees ] in the case of direction deviations, which are larger than the input degree number, sets are inserted and in the case of direction deviations, which are smaller than the input degree number, intersections are calculated. Example: Direction deviation 120° and degree number of 110: Circle is inserted. Direction deviation 120° and degree number of 130: Intersection is calculated. |

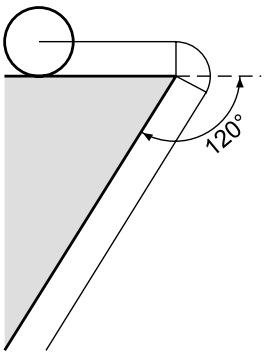
P8845 : --



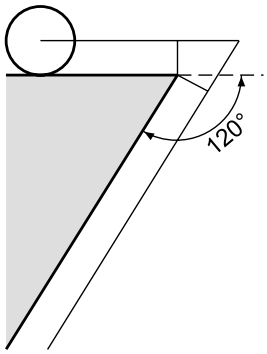

P8845 : 0




P8845 : 110°




P8845 : 130°



## 8.5 Standard channel parameters (continued)

### Program controlling parameters

P8846 Spline modification

| | | |
|---|---|---|
| 0 or -- | 3D-spline (standard) | |
| < > 0 | 5D-spline switched on | |
| | byte 1 | logical axis paragraph of the 4. spline axis |
| | byte 2 | logical axis paragraph of the 5. spline axis |

1., 2., 3. Spline axis are specified over G17, G18, G19.

Example: P8846:$0604 means
4. Spline axis is 4th logical axis
5. Spline axis is 6th logical axis

P8847 Spline modification

| | |
|---|---|
| 0, -- or 0,5 | Standard spline |
| 0,5... 2 | Spline modifies<br>i.e. decaying the Splines is influenced. |
| 0,5 | Flat spline |
| 0,85 | Spline decays more |

Effectiveness becomes clear with large bracket steps.

## 8.5 Standards channel parameters (continued)

### Program controlling parameters

Feed increase or feed degradation with convex or concave sections

P8848 Feed dynamics convex Input: [ 0-100% positively or negatively ]
Feed is proportionally increased or lowered.

P8849 Feed dynamics concave Input: [ 0-100% positively or negatively ]
Feed is proportionally increased or lowered.

When inserting values in P8848 and P8849 the following formula applies:

F calculated feed
F_p programmed feed in the NUMERICAL CONTROL program
R outline radius
WR radius of the tool

F = F_p * (1 +(P8848 or P8849)/100 * (P8850-R)/(P8850-WR))
with R > P8850 is F = F_p

P8850 Feed dynamics
0 or -- Feed dynamics switched off
1 With switched on werkzeugradiuskorrektur the feed becomes the actual path adapted, i.e. the programmed path feed applies to the edge contact tool.
> 1 Petition of the outline Referenzradiuses, starting from which no feed modification one executes. P8848 and P8849 actively.

## 8.5 Standards channel parameters (continued)

### Program controlling parameters

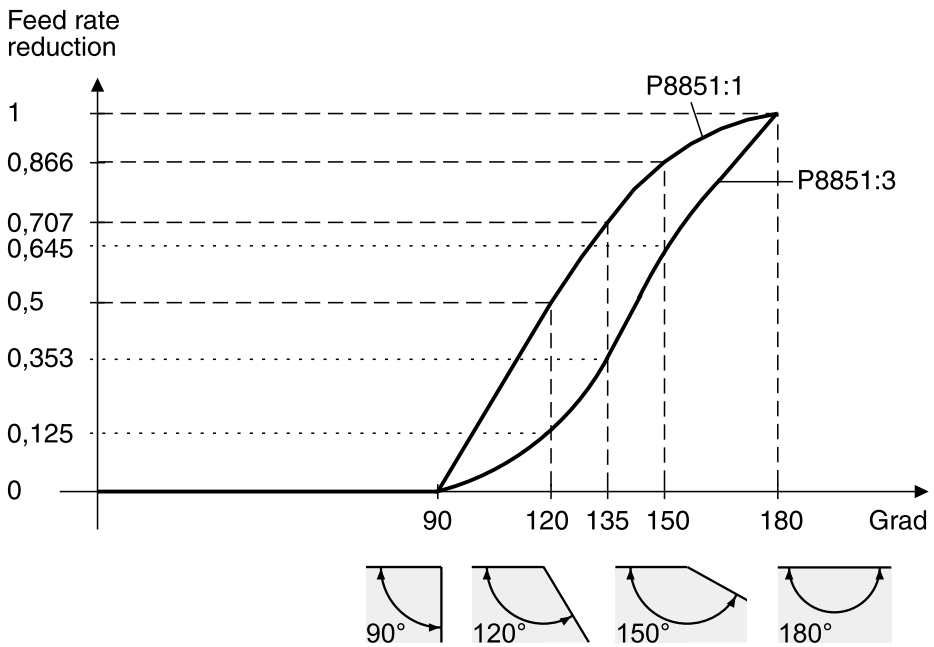
P8851 Corner dynamics [ Input: 0... 10 ]

| | |
|---|---|
| 0 or -- | Standard corner dynamics actively |
| < > 0 | Corner dynamics |
| -1 | Switch off |

Function of the standard corner dynamics
When approaching a corner, the contour feedrate is reduced in dependancy of the corner angle, that means slow down before corners. Because of the corner angle, a reducing factor is effective (cos), which results in the contour feedrate before the corner when multiplying with the programmed feed rate.

Example:

| Corner angle | Corner feed reduction at P8851:1 | at P8851:3 |
|---|---|---|
| ≤90 degree | 0 | 0 |
| 120 degree | 0,5 | 0,125 |
| 135 degree | 0,707 | 0,353 |
| 150 degree | 0,866 | 0,649 |
| 180 degree | 1 | 1 |




Function corner dynamics
At P8851>0, the standard reducing factor is raised to a power with the content of P8851. The larger P8851 is, the more it is slowed down before corners.

## 8.5 Standards channel parameters (continued)

### Program controlling parameters

P8852 Circle dynamics [mm]

0 or -- Circle dynamics switched off

<>0 Circle dynamics active

input value permissible path deviation [mm]

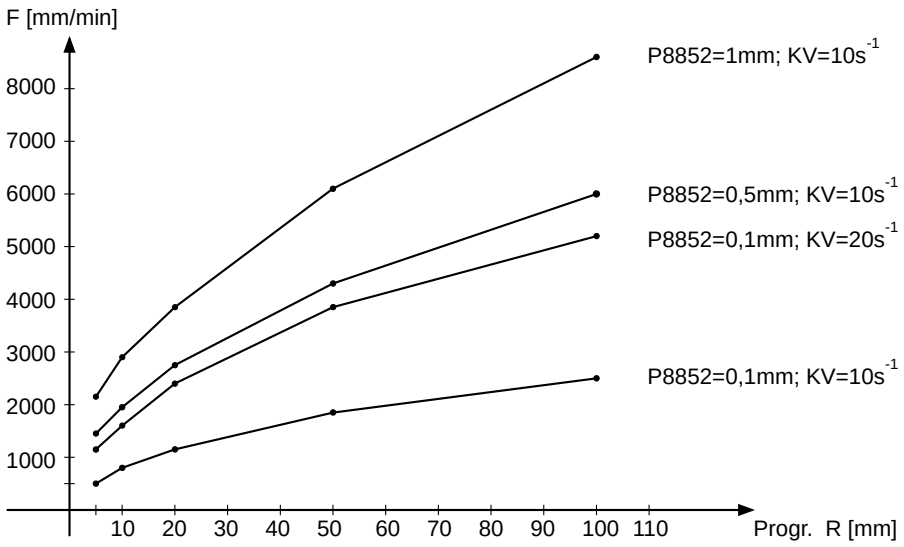
function reduction of the feedrate at circular interpolation

At circular interpolations (G02/G03), an internal circle feed rate is calculated with the help of the permissible path deviation which is limiting the feed rate that is programmed in the NC program.

Internal circle feed rate is dependant of
- programmed radius
- KV factor
- P8852

Remark:
P8852 always has to be smaller than the programmed radius, if not error message M1237 appears

Example



## 8.5 Standards channel parameters (continued)

### Program controlling parameters

P8853 Preset coordinate mode at NC program start
0 or -- No coordinate mode selected
49 NC program is starting with the indicated coordinate mode 49

P8854 Radius correction at G49
0 or -- Radius correction in space, spline-contour G50
1 Radius correction in plane

P8855 Measuring position modification (P12153)
0 or -- Store measuring position ref. display position
1 Store measuring position ref. machine position

P8856 Internal parameter
(zero point setting CNC < —> Bediendeld)

P8857 Outline dynamics with path interpolation
0 or -- Outline dynamics switched off
< > 0 Outline dynamics actively

Input value certified path deviation [ mm ]
Function reduction of the feed
drive path (G1, G2, G3, G50)
The programmed points of path are connected with sets.
Thus the calculated circle radii form the basis for one
possible path feed reduction. To calculation see P8852.

P8858 Definition of rapid traverse (G00)
Rapid traverse rate (see P8816)
0 or -- Rapid traverse always with exact stop,
i.e.. at the end of record feed = 0,
lag distance < exact stop
1 Rapid traverse always with feed stop
i.e.. at the end of record feed = 0,
for lag distance < exact stop is not waited
2 Rapid traverse no stop
end of record handling as with (G1, G2, G3, G50)

## 8.5 Standards channel parameters (continued)

### Program controlling parameters

P8859 G92-Modifikation
Parameter must be settinged before the NC program start!
Byte 1
bit 0 0 G92-Verschiebung rotates with 1. Rotation axis
1 G92-Verschiebung no rotating with 1. Rotation axis
bit 1 0 G92-Verschiebung is turned by G45 (starting from version 090)
1 G92-Verschiebung is not driven by G45

P8860 G95-Modifikation
Byte 1
$xx 0 G95 acquisition data concerning spindle data 1 (P11640)
1 - 8 G95 reference spindle from spindle data 1-8
Byte 2
$xx 1 - 8 G95 acquisition data bezueghlich coupling data 1-8
(* tooth number of masters / tooth number of Slave)

P8861 Feed modification for not interpolated axes
Only effectively if P8893 < > 0;
0 or -- Axis feed concerning absolute feed P12122
1 Equal axis feed programmed path feed in the NC program
2 Axis feed equal programmed path feed proportion everything
in the NC Progroramm more programmieter (not interpolated axes)
i.e.. Axis final positions are achieved at the same time.

P8865 Channel-specific definition of the Overrides for interpolation rate
0 or -- Default Override 1 (1-8)
Observe:
Override Definitions in the axis data (P12125) are superordinate!

P8866 Channel-specific definition of the Overrides for relative velocity
0 or -- Default Override 1 (1-8)
Observe:
Override Definitions in the axis data (P12126) are superordinate!

P8867 Channel-specific definition of the Overrides for absolute speed
0 or -- Default Override 1 (1-8)

Note: Override Definitions in the axis data (P12127) are superordinate!

## 8.5 Standards channel parameters (continued)

### Program controlling parameters

P8880 Axis change, switch on, switch off
0 or -- Switched off
1 Axis change on

If an axis change is switched on, the display position is exchanged.

Zero point shifts from G53 to G59 effect on the physical axes, they remain at the same physical axis at an axis change.
Zero point shift G92 and correction G44 effect on logical axes and are influenced therefore by the axis exchange.

P8881 Exchange the two physical axes
Byte 1: on axis
Byte 2: from axis
Input of the logical axis numbers

Example: P8881 : $0106
P8882 : $0601
i.e. axis change between axis 1 and axis 6

Programmed commands in the NC program
for 1st axis are transmitted to 6th axis,
for 6th axis are transmitted to 1st axis.

P8882 Axis change
P8883 Axis change
:
P8889

## 8.5 Standard channel parameters (continued)

### Program controlling parameters

P8890 Tangential axis
0 No tangential axis available in the channel
1-32 logical axis number
The here indicated axis becomes tangential the programmed path of the NC program adjusted.

P8891 Axis specific block locking

| | | |
|---|---|---|
| Bit 0 | 1 | 1st logical axis with axis-specific block locking |
| Bit 1 | 1 | 2nd logical axis |
| : | | |
| Bit 31 | 1 | 32nd logical axis |

Function:
If the axis-specific block locking is selected, executing the NC program in the interpolator is stopped if axes should be moved which are selected with the axis-specific block locking.

P8892 Axis reflection
Parameter contains bit information

| | | |
|---|---|---|
| Bit 0 | 1 | 1. logical axis reflect |
| Bit 1 | 1 | 2. logical axis reflect |
| : | | : |
| Bit 31 | 1 | 32. logical axis reflect |

Mode of operation:
One reflects around the actual machine position P12150.
Is modified thus the debit position P12151 of + < - > -;
and the indicator position P12154 of + < - > -;
e.g.. P12154: 150,0 P12154 becomes: -150.0
With programmed positive drive, the axis moves around this amount in negative direction.

Parameter is reset with each mode change after HAND.

## 8.5 Standard channel parameters (continued)

### Program controlling parameters

P8893 Traverse axis not interpolating
Parameter with bit information

| | | |
|---|---|---|
| Bit 0 | 1 | 1st logical axis with axis-specific block locking |
| Bit 1 | 1 | 2nd logical axis |
| : | | |
| Bit 31 | 1 | 32nd logical axis |

Mode of operation:
During the processing of a NC program in the Interpolator, the settinged axis becomes from the interpolation removes and parallel (as absolute position with feed P12122... or with progr. To path feed see P8861 driven).
At the NC end of record an exact stop requested waits the CNC to all axes (also the not interpolated) in position, or with not interpolated axes and programmed Vorposition P12113, this is achieved

Parameter is reset in each switching on check.

P8894 Axes reduct switch off
Parameter contains bit information

| | | |
|---|---|---|
| Bit 0 | 1 | 1. logical axis no Achsreduct |
| Bit 1 | 1 | 2. logical axis |
| : | | |
| Bit 31 | 1 | 32nd logical axis |

Mode of operation:
During processing of a NC program the axes indicated here become with the calculation of the feed dynamics (P8851) does not consider, or with programmed path feed (see P8861) proceed.

Parameter is reset in each switching on routine.

P8899 Bracket axis system modification (see P11830 etc..)

0 Path operation
(display as programmed, to axes drive with bracket proportions)

1 Axis operation
(drive display with bracket proportions, of axes as programmed)

8.5 Standard channel parameters (continued)

**Real time - Information block analysis**

P8900 Actual program numbers of the NC - program
P8901 Actual block number of the NCS - program

P8904 Actual cycle number
if cleared, no cycle active.
P8905 Actual block number in the cycle
if cleared, no cycle active.

P8906 Actual program number when NC program is aborted
- is loaded with the actual program number when NC program is aborted
- is written 0 at program end with M30

P8907 Actual block number when NC program is aborted
- is loaded with the actual program number when NC program is aborted
- is written 0 at program end with M30

P8910 Faulty program
- When the actual NC - program is aborted by the NC - interpreter (because of error message) the faulty program, which has led to the abort, is indicated here.

P8911 Faulty block
- When the actual NC - program is aborted by the NC - interpreter (because of error message) the faulty block, which has led to the abort, is indicated here.

P8912 Actual sub-program plane

P8913 Actual sub-program call up, program number
Here the actual program number is placed when switching to a sub-program.
P8914 Actual sub-program call up, block number
Here the actual block number is placed when switching to a sub-program.

P8918 I
P8919 J
P8920 K
P8921 R

P8925 S1 programmed in NC - block
:
P8932 S8 programmed in NC - block

## 8.5 Standard channel parameters (continued)

### Real time - Information block analysis

| | | | |
|---|---|---|---|
| P8934 | Programmed loop counter | M24 | |
| P8935 | Actual loop counter | M24 | |
| P8936 | Programmed feedrate F | | |
| P8937 | Programmed block end feedrate | | |
| P8938 | Actual feed F (of the interpolator) | | |
| P8940 | Actual interpolation mode | G00 / G01 / G02 / G03 | (to the PLC) |
| | 0 | G00 | (PLC:G00_K1) |
| | 1 | G01 | (PLC:G01_K1) |
| | 2 | G02 | (PLC:G02_K1) |
| | 3 | G03 | (PLC:G03_K1) |
| P8941 | Programmed dwell | G04 | [ s ] |
| P8942 | Actual dwell | G04 | [ s ] |
| | When running a dwell (G04) programmed in the NC - program, the remaining dwell is indicated here. | | |
| P8943 | Actual rotating direction circular axis | G05 / G06 / G07 | |
| P8945 | Actual polar coordinate programmng | G10 / G11 | |
| P8946 | Actual contour programming | G12 | |
| P8947 | Actual tangential axis | G13 / G14 | |
| P8948 | Actual polar transformation | G15 / G16 | |
| P8950 | Actual interpolation plane | G17 / G18 / G19 | |
| P8951 | Axis 1 | | |
| P8952 | Axis 2 | | |
| P8953 | Axis 3 | | |
| P8958 | Actual exact stop modal | G28 / G29 | |
| P8964 | Actual tool - radius - function | G40 / G41 / G42 | |
| P8965 | Actual axis correction | G43 / G44 | |
| P8966 | Actual rotating on / off | G45 / G46 | |
| P8967 | Actual co-ordinate system | G47 / G48 / G49 | |
| P8968 | Actual | G50 / G51 / G52 | |
| P8969 | Actual zero pointes | G53 . .. G59 | |
| | Content: G53 .. G59 | (actual zero point - shift see P12155.. .) | |

## 8.5 Standard channel parameters (continued)

### Real time - information block analysis

| | | |
|---|---|---|
| P8970 | Actual reflecting on | G61 |
| P8971 | Actual reflecting on | G62 |
| P8972 | Actual feedrate 100% | G63 / G64 |
| P8973 | Actual | G65 |
| P8974 | Actual corrections switched off | G66 |
| P8975 | Actual | G67 / G68 / G69 |
| P8978 | Actual absolute/chain dimension | G90 / G91 |
| P8979 | Actual zero point - shift<br>Content: 0 no G92 - shift active<br>92 G92 - shift active | G92 |
| P8880 | Actual feedrate definition actually | G93 / G94 / G95 |
| P8981 | Actual number of revolution mode spindle | G96 / G97 / G98 |
| P8982 | Actual end feedrate | G99 |

| | |
|---|---|
| P9080 | Tool group number (T-No.) |
| P9083 | Tool Sub record (selected) |
| P9090 | Radius of the tool |
| P9091 | Length of the tool |
| P9092 | Radius correction |
| P9093 | Length correction |
| P9094 | Type of tool (active quadrant 0... 9) |

### Real time - data blocks

| | | |
|---|---|---|
| P9100 | Actual G92 shift 1st. axis | [mm] |
| P9101 | Actual G92 shift 2nd. axis | |
| : | | |
| P9131 | Actual G92 shift 32nd. axis | |
| : | | |
| : | | |
| P9199 | | |

## 8.5 Standard channel parameters (continued)

### Preanalysis-information block of the block interpreter

| | | |
|---|---|---|
| P9300 | Actual program numbers of the block interpreter | |
| P9301 | Actual block number of the bliock interpreter | |
| P9303 | Sub-program - plane | |
| P9304 | Actual cycle number of the block interpreter<br>If cleared, no cycle in the block interpreter. | |
| P9305 | Actual block number in the cycle of the block interpreter<br>If cleared, no cycle in the block interpreter. | |
| P9318 | I | |
| P9319 | J | |
| P9320 | K | |
| P9325 | S1 | |
| : | | |
| P9332 | S8 | |
| P9334 | Loop depth M24 | |
| P9336 | Programmed feedrate F | |
| P9340 | Type of interpolation programmed<br>0, 1, 2, 3, 50, 51, 52<br>Contents with program start 1 | G00 / G01 / G02 / G03<br>G50 / G51 / G52 |
| P9341 | Retention time programmed | G04 |
| P9343 | Direction of rotation programmed round axis | G05 / G06 / G07 |
| P9344 | Programmed exact stop | G08 / G09 |
| P9345 | Polar coordinates programming programmed<br>10, 11<br>Contents with program start 11 | G10 / G11 |
| P9346 | Outline path programming programmed | G12 |

## 8.5 Standard channel parameters (continued)

### Preanalysis-information block of the block interpreter

| | | | |
|---|---|---|---|
| P9350 | Interpolation level programmed<br>17, 18, 19, 117<br>Contents with program start | 17 | G17 / G18 / G19 / G117 |
| P9351 | Axis 1 (1st principal axis) | contents of logical record number | |
| P9352 | Axis 2 (2nd principal axis) | contents of logical record number | |
| P9353 | Axis 3 (delivering axis) | contents of logical record number | |
| P9358 | Programmed exact stop modal<br>28, 29<br>Contents with program start | 29 | G28 / G29 |
| P9364 | Tool offset compensation programmed<br>40, 41, 42<br>Contents with program start | 40 | G40 / G41 / G42 |
| P9365 | Programmed axis correction<br>43, 44<br>Contents with program start | 43 | G43 / G44 |
| P9366 | Programming rotation in/out<br>45, 46<br>Contents with program start | 46 | G45 / G46 |
| P9367 | Programmed coordinate system<br>47, 48, 49, 147<br>Contents with program start | 147 | G47... G147 |
| P9369 | Programming actual zero point<br>53, 54, 55, 56, 57, 58, 59, 153, 154, 155...<br>Contents with program start | 53 | G53... G159 |
| P9370 | Programming reflecting<br>60, 61<br>Contents with program start | 60 | G60 / G61 |
| P9371 | Programming reflecting<br>60, 62<br>Contents with program start | 60 | G60 / G62 |

## 8.5 Standard channel parameters (continued)

### Preanalysis-information block of the block interpreter

| | | | |
|---|---|---|---|
| P9372 | Programmed feed 100%<br>63, 64<br>Contents with program start | 60 | G60 / G63 / G64 |
| P9373 | Programmed | | G65 |
| P9374 | Programmed outlines switched off | | G66 |
| P9375 | Programmed | | G67 / G68 / G69 |
| P9378 | Programmed absolute measure/chaining absolute<br>90, 91<br>Contents with program start | 90 | G90 / G91 |
| P9379 | Zero shift programmed actively<br>0, 92<br>Contents with program start | 0 | G92 |

## 8.5 Standard channel parameters (continued)

### Preanalysis data blocks

| | | |
|---|---|---|
| P9500 | Actual G92 shift 1st. axis | [mm] |
| P9501 | Actual G92 shift 2nd. axis | |
| : | | |
| P9531 | Actual G92 shift 32nd. axis | |
| : | | |
| : | | |
| P9699 | | |

## 8.5 Standard channel parameters (continued)

### Preanalysis NC-Block - informations

| | | |
|---|---|---|
| P9700 | Programmed position 1st. Axis | |
| : | | |
| P9731 | Programmed position 32nd. Axis | |
| | | |
| P9732 | I | |
| P9733 | J | |
| P9734 | K | |
| P9735 | R | |
| P9736 | T | |
| | | |
| P9739 | F | |
| | | |
| P9740 | G-function 1 | |
| : | | |
| P9747 | G-function 8 | |
| P9748 | G-function enlargement field | |
| | | |
| P9750 | M-function 1 | |
| P9761 | M-function 1 | enlargement field 1 |
| P9762 | M-function 1 | enlargement field 2 |
| : | | |
| P9771 | M-function 8 | |
| P9772 | M-function 8 | enlargement field 1 |
| P9773 | M-function 8 | enlargement field 2 |
| | | |
| P9780 | Speed 1 | |
| : | | |
| P9787 | Speed 8 | |

| | |
|---|---|
| P9800 | Tool data - interface |
| : | - Interface to the PLC |
| : | - Actual spindle tool - data block |
| : | - Actual active data block |
| P9999 | |

## 8.6 System parameters

### Key - switch - information

The following parameters are copies of the key-switches.

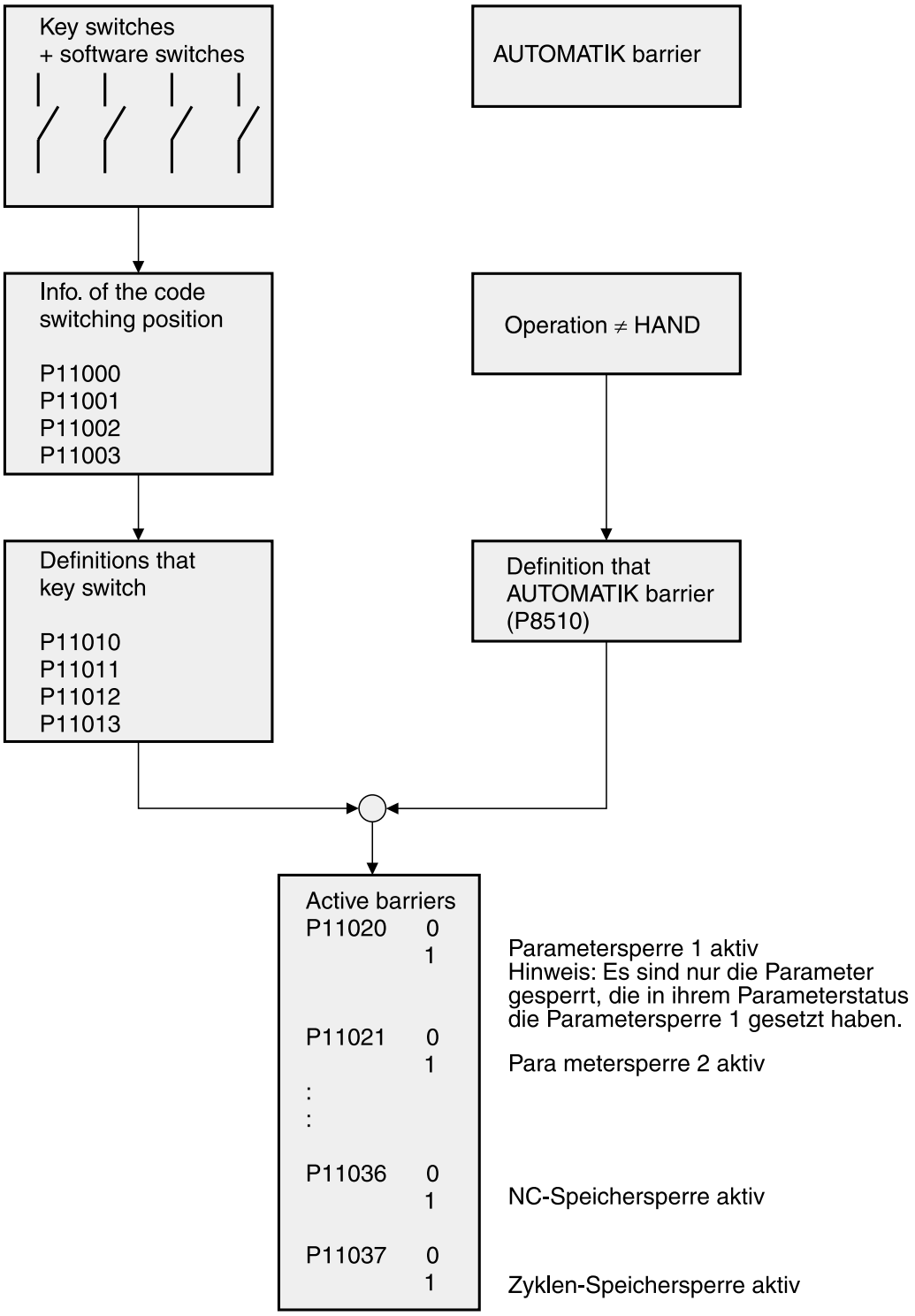
P11000 Key - switch 1 (Info)
0 : Switch open
1 : Switch closed
With the key - switch 1 the conduct of the starting routine is influenced.
P11000 : 0 —> ESR must be confirmed with pressing the key
P11000 : 1 —> ESR runs automatically, in so far as no errors appear.
(e.g.: parameters def., or NC - memory def.)

P11001 Key - switch 2
P11002 Key - switch 3
P11003 Key - switch 4

P11008 Software locking 1
0 not active
1 active lockings activated according to P11018.

## 8.6 System parameters (continued)

### Overall view parameter and NC memory barriers



## 8.6 System parameters (continued)

### Key - switch - definitions

Definition, which locking is selected with the switch.

P11010 Key-switch 1 (see also P8510)
Observe
With activated parameter barrier
- the parameter status is to be described nevertheless,
- the PLC can change nevertheless the parameter value.

Byte 1
Bit 0 parameter locking 1 (see also parameter status byte 3)
Bit 1 parameter locking 2 (see also parameter status byte 3)
Bit 2 parameter locking 3 (see also parameter status byte 3)
Bit 3 parameter locking 4 (see also parameter status byte 3)

Byte 2

Byte 3
Bit 0 NC memory locking
Bit 1 Cycle memory locking

Byte 4
Editing lockings of the MMI's
Bit 0 editing locking parameter mantissa
Bit 1 editing locking parameter status
Bit 2 editing locking axis / spindle / coupling data
Bit 3 editing locking zero point data
Bit 4 editing locking tool data
Bit 5 editor OFF locked

P11011 Key - switch 2
P11012 Key - switch 3
P11013 Key - switch 4

P11018 Software switch 1

## 8.6 System parameters (continued)

### Active lockings

| | | |
|---|---|---|
| P11020 | 0 | Locking not active |
| : | 1 | Locking active |
| P11049 | | |

This area is updated with each modification of a key switch status and each mode change.

| | |
|---|---|
| P11020 | System - parameter - locking 1 |
| P11021 | System - parameter - locking 2 |
| P11022 | System - parameter - locking 3 |
| P11023 | System - parameter - locking 4 |

| | |
|---|---|
| P11036 | NC memory locking |
| P11037 | Cycle memory locking |

Editing lockings of the MMI's

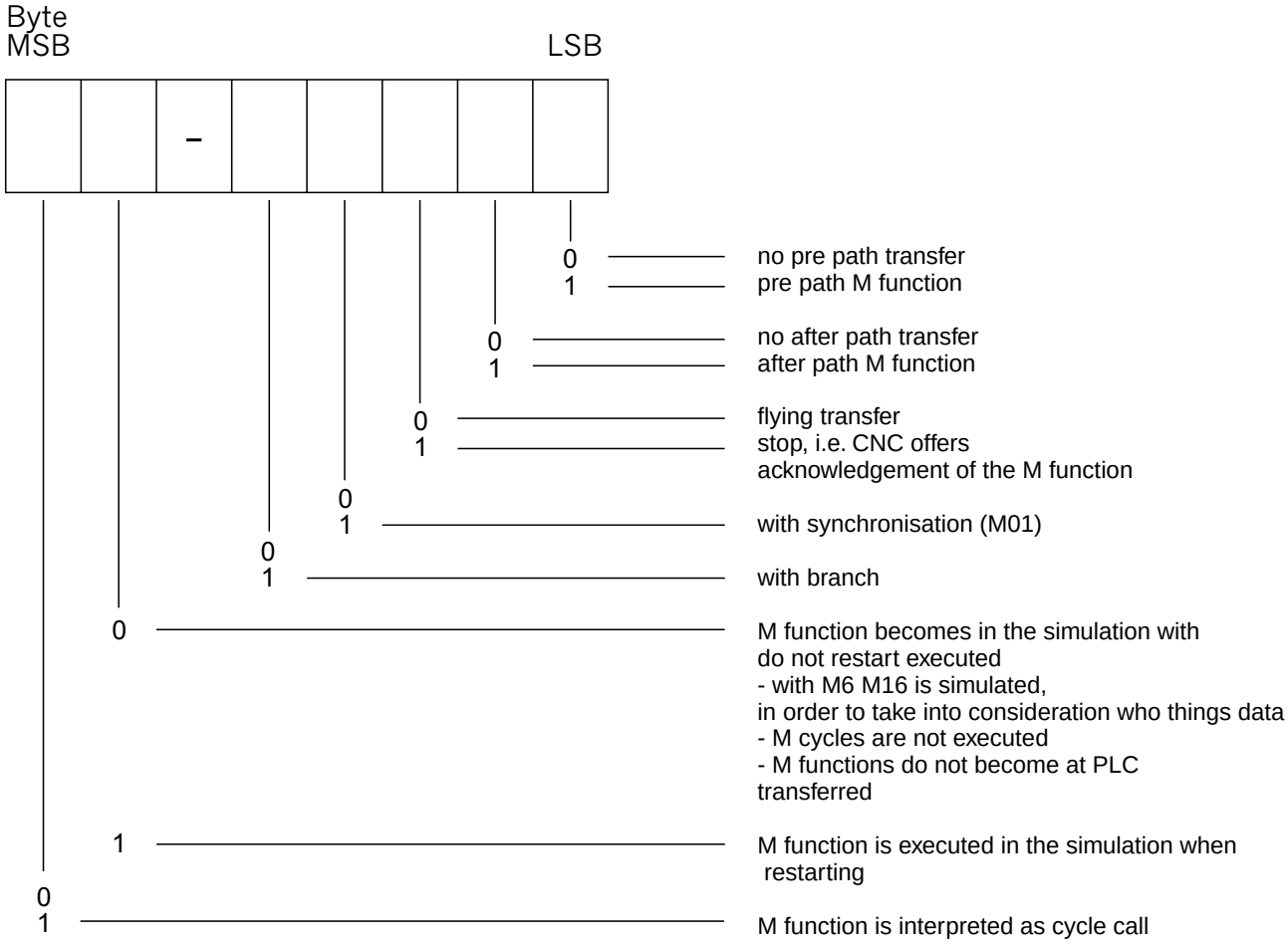
| | |
|---|---|
| P11044 | Editing locking parameter mantissa |
| P11045 | Editing locking parameter status |
| P11046 | Editing locking axis / spindle / coupling data |
| P11047 | Editing locking zero point data |
| P11048 | Editing locking tool data |
| P11049 | Editor OFF locked |

## 8.6 System parameters (continued)

### Definitions of the M - functions

Maximum 200 system overlapping M - functions are programmable (M000 . .. M199). If more than 200 M - functions are
required, those must be defined channel specifically (to M999).
4 M - functions are defined per parameter. Input in hexadecimal!

Info for a M - function :




M-functions without stop are transmitted ‘flying’ to the PLC according to definition before traverse, after traverse or both. The NC - program runs continuously.

## 8.6 System parameters (continued)

M-functions with stop are transmitted to the PLC according to definition before traverse, after traverse or both. Axes run directly before the transfer of the M-function approach their end position with exact-stop. The NC-program sequence is stopped until the M -function is confirmed. The program pre analysis continues working. The confirmations are controlled in the PLC-program with enable block (SAFREK1). Therefore the corresponding marker of a M-function must be connected with stop with enable block.

M-functions with skip work always before traverse with stop! The traverse can be cleared at any time through the single - confirmation of the programmed M-function. When clearing the delay traverse, the measuring - position - parameters are written. In this case the NC program branches to the programmed skip target.
If the skip - M - function is not confirmed, the programmed NC - block is processed completely and switched on to the next block. Marker of a M - function with skip in the PLC may not be connected with enable block (SAFREK1).

M - Function as cycle. If this bit is set in the M - function - definition, no M -function code is sent to the PLC, but a cycle with the corresponding number is called up, i.e. M234 starts Z234.
At this definition the other definitions of this M - function are not considered (before traverse, after traverse or with skip).
The programmed M - function must be programmed without extension (e.g.: M1234.56 is not allowed). The cycle becomes active at the block end. The M - function number must be larger than 30!

Example:

| | | | | | |
|---|---|---|---|---|---|
| P11051 | $ | 10 | 05 | 06 | 01 |
| M - number | | 7 | 6 | 5 | 4 |

i.e.:

| | | |
|---|---|---|
| M07 | with skip | |
| M06 | before traverse active, | with stop |
| M05 | after traverse active, | with stop |
| M04 | before traverse active, | without stop |

Note: Modifications in P11050... becomes with a mode change by HAND after AUTO effectively.

## 8.6 System parameters (continued)

### Definitions of the M - functions

| | | | | |
|---|---|---|---|---|
| P11050M | 03 | 02 | 01 | 00 |
| P11051M | 07 | 06 | 05 | 04 |
| P11052M | 11 | 10 | 09 | 08 |
| P11053M | 15 | 14 | 13 | 12 |
| P11054M | 19 | 18 | 17 | 16 |
| P11055M | 23 | 22 | 21 | 20 |
| P11056M | 27 | 26 | 25 | 24 |
| P11057M | 31 | 30 | 29 | 28 |
| P11058M | 35 | 34 | 33 | 32 |
| P11059M | 39 | 38 | 37 | 36 |
| P11060M | 43 | 42 | 41 | 40 |
| P11061M | 47 | 46 | 45 | 44 |
| P11062M | 51 | 50 | 49 | 48 |
| P11063M | 55 | 54 | 53 | 52 |
| P11064M | 59 | 58 | 57 | 56 |
| P11065M | 63 | 62 | 61 | 60 |
| P11066M | 67 | 66 | 65 | 64 |
| P11067M | 71 | 70 | 69 | 68 |
| P11068M | 75 | 74 | 73 | 72 |
| P11069M | 79 | 78 | 77 | 76 |
| P11070M | 83 | 82 | 81 | 80 |
| P11071M | 87 | 86 | 85 | 84 |
| P11072M | 91 | 90 | 89 | 88 |
| P11073M | 95 | 94 | 93 | 92 |
| P11074M | 99 | 98 | 97 | 96 |
| P11075M | 103 | 102 | 101 | 100 |
| P11076M | 107 | 106 | 105 | 104 |
| P11077M | 111 | 110 | 109 | 108 |
| P11078M | 115 | 114 | 113 | 112 |
| P11079M | 119 | 118 | 117 | 116 |
| P11080M | 123 | 122 | 121 | 120 |
| P11081M | 127 | 126 | 125 | 124 |
| P11082M | 131 | 130 | 129 | 128 |
| P11083M | 135 | 134 | 133 | 132 |
| P11084M | 139 | 138 | 137 | 136 |
| P11085M | 143 | 142 | 141 | 140 |
| P11086M | 147 | 146 | 145 | 144 |
| P11087M | 151 | 150 | 149 | 148 |
| P11088M | 155 | 154 | 153 | 152 |
| P11089M | 159 | 158 | 157 | 156 |
| P11090M | 163 | 162 | 161 | 160 |
| P11091M | 167 | 166 | 165 | 164 |
| P11092M | 171 | 170 | 169 | 168 |
| P11093M | 175 | 174 | 173 | 172 |
| P11094M | 179 | 178 | 177 | 176 |
| P11095M | 183 | 182 | 181 | 180 |
| P11096M | 187 | 186 | 185 | 184 |
| P11097M | 191 | 190 | 189 | 188 |
| P11098M | 195 | 194 | 193 | 192 |
| P11099M | 199 | 198 | 197 | 196 |

## 8.6 System parameters (continued)

### Internal oscilloscope

P11100 Amount of active tracks 1 to 4

P11101 Parameter address for track 1
P11102 Parameter address for track 2
P11103 Parameter address for track 3
P11104 Parameter address for track 4

P11110 Trigger track 1 to 4
P11111 Trigger level

P11112 Trigger slope
- 1 trigger on rising edge
- -1 trigger on dropping edge
- 0 trigger immediately

P11113 Scanning time [ms]

P11114 Oscilloscope Start/Stop
- 0 stop
- 1 start
- 2 automatic new start

P11115 Triggerpoint reached
- 0 not reached
- 1 reached

## 8.6 System parameters (continued)

### Graphics parameter

P11120 Origin of the co-ordinate system screen X
P11121 Origin of the co-ordinate system screen Y
P11122 Origin of the co-ordinate system screen Z
P11123 Zoom - size (P11123 small _> drawn picture large)

P11124 Graphics display
- 0 X,Y - Plane
- 1 Z,X - Plane
- 2 Y,Z - Plane
- 3 3-D

P11125 X tilt
P11126 Z tilt
P11127 Forward / backward of the display

P11128 Display bits

| | | | |
|---|---|---|---|
| Byte 1 | Bit 0 | free | |
| | Bit 1 | free | |
| | Bit 2 | free | |
| | Bit 3 | 1 | display with actual path |
| | Bit 4 | 1 | display with zero point |
| | Bit 5 | 1 | display with circle centre points |
| | Bit 6 | 1 | display with bores |
| | Bit 7 | 1 | display with direction arrows |

## 8.6 System parameters (continued)

### System commands / informations

P11130 Selected language

| | |
|---|---|
| 0 or -- | 1st language |
| 1 | 2nd language |
| : | : |

P11131 Default language

If the language text accord. to P11130 is not available, the default language is used.

| | |
|---|---|
| 0 or -- | 1st language |
| 1 | 2nd language |
| : | : |

P11132 Teachpanel operating mode

| | |
|---|---|
| 0 or -- | Teachpanel off |
| 1 | Teachpanel switched on |

P11133 Teachpanel key pressed / unpressed

| | |
|---|---|
| Byte 1 | Key code (see list from P11200 on) |
| Byte 2 | 0 unpressed |
| | 1 pressed |
| Byte 3 | Channel number 1..8 |

P11134 LED's teachpanel (planned)

P11135 Desired channel in MMI

P11136 Selected channel in MMI

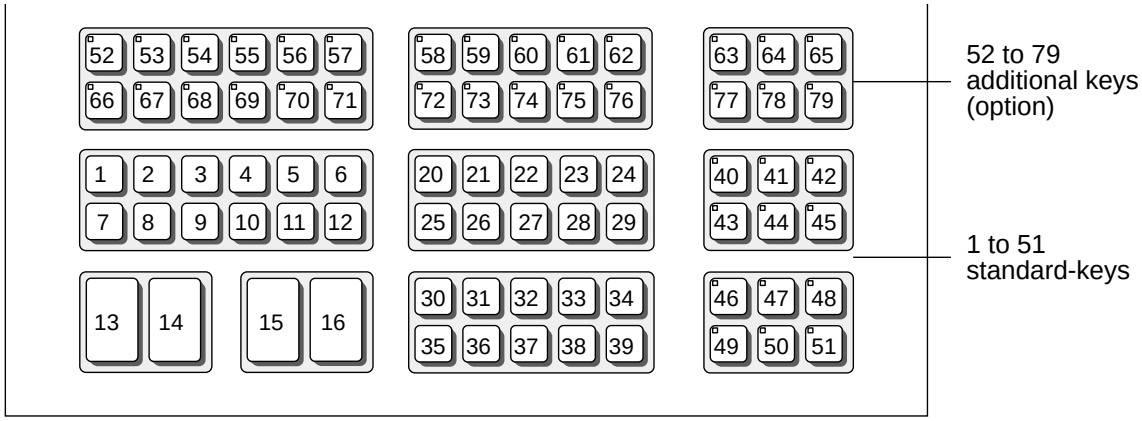
## 8.6 System parameters (continued)

### System commands / information

P11137 Keyboard code pressed / unpressed (only CNC keys)
(parameter is transmitted to the PLC)

| | |
|---|---|
| Byte 1 | Key code |
| Byte 2 | 0 unpressed |
| | 1 pressed |
| Byte 3 | Channel number 1..8 |

Key code CNC keys



## 8.6 System parameters (continued)

### System commands / information

P11138 LEDs 1..12 (bit information)

| | | | |
|---|---|---|---|
| Byte 1 | bit 0 | 0 | LED key 40 out |
| | | 1 | LED key 40 on |
| | bit 1 | | key 41 |
| | bit 2 | | key 42 |
| | bit 3 | | key 43 |
| | bit 4 | | key 44 |
| | bit 5 | | key 45 |
| | bit 6 | | key 46 |
| | bit 7 | | key 47 |
| Byte 2 | bit 0 | | key 48 |
| | bit 1 | | key 49 |
| | bit 2 | | key 50 |
| | bit 3 | | key 51 |

P11139 LEDs (bit information) extended

| | | | |
|---|---|---|---|
| Byte 1 | bit 0 | 0 | LED key 52 out |
| | | 1 | LED key 52 on |
| | bit 1 | | key 53 |
| | bit 2 | | key 54 |
| | bit 3 | | key 55 |
| | bit 4 | | key 56 |
| | bit 5 | | key 57 |
| | bit 6 | | key 58 |
| | bit 7 | | key 59 |
| Byte 2 | bit 0 | | key 60 |
| | bit 1 | | key 61 |
| | bit 2 | | key 62 |
| | bit 3 | | key 63 |

## 8.6 System parameters (continued)

### System - memory / Informations

P11140 Free NC memory

P11141 Amount of NC programs

P11142 Number of NC programs

P11145 Number of latest edited NC - program

P11146 Number of latest edited NC - block

P11149 Display mode in the NC - directory
0 There appears no Z - programs in the directory-list
1 In the directory ALL programs are displayed.

P11150 Display mode 2 in the NC-directory
0 Display of the time stamp and file size
1 Display of the 1st NC block

P11152 First block number when numerating a NC program
If not loaded, the first block number is 10.

P11153 Block step width when numerating a NC program
If not loaded, the step width is 10.

P11159 OVERLAY insertion in operating panel surface
0 or -- Overlay operation reset
1.. Overlay operation display

## 8.6 System parameters (continued)

**System - Clock**

| | | |
|---|---|---|
| P11160 | Second | |
| P11161 | Minute | |
| P11162 | Hour | |
| P11163 | Day | |
| P11164 | Month | |
| P11165 | Year | |
| P11166 | Weekday | |
| P11169 | 100 ms timer | parameter is incremented in stroke of 100 ms |

## 8.6 System parameters (continued)

### I/O circulation Interface 1

P11170 Interfaces Mode (planned, I/O etc.)

P11171 Interfaces Selector (planned, default = operating panel COMxx)
0 hard disk operating panel
1 operating panel COM1
2 operating panel COM2
3 operating panel COM3

P11172 Baudrate standard setting 9600 [Baud]
max 38400

P11173 Data bits standard setting 8

P11174 Stop bits standard setting 2
P11175 Parity check standard setting 0
0 no
1 odd
2 even

P11176 Handshake standard setting 0
0 RTS/CTS
1 Xon/Xoff

P11177 File end signal standard setting 04 (EOT)
Input ASCII sign code
Function At an output (IO-OUTPUT), the file end sign is put as last sign.
At an input (IO-INPUT) the I/O is finished with a received file end sign.

P11178 Controlling information
Bit 0 0 Programs can be overwritten
1 Programs cannot be overwritten over I/O inputs.
A message seems.
Bit 1 0
1 I/O circulation program output 785 - compatibly
i.e.. Program number is provided with leading zeros

## 8.6 System parameters (continued)

### I/O circulation Interface 1

P11179 Block test character with I/O traffic
With P11179 the block test character is switched with I/O IN/COutputs.
Method of operation: With activated block test character the data link becomes between operating console and external data terminal secured. practical in connection with the archiving program NCARC.EXE. The block test character is stored in no file, but in an educated manner from the sender / recipient to the real time in each case / checks.

0 or -- no block test character
I/O INPUT
The block test character of the data which can be read in is optional.
If a block test character is received, it is checked.
With not correct test character:
M1115 and abort of EA traffic.

I/O OUTPUT
no block test character with data output.

1 block test character activates
I/O INPUT
All read in data must with the block test character provided to be.
With missing test character:
M1114 and abort of EA traffic
With not correct test character:
M1115 and abort of EA traffic.

I/O OUTPUT
All data which can be output become with the block test character provide.

## 8.6 System parameters (continued)

### I/O circulation Interface 1

P11181 Parameter output mode
Parameter is reset after each knocked against parameter output!

| | |
|---|---|
| 0 or -- | Parameter EA output from parameter memory |
| 1 | Parameter EA output from FLASH Memory<br>output: D+, i.e. status are also settinged when rereading in |
| 5 | Parameter EA output of all parameters from the parameter memory<br>output: D+, i.e. status are also settinged when rereading in |

| | | | |
|---|---|---|---|
| q0 | ... | q999 | |
| q1000 | ... | q1999 | |
| q2000 | ... | q... | (number of axes) |
| P0 | ... | P5xxx | (user block 1aller of channels) |
| P7000 | ... | P9999 | (fixed channel parameters of all channels) |
| P20000 | ... | P2xxx | (user block 2 of all channels) |

| | |
|---|---|
| 10 | output of the SAMPLE buffer (see also P11270...) |
| 15 | output of the ZSM recordings (see P7950...) |
| 50 | output of the oscilloscope memory<br>output format: Fixed point (ulongs) |

P11183 Info. parameter
actual program number EA input/output

P11184 Info. parameter
actual record number EA input/output

## 8.6 System parameters (continued)

### I/O circulation Interface 2

P11185 Interfaces 2 (planned)
:
P11199

## 8.6 System parameters (continued)

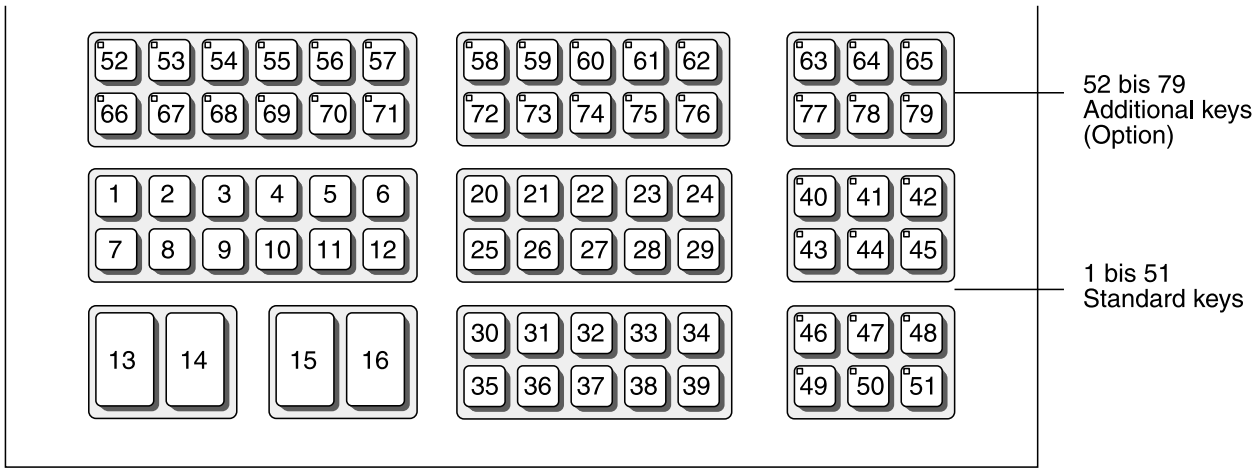
| I/O circulation | Information for diagnostic purposes |
|---|---|
| P11250 | Error messages, which are entered into the error message history of the PLC i.e. each detailed error message.<br>(parameter of the PLC is described)<br>Byte 1 Message paragraph<br>Byte 2 Message paragraph<br>Byte 3 Channel number (1... 8)<br>Byte 4 Axis paragraph (1... 32) |
| P11251<br>:<br>P11259 | Actual pending error messages of the actually selected channel<br>(parameter of the PLC is described)<br>Byte 1 Message paragraph<br>Byte 2 Message paragraph<br>Byte 3 Channel number (1... 8)<br>Byte 4 Axis paragraph (1... 32) |

## 8.6 System parameters (continued)

### Information for event logging for diagnostic purposes

P11260 Key information (parameter by the operating console one describes)
total palpation printouts in this parameter are logged

| | | | |
|---|---|---|---|
| Byte 1 | | Key paragraph or | (CNC keys) |
| | | ASCII character | (keyboard) |
| Byte 2 | 0 | Key released | (only with CNC Keys) |
| | 1 | Key pressed | |
| Byte 3 | 0 | | |
| Byte 4 | 0 | Keyboard key | |
| | 1 | Function key | |
| | 2 | CNC Key | |
| | 3 | Teachpanel key | |




P11261 Bildname1 CNC Surface (parameter by the operating console one describes)

| | |
|---|---|
| Byte 1 | CHAR 1 |
| Byte 2 | CHAR 2 |
| Byte 3 | CHAR 3 |
| Byte 4 | CHAR 4 |

P11262 Bildname2 CNC Surface (parameter by the operating console one describes)

| | |
|---|---|
| Byte 1 | CHAR 5 |
| Byte 2 | CHAR 6 |
| Byte 3 | CHAR 7 |
| Byte 4 | CHAR 8 |

## 8.6 System parameters (continued)

### Event logging for diagnostic purposes

P11270 Activation of the recording ring buffer
(in further Textals SAMPLE buffer marks)
0 Events are written into the SAMPLE buffer
1 SAMPLE buffer is not no more described

With active SAMPLE buffer (P11270:0) all CNC Key generally always becomes presses and all messages (CNC messages P8500.. P8503 and SPS messages (P8509 or over P11263) as well as P11279 with a zeitmarke stored.
Memory depth corresponds to 100 (083671 before index C) or 2000 (084564) Recordings.
The available recordings can over I/O circulation with parameter output to be read, if before the output the parameter output mode (P11181) = 10 one settings.

Starting from status 082 of 1.2.99
With a function call in the CNC DLL can this SAM polarizing ring buffer as section NC RAM to be specified.
The size of this buffer is freely definable. (number of Samples)
The available NC memory is reduced accordingly.
Contents of this static ring buffer remain after switching off that Controller preserve. (is with back-up battery like the NC memory)

## 8.6 System parameters (continued)

### Event logging for diagnostic purposes

An output could look as follows:

```
_____________________________________
SAM polarizing DATA
_____________________________________
Output:
DATE:  1.  2,99                    date / time-of-day of the output
Time:  02:12:57

# hh:mm:ss, ms cmd
1 00:00:00,000 ======== system boot =============

2 02:08:39,445 PICTURE:  INIT                          picture change
3 02:08:42,455 PICTURE:  A_INIT                        picture change


33 02:11:55,650 C-KEY AX 1                             CNC key axis selection 1
34 02:11:56,965 F-KEY F5                               function key F5
35 02:11:58,525 KEY ‘ 1 ‘                              PC key ‘ 1 ‘

42 02:12:00,655 F-KEY RETURN                           function key RETURN
43 02:12:01,290 F-KEY cursor V                         function key cursor

57 02:12:08,990 PARA CNC —> PLC K0 q1137:  65822       Parameter transmitted by CNC at PLC

60 02:12:08,995 PARA CNC< —PLC K1 P8703:  1            parameter transmitted by PLC at CNC

97 02:12:13,820 K0 message:  M3498                     message M3498

448 02:12:21,015 PROG:  K1 P1000 N11160                processing of NC block
449 02:12:21,015 PROG:  K1 P1000 N11170

831 02:12:21,340 K1   M30 —> PLC, NR in the Satz:0,    without branch
                                                       transfer of m functions at PLC
832 02:12:21,340 K1   END OF BLOCK CNC —> PLC, CNC WAITS for acknowledgement
834 02:12:21,340 K1   CNC < — PLC SAFRE:  1

934 02:13:22,540 P11279:  12345                        entry over P11279

SAM-POLARIZE-END
_____________________________________
```

## 8.6 System parameters (continued)

### Event logging for diagnostic purposes

P11271 Activation of additional recordings into the SAM polarizing buffer for channel 1

| | | | |
|---|---|---|---|
| 0 or -- | | | No additional recordings |
| Byte 1 | bit 0 | 1 | Parameter transfers between CNC < —> PLC are recorded. |
| | bit 1 | 1 | Parameter transfers between CNC < —> operating panel are recorded. |
| | bit 2 | 1 | Parameter with parameter SAM polarizing identifier are recorded. (see parameter status Byte2 Bit8) (parameters from channel 1 become together with q-parameters recorded) |
| | bit 4 | 1 | M functions at PLC, end of block, end of record, M function-acknowledgements and block release are recorded. |
| Byte 2 | bit 0 | 1 | beginning of a NC block with Programmnumme becomes recorded. (pre path acknowledgement in the real time) |

P11272 Activation of additional recordings into the SAM polarizing buffer for channel 2

P11273 Activation of additional recordings into the SAM polarizing buffer for channel 3

P11274 Activation of additional recordings into the SAM polarizing buffer for channel 4

P11275 Activation of additional recordings into the SAM polarizing buffer for channel 5

P11276 Activation of additional recordings into the SAM polarizing buffer for channel 6

P11277 Activation of additional recordings into the SAM polarizing buffer for channel 7

P11278 Activation of additional recordings into the SAM polarizing buffer for channel 8

P11279 SAM-POLARIZE - entry
With the describing of P11279 an entry in the SAM polarizing buffer is made.

## 8.6 System parameters (continued)

### System diagnostic

P11280 Activating the interface diagnostic
- 0 Interface diagnostic off
- 1 PLC <-> CNC interface diagnostic on

P11281...P11289 direction CNC —> PLC
P11290...P11299 direction CNC <— PLC

| | | | |
|---|---|---|---|
| P11281 | Event counter | CNC —> PLC | |
| P11282 | Channel number | CNC —> PLC | |
| P11283 | Parameter number | CNC —> PLC | |
| P11284 | Parameter content | CNC —> PLC | |
| P11291 | Event counter | CNC <— PLC | (q1160 is not indicated and not counted as event.) |
| P11292 | Channel number | CNC <— PLC | |
| P11293 | Parameter number | CNC <— PLC | |
| P11294 | Parameter content | CNC <— PLC | |

## 8.6 System parameters (continued)

### System data for Interpolator

P11300 Interpolation nicety [ INC/mm ]
Specifies the internal path resolution at the Interpolator
0 preset: 10000
Input 100, 1000, 10000
In the case of a modification of this parameter the controller must again be started.

P11301 Position adjustment timer [ ms ]
In the case of a modification of this parameter the controller must again be started.

P11302 DSI timer [ ms ]
In the case of a modification of this parameter the controller must again be started.

P11305 Definition of the axis card off set
In the case of a modification of this parameter the controller must again be started.
This axis allocation can by means of P12003... for each axis separately and
to be made axis-card-independently.
0 or -- physical axis numbering sequentially

| Example: | 1. Axis card | | physical numbering |
|---|---|---|---|
| | ASM | 1 | 1 |
| | | 2 | 2 |
| | | 3 | 3 |
| | 2. Axis card | | |
| | AAZ4 | 1 | 4 |
| | | 2 | 5 |
| | | 3 | 6 |
| | | 4 | 7 |

1 per card slot 4 physical axes are addressed

| Example: | 1. axis card | | physical numbering |
|---|---|---|---|
| | ASM | 1 | 1 |
| | | 2 | 2 |
| | | 3 | 3 |
| | 2. Axis card | | |
| | AAZ4 | 1 | 5 |
| | | 2 | 6 |
| | | 3 | 7 |
| | | 4 | 8 |

## 8.6 System parameters (continued)

### System data for Interpolator

P11306 Definition for axis cards disable
In the case of a modification of this parameter the controller must again be started.
0 or -- physical axis numbering sequentially

Bit 0-31 No. of the respective slot
e.g.. 0x2 in slot 2 no card (AAZ, DAW, ADW) is detected

P11308 Input system

0 or -- Input system metrically
1 Input system inch, post-decimal positions around a position extends
2 Input system inch, post-decimal positions around two positions extends
3 Input system inch, post-decimal positions around three positions extends

Inch switching
With ‘ parameter reset ‘ in the switching on routine becomes
- in the zero point data array,
- all kanalgemappten Achsparametern, (P12153..12157...),
- the tool data interface, (P8110/11/12/13 and P8160/61/62/63),
- and the feed parameters in the channel
the inch bit in the parameter status settinged.
With the axis data of round axes no inch information is settinged. If one is linear axis without inch switching to be, then if the inch bit is to be removed in the q2x54.
After switching the system of units of INCH - > METRIC or METRIC - > INCH only these parameters become into respective the different one.
System of units converted, which the ZOLL bit in the parameter status settinged.

Step-by-step operation:
Incrementation table is preserved, however the actual incrementation becomes always over factor 10 reduces
(see also G170 / G171).

P11309 System internal command parameter
Interpolator —> CNC
1 trigger for reference status

## 8.6 System parameters (continued)

### Override (1 - 9)

The override allocation is defined depending on the traverse mode per axis (see P12125.. .).

General: From the operating panel the corresponding override value is written in P11311 (content : 0.. 255). P11311 is a procedure - parameter. In the started system sub-routine the override-schedule is accessed according to P11314 (pointer on table). The result is copied to P11310. P11310 is limited through P11312/P11313.

| | | | |
|---|---|---|---|
| | Override 1 | | |
| P11310 | Actual value | [%] | value from table |
| P11311 | Actual value | | from digital-to-analogue converter |
| P11312 | Minimum limit | [%] | e.g. 0 % |
| P11313 | Maximum limit | [%] | e.g. 120% |
| P11314 | Pointer on override-table | | |
| | If pointer on override-schedule is cleared or =0, the override is active continuously. Pointer-number shows on a q-parameter. | | |

| | | |
|---|---|---|
| P11315 | Override 2 | |
| P11320 | Override 3 | |
| P11325 | Override 4 | (Teachpanel) |
| P11330 | Override 5 | (fixed value 0%) |
| P11335 | Override 6 | (fixed value 10%) |
| P11340 | Override 7 | (fixed value 50%) |
| P11345 | Override 8 | (fixed value 100%) |

## 8.6 System parameters (continued)

### Override (1 - 9)

| | | |
|---|---|---|
| P11370 | Override-table | Amount: Preset 27 values |
| P11371 | 0 % | |
| P11372 | 1 % | |
| P11373 | 2 % | |
| P11374 | 5 % | |
| P11375 | 10 % | |
| P11376 | 15 % | |
| P11377 | 20 % | |
| : | | |
| P11397 | 120 % | |

## 8.6 System parameters (continued)

### Hand-wheels (1 - 8)

Hand-wheel 1

P11400 Hand-wheel connected on axis (physical axis number)

P11401 Hand-wheel works on axis (physical axis number)

P11402 Activating the hand-wheel
0 or -- Hand-wheel not active
1 Hand-wheel active

P11403 Hand-wheel resolution [INC/mm]
The pulses of the measuring system are quadrupled in the AAZ.
Example: resolution 1000, At 1000 INC 1mm is driven.
The sign determines the traverse direction.

P11404 Actual hand-wheel - multiplier
With help of the hand-wheel - multiplier the hand wheel- pulses are multiplied.
Example: P11404 = cleared or 0 or 1, 1000 INC -> 1mm distance
P11404 = 10 1000 INC -> 10mm distance

P11405 Switch to next multiplier
1 switch to next

P11406 Pointer on multiplier, parameters is used from the system.
P11407 Multiplier 1
P11408 Multiplier 2
P11409 Multiplier 3

P11410 Hand-wheel 2
:
P11420 Hand-wheel 3
:
P11430 Hand-wheel 4
:
P11440 Hand-wheel 5
:
P11450 Hand-wheel 6
:
P11460 Hand-wheel 7
:
P11470 Hand-wheel 8
:

## 8.6 System parameters (continued)

### Couplings (1 - 8)

| | | | | |
|---|---|---|---|---|
| | Coupling 1 | | | |
| P11480 | Master - axis | | (physical axis number) | |
| P11481 | Slave - axis | | (physical axis number) | |
| P11482 | Coupling mode | | | |
| | Byte 1 | $01 | Machine coordinates coupling | |
| | Byte 2 | $01 | Rigidity coupling | |
| | Byte 3 | $00 | Type of status coupling | master <——> Slave |
| | | $01 | Differential coupling | master ——> Slave |
| P11483 | Coupling modification | | | |
| | 0 or -- | | Coupling correction on | |
| | 1 | | Coupling correction off | |
| | 2 | | Coupling correction off, however with coupling error control procedure actively | |
| P11484 | Coupling error limit | | | [mm, degree] |
| P11485 | Coupling error supervision time | | | [ms] |
| P11486 | Coupling correction P share | | | [1/s] |
| P11487 | coupling correction I share | | | [ms] |
| P11490 | Synchronization position of the Masteraxis | | | [mm, degree] |
| P11491 | Synchronization position of the Slaveaxis | | | [mm, degree] |
| P11492 | Transmission ratio - relationship masteraxis | | | |
| P11493 | Transmission ratio - relationship slave axis | | | |
| P11494 | Differential constant | | | |
| P11495 | Coupling on / off | | | |
| | 1 | | Coupling on | (PLC:KOP1) |
| | 2 | | Coupling synchronization on (see P11490 or P11491) | (PLC:KOPSYN1) |
| P11496 | Coupling activated | | | |
| | 1 | | Coupling on | |
| | 2 | | Coupling synchronization accomplished | |

## 8.6 System parameters (continued)

### Couplings (1 - 8)

P11500 Coupling 2
:
P11520 Coupling 3
:
P11540 Coupling 4
:
P11560 Coupling 5
:
P11580 Coupling 6
:
P11600 Coupling 7
:
P11620 Coupling 8
:

## 8.6 System parameters (continued)

### Spindle (1 - 8)

Spindle 1

| | | | |
|---|---|---|---|
| P11640 | Spindle works on axis | (physical axis number) | |
| P11641 | Reference axis for G96 | (physical axis number) | |
| | If P11641 = 0, then reference position in P11642 is valid. | | |
| P11642 | Reference position for G96 | | [mm] |
| | e.g. grinding wheel diameter | | |
| P11643 | Reference factor for G96 | | [mm/min] |
| | 0 or -- | mm/min | |
| | 1000 | m/min | |
| P11644 | Maximum speed for G96 | | [mm/min] |
| P11645 | Maximum speed for G97 | | [rpm] |
| P11646 | Reference factor for G97 | | [ rpm ] |
| | 0 or -- | rpm | |
| | 1 | degree/min | |
| P11647 | Definition of speed | (G96, G97) | |
| | Presetting 0 = G97 | | |
| P11648 | Programmed speed | | [rpm or mm/min] |
| P11649 | Actual speed | | [rpm or mm/min] |
| P11650 | Spindle in/out | | |
| | 0 or -- | Spindle out | |
| | 1 | Positive direction of rotation | (PLC:SPIRE1) |
| | -1 | Negative direction of rotation | (PLC:SPILI1) |
| | 2 | Positively spindle reset | (PLC:SPIRR1) |
| | -2 | Negatively spindle reset | (PLC:SPIRL1) |
| P11651 | Speed achieves or programmed speed = 0 | | |
| | 0 or -- | Speed does not achieve | |
| | 1 | Speed achieves | |
| | | (becomes with prog. Speed = 0 not settinged) | (PLC:SPIDZE1) |
| | 2 | Spindle resetting position achieves | (PLC:SPIRPE1) |

## 8.6 System parameters (continued)

### Spindle (1 - 8)

P11652 Spindle resetting position

P11653 Speed monitoring tolerance limit [ % ]

| | |
|---|---|
| 0 or -- | actual speed monitoring switched off |
| 1... 100 | i.e. P11651=1 achieves the info. speed settinged if programmed speed equal actual speed and the deviation between actual speed (Messystem) and smaller than the input value is appropriate for programmed speed. |

P11660 Spindle 2
:
P11680 Spindle 3
:
P11700 Spindle 4
:
P11720 Spindle 5
:
P11740 Spindle 6
:
P11760 Spindle 7
:
P11780 Spindle 8
:

## 8.6 System parameters (continued)

### Data for Robot-system 1

P11800 Linear axes (physical axis numbers)

At 5 axes transformation (Robot)
e.g. the first 3 axes (X, Y, Z)
Byte 3, 2, 1 03 02 01 Hex
Byte 4 direction change (Bit 3, 2, 1)

At 3 axes transformation
e.g. the first 2 axes (X, Y)
Byte 3, 2, 1 00 02 01 Hex
Byte 4 direction change (Bit 2, 1)

At 6 axes transformation
e.g. the first 3 axes (X, Y, Z)
Byte 3, 2, 1 03 02 01 Hex
Byte 4 direction change (Bit 3, 2, 1)

P11801 Robots rotation axes (physical axis numbers)

At 5 axes transformation (Robot)
e.g. the 4th and 5th axes (A, B)
Byte 3, 2, 1 00 05 04 Hex
Byte 4 direction change (Bit 3, 2, 1)

At 3 axes transformation
e.g. the 3rd axis (A)
Byte 3, 2, 1 00 00 03 Hex
Byte 4 direction change (Bit 1)

At & axes transformation (Robot)
e.g. the 4th, 5th and sixth axes (A, B, C)
Byte 3, 2, 1 06 05 04 Hex
Byte 4 direction change (Bit 3, 2, 1)

P11802 At 5 axes transformation (Robot)
Offset x, rotation axis - tool axis [mm]

At 3 axes transformation
Offset radius, tilt - tool peak [mm]

## 8.6 System parameters (continued)

### Data for Robot-system 1

| | | |
|---|---|---|
| P11803 | At 5 axes transformation (Robot)<br>Offset y, rotation axis - tilt | [mm] |
| | At 3 axes transformation<br>Offset angle, tilt - tool peak | [degree] |
| P11804 | Offset z, tool carrier length | [mm] |
| P11805 | Offset, tilt - tool axis | [mm] |
| P11806 | Angle, rotation axis - tilt | [degree] |
| P11807 | Angle, at which the tool is downwards | [degree] |

## 8.6 System parameters (continued)

### Data for Robot-system 2

| | | | |
|---|---|---|---|
| P11810 | Robot linear axes<br>To contents see P11800 | (physical axis paragraphs) | |
| P11811 | Robot rotation axes<br>To contents see P11801 | (physical axis paragraphs) | |
| P11812 | Offset x<br>To contents see P11802 | | [mm] |
| P11813 | Offset y<br>To contents see P11803 | | [mm] |
| P11814 | Offset z<br>To contents see P11804 | | [mm] |
| P11815 | Offset, drag axis - tool axis<br>To contents see P11805 | | [mm] |
| P11816 | Angle, axis of rotation - drag axis<br>To contents see P11806 | | [degrees] |
| P11817 | Angle, with that the tool downwards shows<br>To contents see P11807 | | [degrees] |

## 8.6 System parameters (continued)

### Data for polar-system

| | | | | |
|---|---|---|---|---|
| P11820 | Polar axis | | (physical axis number) | |
| | e.g. the first 2 axes (X, Y) | | | |
| | Byte 3, 2, 1 | 00 02 01 Hex | | |
| | Byte 4 | direction change (Bit 2, 1) | | |
| P11821 | Offset | r0 | | [mm] |
| P11822 | Offset | w0 | | [mm] |
| P11823 | Offset | v0 | | [mm] |

## 8.6 System parameters (continued)

### Data for angle system

P11830 Angle axes (physical axis paragraph)
e.g. the first 2 axes (X, Y)
Byte 3, 2, 1 00 02 01 Hex

P11831 Angle value
[degrees]

## 8.6 System parameters (continued)

### Configuration parameters for robot systems

| | | |
|---|---|---|
| P11850 | Mechanics | |
| | $0100 | 6-Achsen-Knickarm even |
| | $0101 | 6-Achsen-Knickarm diagonally |
| | $0200 | 3-Achsen-Scara |
| | $0201 | 2-Achsen-Scara |

| | |
|---|---|
| P11852 | Pendulum axis paragraph |
| P11853 | Pendulum angle |

### Geometry parameter of the respective robot system

| | | |
|---|---|---|
| P11854 | lever | 1 |
| P11855 | lever | 2 |
| P11856 | lever | 3 |
| P11857 | hand | 1 |
| P11858 | hand | 2 |
| P11859 | hand | 3 |

## 8.6 System parameters (continued)

### Parameter for joystick

| | | |
|---|---|---|
| P11880 | Joystick definition | |
| | Byte 1 | Calibrationing paragraph |
| | Byte 2 | Slot paragraph |

| | |
|---|---|
| P11882 | info. joystick calibration value |
| P11883 | info. joystick calibration value |
| P11884 | info. joystick calibration value |
| P11885 | info. joystick calibration value |
| P11886 | info. joystick calibration value |
| P11887 | info. joystick calibration value |
| P11888 | info. joystick calibration value |
| P11889 | info. joystick calibration value |

### Parameter for welding seam tracing

P11890 Pointer on table

### Parameter for Teachfunktion

P11891 Pointer on table

### Parameter for external Robot simulation

| | | |
|---|---|---|
| P11892 | 0 | Connection off |
| | 1 | Connection with ROBOT actively |

## 8.7 Axis parameters

Each physical axis occupies a parameter block of 200 parameters.

| In the system has physical axis | the area | In the channel has logical axis | the area |
|---|---|---|---|
| 1. | q2000 ... q2199, | 1. | P12000 ... P12199, |
| 2. | q2200 ... q2399, | 2. | P12200 ... P12399, |
| 3. | q2400 ... q2599, | 3. | P12400 ... P12599, |
| 4. | q2600 ... q2799, | 4. | P12600 ... P12799, |
| 5. | q2800 ... q2999, | 5. | P12800 ... P12999, |
| 6. | q3000 ... q3199, | 6. | P13000 ... P13199, |
| 7. | q3200 ... q3399, | 7. | P13200 ... P13399, |
| 8. | q3400 ... q3599, | 8. | P13400 ... P13599, |
| 9. | q3600 ... q3799, | 9. | P13600 ... P13799, |
| 10. | q3800 ... q3999, | 10. | P13800 ... P13999, |
| 11. | q4000 ... q4199, | 11. | P14000 ... P14199, |
| 12. | q4200 ... q4399, | 12. | P14200 ... P14399, |
| 13. | q4400 ... q4599, | 13. | P14400 ... P14599, |
| 14. | q4600 ... q4799, | 14. | P14600 ... P14799, |
| 15. | q4800 ... q4999, | 15. | P14800 ... P14999, |
| 16. | q5000 ... q5199, | 16. | P15000 ... P15199, |
| 17. | q5200 ... q5399, | 17. | P15200 ... P15399, |
| 18. | q5400 ... q5599, | 18. | P15400 ... P15599, |
| 19. | q5600 ... q5799, | 19. | P15600 ... P15799, |
| 20. | q5800 ... q5999, | 20. | P15800 ... P15999, |
| 21. | q6000 ... q6199, | 21. | P16000 ... P16199, |
| 22. | q6200 ... q6399, | 22. | P16200 ... P16399, |
| 23. | q6400 ... q6599, | 23. | P16400 ... P16599, |
| 24. | q6600 ... q6799, | 24. | P16600 ... P16799, |
| 25. | q6800 ... q6999, | 25. | P16800 ... P16999, |
| 26. | q7000 ... q7199, | 26. | P17000 ... P17199, |
| 27. | q7200 ... q7399, | 27. | P17200 ... P17399, |
| 28. | q7400 ... q7599, | 28. | P17400 ... P17599, |
| 29. | q7600 ... q7799, | 29. | P17600 ... P17799, |
| 30. | q7800 ... q7999, | 30. | P17800 ... P17999, |
| 31. | q8000 ... q8199, | 31. | P18000 ... P18199, |
| 32. | q8200 ... q8399 | 32. | P18200 ... P18399 |

In the channel descriptor physical axes are attached to the channel axes (q110 ... q141, Byte 3).

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12000 Connected axis

| | |
|---|---|
| 0 or — | axis not connected |
| 1 | axis connected |
| 2 | axis may not be driven, otherwise message seems M2020 |
| -1 | axis simulation, Messystem not necessarily, Command value output according to actual axis rate, point of reference taken. |

P12001 Round axis

| | | | |
|---|---|---|---|
| 0 or — | no round axis | | |
| 1 | round axis | | |
| 2 | round axis drives shortest path | | |
| 3 | round axis drives pursuant to | G5 | positively |
| | | G6 | negatively |
| | | G7 | shortest path |

P12002 Diameter axis

| | |
|---|---|
| 0 or — | no diameter axis |
| 1 | diameter axis |

P12003 Axis module address

| | | |
|---|---|---|
| 0 or — | address recognition internally | |
| Byte 1 | | |
| | $xx | axis paragraph 1,,8 (axis on the axis module) |
| Byte 2 | | |
| | $xx | slot paragraph 1... 32 |
| Byte 3 | | |
| | $xx | drive address with Sercos Axes 1... 255 |
| | $00 | drive address equal axis paragraph |

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12004 Maximum axis speed [mm/min, degree/min]
with Sercos axes transfer at final drive is affected as:
S-0-0091 speed limiting value bipolar

P12005 Slope speed 1 [mm/min, degree/min]
0 or — Slope rate = 10 % max. axis speed
to Slope to activate see P12136

P12006 Slope speed 2 [mm/min, degree/min]
0 or — Slope rate = 20 % max. axis rate
to Slope to activate see P12136

P12008 Machine dynamics 1 [ms]
0 or — default = 250 msec

The dynamics determine the time in that the axis of 0 on max axis rate one accelerates or one brakes. Always works with manual operation and automatic (G0).
With Sercos axes the transfer to the final drive is affected as:
S-0-0138 acceleration bipolar,
S-0-0042 reference driving acceleration.

P12009 Machine dynamics 2 [ms]
0 or — default = dynamics 1
dynamics 2 > dynamics 1, then always work dynamics 2 with path driving (G1, G2, G3, G50) not with G0.

P12010 Dynamic definition
0 or — linear axis acceleration drive.
1 sine axis acceleration drive.

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12012 Measuring system - dissolution numerator [INC/mm, degree]
Input only integral !

P12013 Measuring system - dissolution denominators
The pulses of the measuring system are quadrupled in the AAZ.
Example: measuring system with 2500 INC/r, pitch of the spindle of 10mm/r
i.e. 1 revolution -> 2500INC * 4 = 10000 INC / 10mm
Input: P12012 1000 ; P12013 1
Input only integral !

P12014 Measuring system - counting reverse

| | | |
|---|---|---|
| Byte 1 | $01 | inverted |
| Byte 2 | $xx | number of invalid data bits on the right hand side |
| Byte 3 | $xx | number of invalid data bits on the left hand side (ref. 32 Bit) |

Example of an absolute encoder

```
32                                  1
____________________________________
xxxxxxxx00000000000000000000xxxx
____________________________________
xxxxxxxx                        xxxx
8-bits to the left fade out     4-Bit on the right fade out
```

Input P12014: $080400

P20015 Measuring system - absolute encoder (AZA)

| | | |
|---|---|---|
| Byte 1 | $xx | number of data bits that have to be transmitted<br>00H = 1. Bit ... 1FH = 32. Bit |
| Byte 2 | $xx | Transmitting frequency<br>00H = 250khz, 01H = 330kHz, 02H = 500 kHz, 03H = 1mhz |
| Byte 3 | $xx | Data mode<br>00H = binary code, 01H = Gray code |
| Byte 4: | $01 | Actual position is settinged in ESR on old value from P12152<br>i.e.. Axis reported (indicator REF1=1) |

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12016 Exact stop boundary finely [ mm, degree ]
0 or — default = square root (1 / measuring system resolution)

Example: resolution scrutineer 1000
denominator 1
Default = sqrt (1 / (1000 / 1)) = 0,0316 mm

P12017 Exact stop boundary roughly [ mm, degree ]
0 or — default = 8 x exact stop boundary finely

Mode of operation: An axis starts a programmed position with exact stop, i.e. programmed position is achieved:
- lag distance (Sollpos being) is smaller than exact stop boundary gross, in such a way the drift correction is activated.
- lag distance is small exact stop boundary finely, in such a way the signal driving instruction (P12188) is reset.

P12018 Downtime monitoring [ ms ]
0 or — default = 3000 ms

If this monitoring time is exceeded, error message (M2022) is affected.

P12020 KV factor [ 1/s ]
0 or — default = 16 x 1/s

The KV factor is a valuation (p-proportion) the Lagereglung.
With Sercos Axes transfer at final drive is affected as:
S-0-0104 KV factor attitude control

P12021 P-reinforcement speed controlling device
0 or — default = speed regulation in the drive

With Sercos Axes transfer at final drive is affected as:
S-0-0100 p-proportion of speed controlling devices

P12022 I-reinforcement (reset time) [ ms ]
0 or — default = 10000ms (drift correction)

With Sercos axes transfer at final drive is affected as:
S-0-0101 i-proportion of speed controlling devices

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12024 Lag error limit [ % ]
0 or — default = 50% over debit lag distance

With the help of the axis speed and the KV's that can
Lag distance to be calculated.
Lag distance [ mm ] = feed [ mm/min ] / (60 x KV [ 1/s ])

P12025 Lag error limit monitoring time [ ms ]
0 or — default = 50ms
-1 error limit monitoring switched off

If this lag is exceeded, error message (M2001) is affected

P12026 Admissible command value output [ volts ]
Around this monitoring to switch on P12026 must be > 0, and P12142 = 1.
With achieving this lag is affected error message (M2002)
and analog output = 0 settinged.

P12027 Maximum command value output [ volts ]
0 or — default = 9,5V

Those max. output voltage is achieved, if these
axis with max. axis speed drives.

P12028 Command value output direction reversal
1 inverts

P12029 Command value output axis exchange
0 command value output to this axis
1,,32 command value output to indicated axis
(caution: Duplicate of axes avoid)

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

| | | |
|---|---|---|
| P12030 | Software limits positive;<br>if cleared, no limit | [mm, degree] |
| P12031 | Software limits negative;<br>if cleared, no limit | [mm, degree] |
| P12032 | Emergency - position absolute<br>absolute measure, refered to machine zero point<br>approach emergency position see P12131 | [mm, degree] |
| P12033 | Emergency - position relative<br>relative measure, refered to machine-location<br>approach emergeny position see P12131 | [mm, degree] |
| P12034 | Basic position absolute<br>absolute measure, in reference to machines - zero point<br>approach to basic position see P12131 | [mm, degree] |
| P12035 | Basic position relative<br>relative measure, refered to machine-location<br>approach basic position see P12131 | [mm, degree] |
| P12036 | Fixed position<br>absolute measure, refered to machine zero point<br>approach fixed position see P12132 | [mm, degree] |
| P12037 | Pendling position<br>relative measure, refered to machine-location<br>approach pendling position see P12132 | [mm, degree] |
| P12038 | Dwell for pendling position 1<br>0 or cleared Pendling position 1 with exact stop<br>approach pendling position see P12132 | [s] |
| P12039 | Dwell for pendling position 2<br>0 or cleared pendling position 2 with exact stop<br>approach pendling position see P12132 | [s] |

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12040 Reference point offset [mm, degree]
When taking the reference points (e.g. in the moment of T0), the actual position (P12151) is loaded with P12040. This means if this axis is approached, the axis is standing on it's reference point.

P12041 Modulo measure [degree]
0 or -- Presetting 360°

P12042 Acceptable distance (reference switch - zero pulse) [mm, degree]
when exceeding -> error message

P12043 Reference distance (distance coded measuring system) [mm, degree]

P12044 Reference driving logic
Byte 1
$01 Release of the reference accommodation in positive driving direction (see also P12130, byte 1)
Byte 2
$01 Release of the reference accommodation in negative driving direction (see also P12130, byte 2)
Byte 3
Bit0 0 with switch edge
1 with switch and nullimpuls
Bit4 0 standard measuring system
1 2. Measuring system
Byte 4
Bit0 0 switch positively switching
1 switch negatively switching
Bit1 0 reference switch info. (P12180, byte 2) always actually
1 reference switch info. (P12180, byte 2) becomes after point of reference taken no more does not update.

Conditions for the reference accommodation
P12044 Reference driving logic specify
P12079 Byte3 Sercos reference driving control parameter specify

P12130 starts reference accommodation,
Reference accommodation acknowledgement P12180,
so long reference travel actively,
- P12130 Byte 3 $01 / PLC:REPOF1 = 1 reference position release is the drive to be driven as follows
- adjusted without restarting
P12140 Byte 2 $01 / PLC:NGOW1 = 1

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12045 Sensor logic

Byte 1

$01: Release of measuring position accommodation in positive driving direction

Byte 2

$01: Release of measuring position accommodation in negative driving direction

Byte 4

| | | |
|---|---|---|
| Bit0 | 0 | switch edge positively effectively |
| | 1 | switch edge negatively effectively |
| Bit4 | 0 | standard pressure foot |
| | 1 | 2. Sensor |

Conditions for the measuring position accommodation

| | | |
|---|---|---|
| P12045 | | Pressure foot logic specify |
| P12079 | Byte4 | Sercos sensor expensive parameter specify |
| P12082 | | Sercos sensor of 1 measuring pos parameter specify (S-0-0130 (pos edge), S-0-0131 (neg edge) |
| P12084 | | Sercos sensor of 2 measuring pos parameters specify (S-0-0132 (pos edge), S-0-0133 (neg edge) |

P8716, P8717, P12131 start measuring accommodation with M26,
Measuring accommodation acknowledgement P8696, P12181
Measuring position P12152

P12046 Error logic

Byte 1

$01 Wire break T0, T1, T2, inverted signals missing

Byte 2

$01 UAS signal responded (interference, contamination)

Byte 3

$01 Measuring system frequency too largely

Byte 4

$01 Sercos messages actively

P12047 Emergency stop logic

Bit 0 - 31 According to axis 1 - 32
A emergency stop position (P12032, P12033) is started,
the axes indicated in P12046 are stopped.

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

### Drift correction

P12049 Drift correction (integral action time in P12022)

- 0 drift correction only in standstill
- 1 drift correction always active
- 2 drift correction switched off

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

P12050 Feed forward correction [%]
0 or — Feed correction out

Example:
P12050:50% the actual lag distance is bisected
P12050:100% the actual lag distance close zero
i.e.. Axis drives error limits freely

P12051 Feed forward delay [ms]

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

lot correction

P12052 Backlash correction [ mm, degree ]

0 or — Backlash correction out

Input value is bisected for both driving directions
Example: Input 0.042mm
- Korretur +0,021 with positive drive
- Korretur -0,021 with negative drive

P12053 Backlash correction time [ ms ]

0 or — Backlash correction in P12052 works as static value

> 0 Backlash correction in P12052 works as dynmischer value over the time after everyone, input in P12053 travel direction changes

< 0 Backlash correction in P12052 works as dynmischer value over the time after everyone, input in P12053 start of a movement

### Correction dynamics

This dynamics cause that modifications of the axis correction (backlash -, measuring system -, upward gradient correction) with this admissible dynamics to be executed.

P12055 Correction dynamics [ ms ]

0 or — default (machine dynamics 1 / 2)

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

Measuring system correction with 2. Measuring system

P12056 Measuring system correction datum axis (2. Measuring system)

Byte 1

$xx 1 - 32 physical axis paragraph 2. Measuring system
2. Measuring system becomes by 1. Measuring system reports.
Debit 2. Measuring system reference system its,
so P12044 must: (byte 4, Bit4=1) to be settinged.
1. Measuring system becomes by 2. Measuring system reports.

Byte 2

$xx: 1 - 32 physical axis paragraph 2. Measuring system
2. Measuring system as exchange axis,
i.e.. Messsytemposition (all axis positions)
2. Measuring system become on the 1. Measuring system
rerouted and displayed.

Byte 3

$xx: 1 - 32 physical axis paragraph 2. Measuring system
2. Measuring system as scrutineer axis,
i.e.. Messsytem scrutineer 2. Measuring system
become on the 1. Measuring system rerouted.

Example of activation 2. Measuring system:
q 118: $00060000 (6th axis log on)
P13001 if round axis
P13012, P13013, P13014 Messystem resolution

P12057 Measuring system correction reset time [ ms ]

0 or — Correction off
> 0 Correction on

P12058 Measuring system correction admissible correction [ mm ]

0 or — Default 10mm

## 8.7 Axis parameters (continued)

### Machine data for the 1st. axis

Measuring system correction with 2. Measuring system

P12059 Measuring system correction with internal correction table

| | | |
|---|---|---|
| 0 or — | Function not actively | |
| > 0 | Measuring system correction with correction table | |
| | Input of the distance of the corrections | [ mm ] |

Note: This function should be only activated, if those resolution 2. Measuring system more roughly is than the resolution too correcting axis.
(axis for swinging would be lively)

In order to structure the correction table, must after the activation the axis uniquely from the negative software end position to the positive software end position to be moved.

## 8.7 Axis parameters (continued)

### Drive data for digital drives 1st. axis

Pitch correction

P12060 Pitch correction pointer on table
Parameter (q-NR.) where table starts.

P12061 Pitch correction number of corrections
0 or — Correction out
> 0 Correction

P12062 Pitch correction table offset
Table access is permitted only with values of item between the end positions.
Thus the table offset must become so in against that this applies.
Offset = - (machine position (ßt measured value) / distance of the corrections)
Example: P12062: -6 = (P12150: 120,000) / P12063: 20,000)

P12063 Pitch correction distance of the corrections [ mm ]

P12064 Pitch correction datum axis (interaxis correction, cross correction)
Input physical axis paragraph

0 or — Correction algorithm uses the axis position (q2x50)
the personal axis, over in the correction table the suitable
to obtain steigungsfehler.
1... 32 Physical axis paragraph
correction algorithm uses the axis position (q2x50)
the datum axis, over in the correction table the suitable
to obtain steigungsfehler.

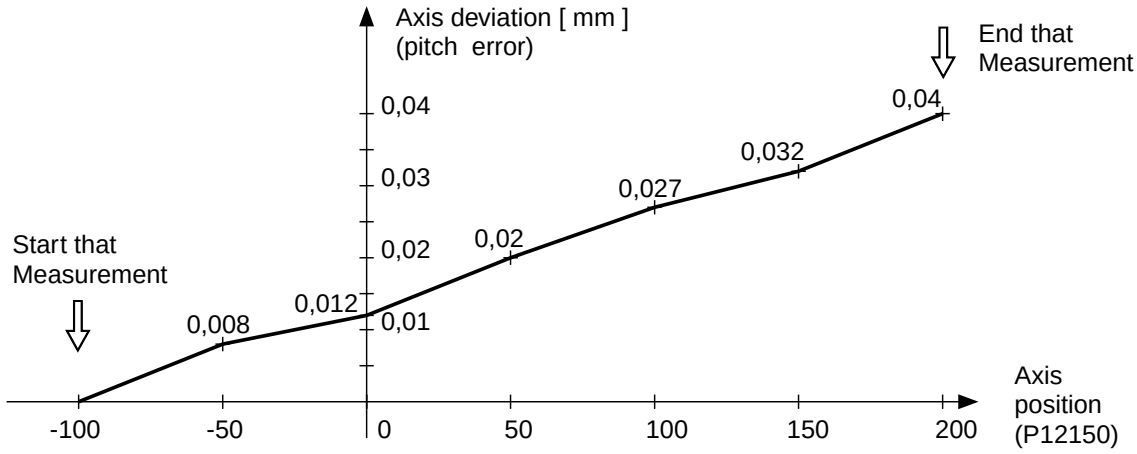
Notes to the upward gradient correction:
To obtain if the machine position of the axis becomes larger than in the correction table covered correction area, the correction algorithm ‘ interconnects ‘ start and end the correction table around the entspechenden correction value,
i.e.. Correction values repeat themselves.

Recurring corrections can so in a compact correction table to be stored.
Start and end of the correction table should contain thereby the same values, since it can lead otherwise within this area to striking the axis.

## 8.7 Axis parameters (continued)

### Drive data for digital drives 1st. axis

Example of pitch correction




Allocation of the parameters

| | | | | table parameter | of values |
|---|---|---|---|---|---|
| Pointer on table | P12060 | 20000 | > | q20000 | 0 |
| Number of corrections | P12061 | 7 | | q20001 | 0,008 |
| Table offset | P12062 | 2 | | q20002 | 0,012 |
| Distance of the corrections | P12063 | 50 [ mm ] | | q20003 | 0,02 |
| | | | | q20004 | 0,027 |
| | | | | q20005 | 0,032 |
| | | | | q20006 | 0,04 |

## 8.7 Axis parameters (continued)

### Drive data for Sercos

| | | |
|---|---|---|
| P12070 | Sercos parameter (“S”, “ p”) | * |
| P12071 | Sercos parameter (record) | * |
| P12072 | Sercos parameter (paragraph) | * |
| P12073 | Sercos parameter (attribute) | * |
| P12074 | Sercos parameter (value) | * |
| P12075 | Sercos parameter (minimum) | * |
| P12076 | Sercos parameter (maximum) | * |

* In the menu: parameter / axis - parameters / drive - parameter contents of all Sercos (s) - product (p) - know parameters over input - boxes, output - boxes to be displayed and changed.

## 8.7 Axis parameters (continued)

### Drive data for Sercos

P12078 Sercos drive operating modes (selection over P12144, byte 4)
Byte 1 S-0-0032 main operating mode
- $02 Speed control
- $03 Position adjustment error limit-afflicted with generator 1(Motor)
- $04 Position adjustment error limit-afflicted with generator 2(Ext.)
- $0b Position adjustment error limit-free with generator 1(Motor)
- $0c Position adjustment error limit-free with generator 2(Ext.)

Byte 2 S-0-0033 type of subsidiary establishment 1
- $02 Speed control
- $03 Position adjustment error limit-afflicted with generator 1(Motor)
- $04 Position adjustment error limit-afflicted with generator 2(Ext.)
- $0b Position adjustment error limit-free with generator 1(Motor)
- $0c Position adjustment error limit-free with generator 2(Ext.)

Byte 3 S-0-0034 type of subsidiary establishment 2
- $xx: (planned)

Byte 4 S-0-0035 type of subsidiary establishment 3
- $xx: (planned)

## 8.7 Axis parameters (continued)

### Drive data for Sercos

P12079 Sercos drive definitions

Byte 1

| | | |
|---|---|---|
| Bit0 | 0 | Position data in absolute absolute |
| | 1 | Position data in modulo format |
| Bit1 | 0 | Speed data in m/min |
| | 1 | Speed data in U/mim |

Byte 2

| | | |
|---|---|---|
| $xx | | External measuring system (paragraph of the axis) |

Byte 3 Sercos S-0-147 reference driving control parameter

| | | |
|---|---|---|
| Bit0 | 0 | Clockwise rotation of the motor shaft |
| | 1 | Anti-clockwise turn of the motor shaft |
| Bit3 | 0 | Reference take with motor generator |
| | 1 | Reference take with external generator |
| Bit5 | 0 | Reference switch is analysed |
| | 1 | Reference switch is not analysed |
| Bit6 | 0 | Reference label is analysed |
| | 1 | Reference label is not analysed |
| Bit7 | 0 | Any position after reference take |
| | 1 | Point of reference after reference take |

Byte 4 Sercos S-0-169 sensor control parameter

| | | | |
|---|---|---|---|
| Bit0 | 0 | Positive edge | sensor 1 is not analysed |
| | 1 | Positive edge | sensor 1 is analysed |
| Bit1 | 0 | Negative edge | sensor 1 is not analysed |
| | 1 | Negative edge | sensor 1 is analysed |
| Bit2 | 0 | Positive edge | sensor 2 is not analysed |
| | 1 | Positive edge | sensor 2 is analysed |
| Bit3 | 0 | Negative edge | sensor 2 is not analysed |
| | 1 | Negative edge | sensor 2 is analysed |
| Bit4 | 0 | Position actual value to operating mode (S-0-0051/S-0-0053) referred | |
| | 1 | Position actual value always to S-0-0051 referred | |
| Bit5 | 0 | Release individual measuring for | sensor 1 |
| | 1 | Release subsequent measurement for | sensor 1 |
| Bit6 | 0 | Release individual measuring for | sensor 2 |
| | 1 | Release subsequent measurement for | sensor 2 |

## 8.7 Axis parameters (continued)

### Drive data for Sercos

P12080 Sercos phase switching (acknowledgement in P12081)
- 0 Switching on phase
- 2 Parameter mode
- 4 Operating mode

P12081 Sercos system status (acknowledgement of P12080) (PLC:SZSA_01)
- $E001 Sercos phase 0
- $E002 Sercos phase 1
- $E003 Sercos phase 2
- $E004 Sercos phase 3
- $E005 Sercos phase 4

Sercos drives are ready for use,
other values show entsprechene intermediates phase on

P12082 Sercos cyclic actual value 3 request
Paragraph by the Sercos parameter
z.B.:130 (S-0-0130 measured value 1-postiv)

P12083 Sercos cyclic actual value 3 acknowledgement
Worth from Sercos parameter
e.g.: Worth to the s-paragraph (S-0-0130 measured value 1-positiv), which over P12082 was called)

P12084 Sercos cyclic actual value 4 request
Paragraph by the Sercos parameter
z.B.:84 (S-0-0084 torque actual value)

P12085 Sercos cyclic actual value 4 acknowledgement
Worth from Sercos parameter
e.g.: Worth to the s-paragraph (S-0-0084 torque actual value) which over P12084 was called)

P12089 Sercos speed standardisation
- 0 or — Standart Sercos priority
- > 0 Relation between motor priority and load priority

## 8.7 Axis parameters (continued)

### Area monitoring axes

Area 1

P12100 Channel paragraph
0 or — P12101 and P12102 = q-parameter
1-8 P12101 and P12102 = p-parameter

P12101 Reference position
Contents: Pointer on parameters
0 or — Reference position = internal machine position (q2150)
-2150 Reference position = internal machine position (q2150)
-2152 Reference position = internal machine position (q2152)
With the reference position (internal) are these positions immediately for the order, over parameters only time-delayed.

P12102 Control position
Contents: Pointer on parameters
0 or — Monitoring logic not actively

P12103 Area 1 relative related to P12101
Acknowledgement achieves P12188 byte 2 = 1

P12104 Area 2 relative related to P12101
Acknowledgement achieves P12188 byte 3 = 1

## 8.7 Axis parameters (continued)

### Area monitoring axes

Area 2

P12105 Channel paragraph
0 or — P12106 and P12107 = q-parameter
1-8 P12106 and P12107 = p-parameter

P12106 Reference position
Contents: Pointer on parameters
0 or — Reference position = internal machine position (q2150)
-2150 Reference position = internal machine position (q2150)
-2152 Reference position = internal machine position (q2152)
With the reference position (internal) are these positions immediately for the order, over parameters only time-delayed.

P12107 Control position
Contents: Pointer on parameters
0 or — Monitoring logic not actively

P12108 Area 1 relative related to P12106
Acknowledgement achieves P12189 byte 2 = 1

P12109 Area 2 relative related to P12106
Acknowledgement achieves P12189 byte 3 = 1

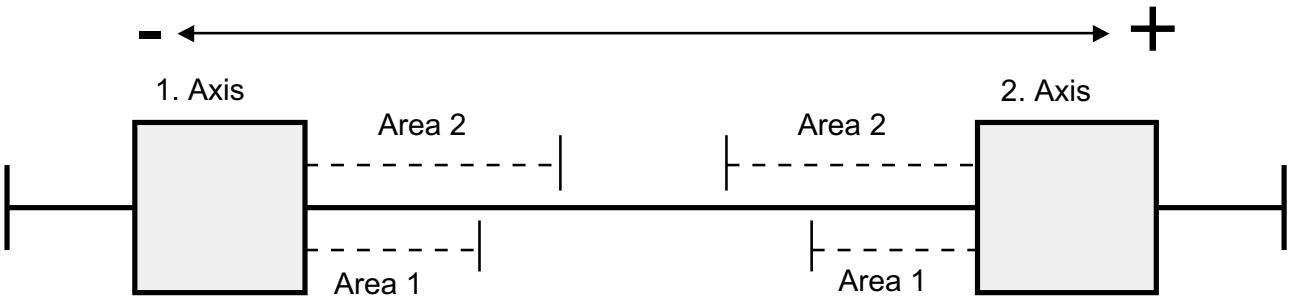
## 8.7 Axis parameters (continued)

### Area monitoring axes

Area 2 relative related to P12106
Acknowledgement achieves P12189 byte 3 = 1

Example: Area monitoring 1. and 2. Axis

| | | | |
|---|---|---|---|
| P12100 | 0 | P12300 | 0 |
| P12101 | 0 | P12301 | 0 |
| P12102 | 2350 | P12302 | 2150 |
| P12103 | 10 | P12303 | -10 |
| P12104 | 20 | P12304 | -20 |




If axis 1 drives 2 from axis 2 into area, indicator K1BE1 is settinged
If axis drives 1 into area 1 from axis 2, indicator K1B1E1 is settinged
If machine pos. Axis 1 = machine pos. Axis 2 is settinged indicator K1B1

If axis drives 2 into area 2 from axis 1, indicator K1BE2 is settinged
If axis 2 drives 1 from axis 1 into area, indicator K1B1E2 is settinged
If machine pos. Axis 2 = machine pos. Axis 1 is settinged indicator K1B2

## 8.7 Axis parameters (continued)

### Axis commands / functions

P12110 Axis position setting [ mm, degree ]
Display or debit position is settinged to input value.
If parameter is reset, then old value is displayed.

P12111 Relative relative start [ mm, degree ]
Axis starts when describing.

| | |
|---|---|
| Feed in | P12121 |
| Override in | P8866 or P12126 |
| Acknowledgement achieves | P12191=1 |
| If P12111 reset | P12191=0 |

An active relative positioning is aborted .

P12112 Absolute absolute start [ mm, degree ]
Axis starts when describing.

| | |
|---|---|
| Feed in | P12122, |
| Override in | P8867 or P12127 |
| Acknowledgement achieves | P12192=1 |
| If P12112 reset | P12192=0 |

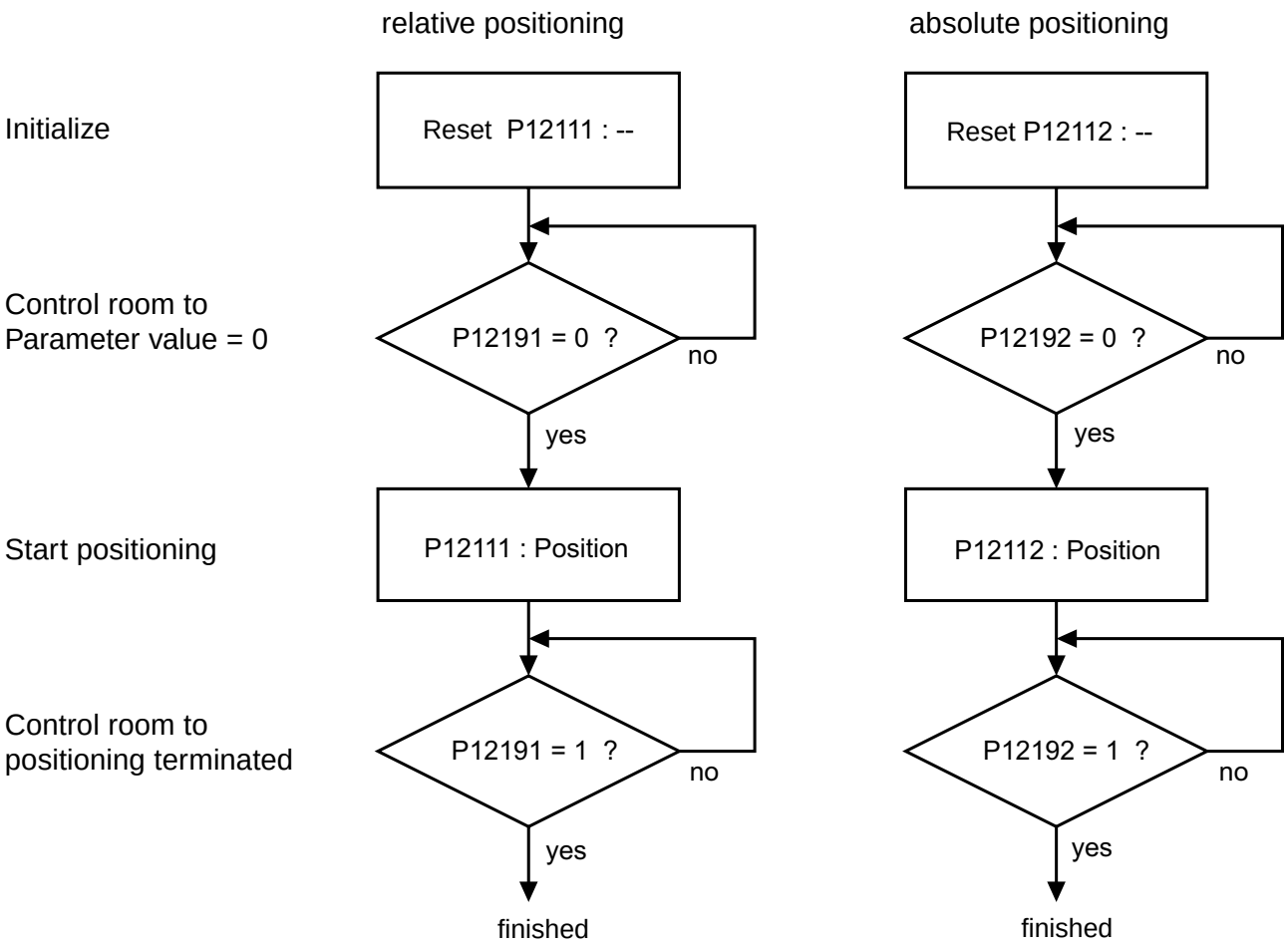
An active absolute positioning is aborted.

P12113 Absolute before position [ mm, degree ]
0 or — Before position check not actively
This before position can, with programmed not-interpolated axes (P8893)
in the NC program and active exact stop (G8, G28) for
premature step up of the active NC block to be used.
With achieving these before position
this is settinged in the parameter on zero,
i.e. it is active only for a monitoring.
Example:
N100 G28 F100 X:100
N110 P12113:20 X200
N120 Y100
i.e. with drive into block N110 and path difference to
Final position X200 < = P12113 is affected block changes after N120.

## 8.7 Axis parameters (continued)

### Axis commands / functions

Example of a relative / an absolute absolute



## 8.7 Axis parameters (continued)

### Axis commands / functions

P12114 Output skip
Axis is moving with the input (speed) without dynamic (skip function) in the selected direction. Axis position is updated.

P12115 Output via output cards (AK, AEK)
0 or — Not actively
-1 i.e. the four signals become into those PLC Interface (see P12195) written.

Byte 1
$xx 1-32 AK clip No. for this axis
Axis drives over outputs of a AK, AEK
per axis of 4 binary signals:
example:
Kl. 1 - drive positively
Kl. 2 - drive negatively
Kl. 3 - drive with max axis speed
Kl. 4 - drive with Slope speed
(settinged if indicator SLOP11 = 1)

Byte 2
$xx: 1-32 slot No. of the AK -, AEK card

## 8.7 Axis parameters (continued)

### Axis commands / functions

| | | | |
|---|---|---|---|
| P12119 | Handwheel speed<br>0 or — max. Axis speed | | [ mm/min, degree/min ] |
| P12120 | Interpolation speed<br>0 or — max. Axis speed | | [ mm/min, degree/min ] |
| P12121 | Relative velocity<br>0 or — max. Axis speed | | [ mm/min, degree/min ] |
| P12122 | Absolute speed<br>0 or — max. Axis speed | | [ mm/min, degree/min ] |
| P12123 | Fixed position speed<br>0 or — max. Axis speed | | [ mm/min, degree/min ] |
| P12124 | Spindle speed<br>0 or — max. Axis speed | | [ degree/min ] |

## 8.7 Axis parameters (continued)

### Axis commands / functions

P12125 Override with interpolation speed drive
0 or — Default see P8865
Otherwise Override paragraph 1-8

P12126 Override with relative speed drive
0 or — Default see P8866
Otherwise Override paragraph 1-8

P12127 Override with Absolu t speed drive
0 or — Default see P8867
otherwise Override paragraph 1-8

P12128 Override with fixedposition - speed drive
Default = 1 contents Override paragraph 1-8

P12129 Override at spindle speed drive
Default = 2 contents Override paragraph 1-8

## 8.7 Axis parameters (continued)

### Parameter block of PLC (Marker interface)

P12130 Approach reference position

Byte 1

| | | |
|---|---|---|
| $00 | Stop of the positive reference drive | (PLC: REPO+1) |
| $01 | Start of the reference drive in positive direction.<br>feed: Hand feed P8755<br>back message achieves P12180 | |

Byte 2

| | | |
|---|---|---|
| $00 | Stop of the negative reference drive | (PLC: REPO-1) |
| $01 | Start of the reference drive in negative direction.<br>feed: Hand feed P8755<br>back message achieves P12180 | |

Byte 3

| | | |
|---|---|---|
| $01 | Reference position release<br>back message achieves P12180<br>(see also P12044)<br>note: If with one already ref erenzierten axis the reference position release is again settinged, the reference point reset.<br>the axis can again be referenziert. | (PLC: REPOF1) |

Byte 4

| | | |
|---|---|---|
| $01 | Reference position setting<br>back message achieves P12180 | (PLC: REPOS1) |

## 8.7 Axis parameters (continued)

### Parameter block of PLC (Marker interface)

P12131 Approach measuring position

Byte 1

| | | |
|---|---|---|
| $00 | Stop of the positive measuring travel | (PLC: MEPO+1) |
| $01 | Start of the measuring drive in positive direction.<br>feed: Hand feed P8755<br>back message started P12181 | |

Byte 2

| | | |
|---|---|---|
| $00 | Stop of the negative measuring drive | (PLC: MEPO-1) |
| $01 | Start of the measuring drive in negative direction.<br>feed: Hand feed P8755<br>back message started P12181 | |

Byte 3

| | | |
|---|---|---|
| $01 | Measuring position release<br>back message settinged P12181 | (PLC: MEPOF1) |

Byte 4

| | | |
|---|---|---|
| $01 | Measuring position setting<br>back message settinged P12181 | (PLC: MEPOS1) |

## 8.7 Axis parameters (continued)

### Direction PLC —> interpolator

P12132 Approach emergency position, basic position

Byte 1 0 Stop for emergency position absolutely achieve (PLC: NOPOA1)
1 Start for emergency position absolutely achieve
Position in P12032
Feed: max. axes speed
Override 100%
All other axes in the channel go on axis stop.
Back message achieves in P12182
When starting to that emergency position drive becomes those message M2000 settinged.

Byte 2 0 Stop for emergency position relatively achieve (PLC: NOPOR1)
1 Start for emergency position relatively achieve
Position in P12033
Feed: max. axes speed
Override 100%
All other axes in the channel go on axis stop.
Back message achieves in P12182
When starting to that emergency position drive becomes those message M2000 settinged.

Byte 3 0 Stop for reason of position absolutely achieve (PLC: GRPOA1)
1 Start for reason of position absolutely achieve
Position in P12034
Feed: max. axes speed
Back message achieves in P12182
Override P12128

Byte 4 0 Stop for reason of position relatively achieve (PLC: GRPOR1)
1 Start for reason of position relatively achieve
Position in P12035
Feed: max. axes speed
Back message achieves in P12182
Override P12128

## 8.7 Axis parameters (continued)

### Direction PLC —> interpolator

P12133 Approach fixed position, pendling position

| | | | |
|---|---|---|---|
| Byte 1 | 0 | Stop for approaching fixed position | (PLC: FEPO1) |
| | 1 | Start for approaching fixed position<br>Position in P12036,<br>Feed in P12123,<br>Feedback reached in P12183 | |
| Byte 2 | 0 | Stop for approaching pendling position | (PLC: PEPO1) |
| | 1 | Start for approaching pendling position<br>Position in P12037,<br>Feed in P12123<br>Feedback reached in P12183 | |

P12134 Drive spindle

| | | | |
|---|---|---|---|
| Byte 1 | 0 | Stop for driving spindle positive | (PLC: SPE+1) |
| | 1 | Start for driving spindle positive<br>Speed in P12124,<br>Feedback reached in P12184 | |
| Byte 2 | 0 | Stop for driving spindle negative | (PLC: SPE-1) |
| | 0 | Stop for driving spindle negative | |
| | 1 | Start for driving spindle negative<br>Speed in P12124,<br>Feedback reached in P12184 | |

## 8.7 Axis parameters (continued)

**Direction PLC —> interpolator**

P12135 End position reached

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Positive hardware end position reached | (PLC: EL+1) |
| Byte 2 | 1 | Negative hardware end position reached | (PLC: EL-1) |

P12136 Slope

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Activate slope 1<br>actual axis speed <= slope speed 1<br>slope speed in P12005 | (PLC: SLOP11) |
| Byte 2 | 1 | Activate slope 2<br>actual axis speed <= slope speed 2<br>slope speed in P12006 | (PLC: SLOP21) |

P12137 Drive locking / drive stop

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Drive locking for positive direction | (PLC: FASP+1) |
| Byte 2 | 1 | Drive locking for negative direction | (PLC: FASP-1) |
| Byte 3 | 0 | Axis stops with dynamics function (axis stop) | (PLC: FASOD1) |
| | 1 | Axis stops without dynamics function (axis locking)<br>Dynamics in P12008, P12009 | |

## 8.7 Axis parameters (continued)

**Direction PLC —> interpolator**

P12138 Axis simulation

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Simulation without output voltage<br>i.e. the axis moves controlled (P12139) and<br>the reference signal is simulated internally. | (PLC: SIMMA1) |

P12139 Axis controlled

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Controlled with measuring system<br>i.e. the real axis position is carried internally.<br>If controlled is cleared (positioning control on), this axis position is taken as actual position | (PLC: GSMM1) |
| Byte 2 | 1 | Controlled without measuring system | (PLC: GSOM1) |

P12140 Axis updated (target = actual)

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Updating with reapproaching the old position | (PLC:NGMW1) |
| Byte 2 | 1 | Updating without reapproaching | (PLC: NGOW1) |

P12141 Axis clamped

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Clamping is switched on<br>i.e. no drive locking for axis;<br>drift correction is switched off<br>Axes output = 0 volts | (PLC: GEKL1) |

## 8.7 Axis parameters (continued)

### Direction PLC —> interpolator

P12142 Admissible output monitoring

0 or — Monitoring switched off
Around this monitoring to switch on must:
P12026 > 0, and P12142 = 1 its.
With achieving this boundary is affected error message (M2002)
and analog output = 0 is settinged.

P12143 Relative positions separately announce

Byte 1 1 Relatively movements (P12111) are summed up in P12158.
Display position is preserved.
P12158 is reset when switching on on.

Byte 2 1 Handwheel movements are summed up in P12158

P12144 Sercos drive control word (PLC - > Interpolator - > Sercos Drive)

Byte 1

| | | |
|---|---|---|
| $00 | drive off | (PLC:ATEIN1) |
| $01 | drive on | |

Byte 2

| | | |
|---|---|---|
| $00 | no release | (PLC:ATFRG1) |
| $01 | drive release | |

Byte3

| | | |
|---|---|---|
| $00 | drive stop | (PLC:ATSTR1) |
| $01 | drive start | |

Byte4

| | | |
|---|---|---|
| $00 | selection head operating mode<br>(byte specifies 1) in P12078,<br>e.g.: Position of control with generator 1 drag errors freely | (PLC:ATBTR1) |
| $01 | selection apart from operating mode 1<br>(byte specifies 2) in P12078,<br>e.g.: Speed control | |

## 8.7 Axis parameters (continued)

### Axis feedbacks / informations

P12150 Machine position [mm, degree]
actual mechanical position of the axis

P12151 Target position [mm, degree]
position of the axis referred to the machine reference point G53

P12152 Actual position [mm, degree]
actual measuring position of the axes

P12153 Measuring position (display) [mm, degree]
stored display position at measuring signal (P8855)
(Channel mapping) *

P12154 Display - position [mm, degree]
Display = target position - display shift
(Channel mapping) *

P12155 Programmed position [mm, degree]
position programmed in the NC block
(Channel mapping) *

P12156 Delta position [mm, degree]
Delta = programmed position - display position
(Channel mapping) *

P12157 Display - shift [mm, degree]
Sum of all shifts (e.g. zero point, G92 shift, tool length)
(Channel mapping) *

* Channel mapping parameters are channel specific,
i.e.. it does not exist a channel-spreading q-parameter.
During the switching on routine becomes however the parameter status q-parameter into the parameter status of the p-parameter copies; i.e. is in a parameter with channel mapping the parameter status to be redefined, then this must in suitable status of the q-parameter are affected.
Example: P12153 is to be provided with 4 post-decimal positions
—> setting parameter status of q2153 with $24xxxxxx
After restarting parameter status in P12153 corresponds
the parameter status q2153

## 8.7 Axis parameters (continued)

### Axis feedbacks / information

| | | |
|---|---|---|
| P12158 | Position shift<br>(e.g. handwheel-shift in Automatic) | [mm, degree] |
| P12159 | Distance reference switch -> reference mark | [mm, degree] |
| P12160 | Actual lag distance | [mm, degree] |
| P12161 | Actual coupling correction | [mm, degree] |
| P12162 | Actual drift correction | [mm, degree] |
| P12163 | Actual backlash correction | [mm, degree] |
| P12164 | Actual measuring system correction | [mm, degree] |
| P12165 | Actual pitch correction | [mm, degree] |

## 8.7 Axis parameters (continued)

### Axis feedbacks / information

| | | |
|---|---|---|
| P12167 | Command speed (regulator)<br>Access with oscilloscope functions | [ mm, degree ] |
| P12168 | Actual speed (measuring system)<br>Access with oscilloscope functions | [ mm, degree ] |
| P12169 | Actual output voltage of the position adjustment | [ V ] |
| P12170 | Actual axis speed | [mm/min, degree/min] |
| P12171 | Actual relative speed | [mm/min, degree/min] |
| P12172 | Actual absolute speed | [mm/min, degree/min] |
| P12173 | Actual fixed position speed | [mm/min, degree/min] |
| P12174 | Actual spindle speed | [degree/min] |

## 8.7 Axis parameters (continued)

### Axis feedbacks / information

P12176 ADW module Address
Byte 1
$xx ADW input Paragraph 1... 4
(selection of the A/D transducer on the ADW Module)
Byte 2
$xx slot paragraph 1... 32

P12177 ADW Input value
the A/D of transducer addressed in P12176
Contents: [ 32767... -32768 ]

P12178 DAW module address
Byte 1
$xx DAW output Paragraph 1... 4
(selection of the D/A transducer on the DAW module)
Byte 2
$xx slot paragraph 1... 32

P12179 DAW output value [ V ]
the D/A of transducer addressed in P12178
Note:
If P12178 does not specify, the DAW value becomes up
the axis module of this axis output.

## 8.7 Axis parameters (continued)

### Parameter block to the PLC (marker interface)

| | | | | |
|---|---|---|---|---|
| P12180 | Reference position | | | |
| | Byte 1 | 1 | Reference point taken | (PLC: REF1) |
| | Byte 2 | 1 | Switch, active edge going | (PLC: REFS1) |
| P12181 | Measuring position | | | |
| | Byte 1 | 1 | measuring position taken | (PLC: MEGT1) |
| | Byte 2 | 1 | switch, active edge going | (PLC: MES1) |
| P12182 | Emergency position, basic position reached | | | |
| | Byte 1 | 1 | emergency position reached | (PLC: NOPOE1) |
| | Byte 3 | 1 | Basic position reached | (PLC: GRPOE1) |
| P12183 | Fixed position, pendling position reached | | | |
| | Byte 1 | 1 | fixed position reached | (PLC: FEPOE1) |
| | Byte 2 | 1 | pendling position reached | (PLC: PEPOE1) |
| P12184 | Speed reached | | | |
| | Byte 1 | 1 | speed reached | (PLC: DREZE1) |
| P12185 | Software end position | | | |
| | Byte 1 | 1 | positive software end position | (PLC: SWEL+1) |
| | Byte 2 | 1 | negative software end position | (PLC: SWEL-1) |

## 8.7 Axis parameters (continued)

### Parameter block to the PLC

P12186 Axis drives

Byte 1 (PLC: ACHFA1)

0 No axis specification
i.e.: Axis does not drive or axis builds the even lag distance off

1 Axis does not drive —> axis specification / axis feed to zero
i.e.: Axis specifications are available.

P12187 Driving instruction

0 No driving instruction pends
i.e.. - no verfahrweg for axis
- axis finds within exact stop finely (P12016)

Byte 1 (PLC: FB+1)

1 Driving instruction for positive driving direction
(driving instruction remains pending, if e.g. in the drive path the feed to zero becomes)

Byte 2 (PLC: FB-1)

1 Driving instruction for negative driving direction
(driving instruction remains pending, if e.g. in the drive path the feed to zero becomes)

Byte 3

1 Axis drive actual actively
i.e. the even position actual which can be started yet does not achieve.

P12188 Back message area monitoring axes area 1

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Reference position (P12101) = control position (P12102) | (PLC: K1E1) |
| Byte 2 | 1 | Control position area 1 (P12103) achieves | (PLC: K1B1E1) |
| Byte 3 | 1 | Control position area 2 (P12104) achieves | (PLC: K1BÈ1) |

P12189 Back message area monitoring axes area 2

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Reference position (P12106) = control position (P12107) | (PLC: KÈ1) |
| Byte 2 | 1 | Control position area 1 (P12108) achieves | (PLC: K2B1E1) |
| Byte 3 | 1 | Control position area 2 (P12109) achieves | (PLC: K2BÈ1) |

## 8.7 Axis parameters (continued)

### Parameter block to the PLC

P12191 Relative position achieves

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Relative position achieves<br>i.e.: Axis actual around the error limit<br>from the target position removes. | (PLC: REPOE1) |

P12192 Absolute position achieves

| | | | |
|---|---|---|---|
| Byte 1 | 1 | Absolute position achieves<br>i.e.: Axis actual around the error limit<br>from the target position removes. | (PLC: ABPOE1) |

P12194 Sercos drive status (Sercos drive - > Interpolator - > PLC)

Byte 2 1

| | |
|---|---|
| $0000 | Drive not yet ready for the performance power,<br>there drive check not finally. |
| $0001 | Drive ready for the performance power, |
| $0100 | Drive actual ready for use and<br>performance supply switched on,<br>note:<br>due to this back message are those<br>to operate drive releases (P12144) |
| $0101 | Drive actual ready for use,<br>drive releases (P12144) are effective,<br>drive output stage actual actively. |

P12195 AK / AEK - outputs

Definition in P12115

| | | | |
|---|---|---|---|
| Byte 1 | | | |
| | $01 | drive in positive direction | (PLC:POSFA1) |
| Byte 2 | | | |
| | $01 | drive in negative direction | (PLC:NEGFA1) |
| Byte 3 | | | |
| | $01 | drive with max. Axis speed | (PLC:SCHFA1) |
| Byte 4 | | | |
| | $01 | drive with Slope speed | (PLC:LGSFA1) |

## 8.7 Axis parameters (continued)

### Parameter block to the PLC

| | | |
|---|---|---|
| P12197 | Message number<br>Message display for this axis<br>e.g. M2110 approach reference position | (PLC: MELNR1) |
| P12198 | Channel number<br>Axis belongs to this channel (1...8) | (PLC: KANNR1) |
| P12199 | Logicals axis number<br>Axis has this logical number (1. ..32) in the channel | (PLC: LANA1) |

# 9. Messages

## 9.1 Groups of messages

| | |
|---|---|
| M1000 . .. M1999 | Messages of the CNC, block interpreter, I/O |
| M1150... M1199 | Error off tool radius correction |
| M1950... M1999 | SYSTEM error with the call by DLL Functions |
| M2000 . .. M2999 | Messages of the interpolator |
| M3000 . .. M3999 | Messages of the PLC |
| M3000 . .. M3499 | Global messages of the plant (i.e. channel overlapping) |
| M3000 . .. M3249 | Messages are indicated with gray writing on red ground |
| M3250 . .. M3499 | Messages are indicated with black writing on turquois ground |
| M3500 . .. M3999 | Channel specific messages |
| M3500 . .. M3749 | Messages are indicated with gray writing on red ground |
| M3750 . .. M3999 | Messages are indicated with black writing on turquois ground |
| M4000 ... M4999 | Messages of the operating panel |
| M4000 ... M4499 | BWO messages |
| M4000 ... M4299 | DOS messages |
| M4300 ... M4399 | Messages of the system |
| M4400 ... M4499 | Messages of the MMI |
| M4500 ... M4999 | free for the user |
| M5000 . .. M7999 | Reserved |
| M8000 . .. M8999 | Messages of cycles |
| M8000 . .. M8499 | Standard cycles |
| M8500 . .. M8999 | Free for users |
| M9000... M9999 | Error message off CNC DLL |
| M9000... M9099 | Reserves for BWO |
| M9100... M9999 | Freely for users |

## 9.2 General CNC messages

| Message | Meaning |
|---|---|
| 1000 | Error when writing in Flash-memory<br>P8505 Error code<br>P8506 Channel number |
| 1001 | FLASH Function not executed |
| 1002 | No NC program in the Flash-memory |
| 1008 | Approach reference points |
| 1009 | Switching AUTO <—> POS not allowed<br>Switching has to be done in MANUAL! |
| 1050 | Tool group not found in the tool data memory |
| 1098 | Error message when renumbering a NC program<br>-> skip target is not available.<br>The renumbering is not executed.<br>Number of the NC block which has caused this message is written in P8505. |
| 1099 | Error message when renumbering a NC program<br>-> indirect skip in NC memory available.<br>Renumbering is not stopped, but this NC block is marked with the text ‘warning’. |

## 9.3 Messages at input/output

| Message | Meaning |
|---|---|
| 1100 | Error in the test character or in the character number with the datentransfer between operating panel and CNC, i.e. the operating panel obtain on divergent<br>Test character / file size as the CNC. |
| 1102 | No abort confirmation from the operating panel<br>Each I/O-abort-confirmation-telegram (CNC —> OP) has to be confirmed by the operating panel.<br>If this is not the case, the message 1102 is |
| 1105 | Error when opening a program in the NC memory |
| 1106 | NC program becomes overwritten |
| 1107 | NC program is already existing and will not be overwritten |
| 1110 | Wrong file identification<br>i.e.: the identification at the file start is not correct<br>‘P’ for NC programs<br>‘D’ for parameters<br>‘B’ for zero points<br>Line number in P8505 |
| 1111 | Line read can not be interpreted<br>Line number in P8505<br><br>Reasons e.g.:<br>- NC block does not start with block number<br>- parameter line is damaged<br>- preceeding file has no end identification (#)<br>- I/O parameter is not correct (Baudrate, parity ...) |
| 1112 | Invalid channel<br>Reason: Read or write operations with channel parameters of which the channel does not exist. |

## 9.3 Messages at input/output (continued)

| Message | Meaning |
|---|---|
| 1113 | Reception string overflow with I/O traffic (input)<br>(max. character length of a line: 400)<br>Read in string actual longer than reception s string.<br>A cause: - It tried on false file format to read in (EXE, being file...)<br>- Errors in the input file |
| 1114 | Reception string does not contain a test character |
| 1115 | Reception string contains false test character |
| 1120 | Memory space problem with the system down load<br>(too little temporary memory (HEAP) available) |
| 1121 | Download software does not fit the hardware version of the CNC Card,<br>e.g.. to charge it tried on BS902.xxx into a CNC Hardware 084564. |
| 1122 | Check total the loaded system software actual not correctly.<br>- > file possibly damages<br>- > problems while the loading. |
| 1123 | Check total the system software actual burned in the FLASH not correctly.<br>- > file possibly damages<br>- > hardware problem |

## 9.4 Messages with the tools radius correction

| Message | Meaning |
|---|---|
| 1151 | Tool radius too largely |
| 1152 | Circle radius too small (message with stop) |
| 1153 | Tool radius correction error with ON/OFF drive |
| 1154 | G0 / G1 with tool radius correction not possibly |
| 1155 | G2 / G3 with tool radius correction not possibly |
| 1156 | With tool radius correction no intersection of the sets |
| 1157 | Too many blocks without path |
| 1158 | G12 not possible |
| 1159 | No path difference |

## 9.5 Messages of the NC interpreter

| Message | Meaning |
|---|---|
| 1200 | Coprocessor is missing |
| 1201 | Channel descriptor not valid |
| 1202 | Parameter number too large |
| 1203 | Division through zero |
| 1207 | Too many axes programs. Message only in the export version<br>A cause: It is tried, in a block more axes to interpolate as certified.<br>Error correction: Program fewer axes in the incorrect block. |
| 1208 | Too many parameters programmed in the block (max. 32) |
| 1209 | Too many bracket levels (maximum 10) |
| 1210 | Bracket is missing |
| 1211 | Syntax error |
| 1212 | Negative root |
| 1213 | Function can not be executed<br>e.g. at - logarithm-calculation<br>- tan (90) ... |
| 1214 | No parameter operation |
| 1215 | Syntax error |
| 1216 | Unknown axis name |
| 1217 | Error at M25<br>The NC program contains on loop end (M25) without loop start (M24). |
| 1218 | Error at M24 |
| 1219 | Errors at sub-routine call up |
| 1220 | Too many sub-routine call up |

## 9.5 Messages of the NC interpreter (continued)

| Message | Meaning |
|---|---|
| 1221 | Parameters not loaded |
| 1222 | too many M - or G - or P - functions in a block programs |
| 1223 | Error in the outline path<br>In the case of NC program abort:<br>A possible cause tool radius actual too largely, in order to process outline.<br>Error correction Tool with smaller tool tools use.<br><br>With NC program stop:<br>Programmed outline radius actual smaller than the half chord. Radius is corrected.<br>NC program can be started again. |
| 1224 | Spindle not available |
| 1225 | No tool group defined |
| 1226 | Geometry error<br>possible reason: - at G12, G123 next block with travel is missing<br>- function G123 is programmed with M01 |
| 1227 | M - function number too large |
| 1228 | M - function definition not correct<br>- a M-function with skip target is in the NC program.<br>M-Function is not defined as skip-M-function.<br>- a M-function without skip target is in the NC program.<br>M-Function is defined as skip-M-function. |
| 1229 | M1 is not allowed in this block<br>e.g. it may not be synchronized if tool radius correction is switched on. |
| 1230 | No feed was programmed for G01/02/03 |
| 1231 | G02/G03 without path difference |
| 1232 | Not allowed combination of G or M function programmed in the NC block. |
| 1233 | Circular interpolation (G02/G03) programmed without R or I / J / K |

## 9.5 Messages of the NC interpreter (continued)

| Message | Meaning |
|---|---|
| 1234 | Programmed outline radius actual smaller than the half chord,<br>i.e. with this programmed radius can the programmed terminator point not to be achieved.<br>NC program is stopped. Radius is corrected.<br>NC program can be started again. |
| 1235 | Spline not possible |
| 1237 | Circle dynamics, Error when calculating feed<br>Reason:<br>Acceptable path deviation (P8852) is larger than the programmed radius.<br>Erasing the error:<br>Reduce path deviation (P8852) |
| 1238 | Programmed centre point is not correct with programmed start and terminator point (see also P8843) |
| 1240 | No valid operation range defined (P8555)<br>Message appears e.g. at zero point call up |
| 1249 | Invalid NC interpreter default<br>Error correction:<br>The following parameters check:<br>Parameter P8830 Preset zero point<br>Parameter P8853 Preset type of coordinate |
| 1252 | Program not found |
| 1255 | Block not found |
| 1256 | NC memory full |
| 1257 | Memory error in drip-feed-buffer<br>Over - or underflow |
| 1258 | Memory error in drip-feed-buffer<br>Faulty block synchronization when reading the buffer |
| 1259 | NC block with defective check sum |

## 9.5 Messages of the NC interpreter (continued)

| Message | Meaning |
|---|---|
| 1260 | Error when reading NC memory |
| 1261 | Error when writing in NC memory |
| 1262 | File not defined |
| 1263 | Program not found |
| 1264 | Program not opened for reading |
| 1265 | Program write-locked<br>Interlocking through key-operated switch etc.. |
| 1266 | NC program is locked<br>Program is already opened for writing by an other user. |
| 1267 | Too many programs opened |
| 1268 | Circle buffer - overflow e.g. Drip-feed-buffer overflow |
| 1269 | Applied function is not supported at ring - buffer (Drip-feed-operation) |
| 1270 | Format error (The opened file is not a NC program) |
| 1271 | Faulty NC block e.g. ‘N’ is missing before the block number |
| 1272 | Error at access on the NC memory |
| 1280 | Directory chain of NC memory defective |
| 1281 | File chain of NC program defective |
| 1283 | System data for NC memory organization defective |
| 1285 | Blocks in the NC memory are double-chained |
| 1290 | NC blocks are not sorted<br>(beginning with the small number and ending with the big one)<br>P8505 old block number<br>P8506 new block number |

## 9.5 Messages of the NC interpreter (continued)

| Message | Meaning |
|---|---|
| 1300 | Parameter not installed - cleared |
| 1301 | Parameter-check sum defective |
| 1302 | Parameter - number larger than maximum Parameter - Number |
| 1304 | Parameter is write-locked<br>Parameter number in P8505<br>Channel in P8506 |
| 1305 | Channel parameter not available. It was tried, to write a channel parameter, whose channel does not exist. |
| 1306 | AUTO file frame erre OVERFLOWS<br>A cause: With einges chalteter increasing AUTOMATIC file locks is enough storage space not off (see also P8806). |
| 1310 | Program number not loaded at emergency program call ( P8820 etc. ) |
| 1320 | Mode of operation change locked<br>e.g. during emergency program call it can not be switched to AUTO mode of operation |
| 1321 | Control not in MANUAL operation mode |
| 1322 | Control not in AUTO operation mode |

## 9.6 Messages of the system

| Message | Meaning |
|---|---|
| 1800 | Fatal error; System start again<br>After sequence error - M1820<br>- M1830<br>- M1840 |
| 1810 | Interface CNC —> PLC: Data overflow<br>During a parameter transfer to the PLC there was a data overflow.<br>(floating decimal point format does not fit into the fixed point format, mantissa too largely)<br>Information: Parameter number in P8505 (info. 1), channel in P8506 (info. 2) |
| 1811 | Parameter test character defectively<br>If the channel 1 in the operating mode HAND is, becomes from the operating system in background constantly the total parameter area checks.<br>Info.: Q-parameter number in P8505 (info. 1) |
| 1815 | Real time buffer overflow<br>- faulty real time buffer administration or<br>- faulty feedback of the interpolator |
| 1816 | Feed back buffer overflow<br>- Feedbacks of the interpolator can not be processed any more. |
| 1820 | Floatingpoint exception<br>Exception reason in P8505: Bit 0 : Inexact<br>Bit 1 : Underflow<br>Bit 2 : Overflow<br>Bit 3 : Divide by Zero<br>Bit 4 : Invalid operation<br>Bit 5 : Unimplemented operation<br>System address in P8506<br>Task-Id in P8507 |

## 9.6 Messages of the system (continued)

| Message | Meaning |
|---|---|
| 1830 | NA signal became intermittently active (NA: Power failure signal)<br>After the message M1830 position adjustment may not be eingeschatet any longer!<br>(interlock in the PLC)<br>No more NC programs may be started!<br>Axis positions cannot be correct possibly.<br>To start after the occurance of of this error message actual the system again.<br>(power OFF / on)<br><br>A cause: Cure-early mains voltage failure<br>Errors eliminate: Mains voltage check<br>Power supply unit check |
| 1840 (F0) | General hardware error.<br>Module or network failed.<br>(see also at the operating panel under DIAGNOSIS system configuration) |
| 1841 (F1) | Battery voltage is missing<br>Causes: - Battery defectively<br>- contact problems of the battery plug |
| 1842 (F2) | ±15V-Spannung is missing |
| 1843 (F3) | Battery and ±15V-Spannung are missing |
| 1844 (F4) | Processor fan defectively<br>Caution: With defective fan overheating danger consists, there that processor on the CNC Module is no longer sufficiently cooled.<br>an overheating of the CNC Processor leads to malfunctions or to complete failure of the system. |

## 9.6 Messages of the system (continued)

| Message | Meaning |
|---|---|
| 1950 | DLL Function or subfunction missing<br>Off the CNC DLL a function in the CNC CORE is called, which does not exist.<br>Information: Info1 / P8505: Function code<br>Info2 / P8506: Subfunction paragraph |
| 1951 | Invalid channel with function call<br>Off the CNC DLL a function in the CNC CORE is called, also invalidly / illegal channel number<br>Information: Info1 / P8505: Function code<br>Info2 / P8506: Subfunction paragraph |
| 1952 | Invalid axis paragraph with function call<br>Off the CNC DLL a function in the CNC CORE is called, also invalidly / illegal axis paragraph<br>Information: Info1 / P8505: Function code<br>Info2 / P8506: Subfunction paragraph |

## 9.7 Mssages of the interpolator

| Message | Maning |
|---|---|
| 2001 | Lag distance too large |
| 2004 | Measuring system signal is missing |
| 2005 | Measuring system UAS is missing |
| 2006 | Measuring system frequency too large |
| 2007 | Measuring system correction too large |
| 2020 | Axis can not be moved |
| 2022 | Axis not in position |
| 2023 | Coupling difference too large |
| 2024 | Reference distance too large |
| 2050 | Block buffer overflow in the interpolator |
| 2052 | Coordinate mode not defined<br>Possible causes: - Type of coordinate does not specify, i.e. e.g. with the Robot system is missing to Robot definition in P11800<br>- When switching on of a type of coordinate (G48 on, G49...) are yet all axes involved does not report.<br>Errors eliminate: - Type of coordinate specify<br>- Axes report |
| 2101 | Hardware end position + |
| 2102 | Hardware end position - |
| 2103 | Software end position + |
| 2104 | Software end position - |

## 9.7 Mssages of the interpolator (continued)

| Message | Maning |
|---|---|
| 2110 | Approach reference position |
| 2112 | Approach measuring position |
| 2114 | Approach emergency position |
| 2116 | Approach basic position |

## 9.8 Messages of the PLC

| Message | Meaning |
|---|---|
| 3000 | Connection operating panel <-> CNC was interrupted<br>- Security stop of all axes is set |
| 3501 | Mode of operation change -> Automatic locked |
| 3502 | Mode of operation change -> Manual locked |

## 9.9 Messages of the operating panel

| Message | Meaning |
|---|---|
| | Range 4000 .. 4299 are DOS error messages |
| 4002 | File not found |
| 4003 | Path not found |
| 4004 | Maximum number of files already opened (FILES=xx) |
| 4005 | File access refused |
| 4006 | Invalid file handle not defined or |
| 4012 | Invalid file mode |
| 4015 | Drive number not allowed |
| 4016 | Actual directory can not be cleared |
| 4100 | Error when reading the disc |
| 4101 | Error when storing on the disc |
| 4102 | File variable is not allocated to a file |
| 4103 | File is not opened |
| 4104 | File was not opened for reading operations |
| 4105 | File was not opened for storing operations |
| 4106 | Invalid numerical format |

## 9.9 Messages of the operating panel (continued)

| Message | Meaning |
|---|---|
| 4150 | Disc is not write-locked |
| 4151 | Peripheral device unknown / not connected |
| 4152 | Drive not ready |
| 4153 | Invalid DOS function |
| 4154 | Check sum error when reading from the floppy / hard disc |
| 4155 | Invalid disc parameter block |
| 4156 | Head-positioning error on the floppy / hard disk |
| 4157 | Sector format unknown |
| 4158 | Disc sector can not be localised |
| 4160 | Write error when accessing a peripheral device |
| 4161 | Read error when accessing a peripheral device |
| 4200 | Division with zero |
| 4201 | Range test: error |
| 4202 | Stack test: overflow |
| 4203 | No more space in the Heap-range |
| 4204 | Invalid pointer operation |
| 4205 | Floating point overflow |
| 4206 | Floating point underflow |
| 4207 | Floating point error |
| 4211 | Program too deep |

## 9.9 Messages of the operating panel (continued)

| Message | Meaning |
|---|---|
| | Area 4300... 4399 messages of the operating system operating panel |
| 4300 | More than 400 programs in the directory (CNC: NCDATA \...). it cannot do all to be displayed. |
| 4301 | Operating panel Input SIO parity error |
| 4302 | Operating panel Input SIO Overrun error |
| 4303 | Operating panel Input SIO Framing error |
| 4310 | More than 1600 programs in the directory (CNC: NCDATA \...). it cannot do all to be displayed. (only on PC operating panel with driver CNC900X.EXE starting from 09.06.97.) |
| 4390 | Connection operating panel <-> CNC actual interrupted. No response of the CNC within Timeout. |
| | Area 4400... 4499 messages of the control surface |
| 4400 | Control not in MANUAL |
| 4401 | Changeover to AUTO not made |
| 4402 | Graphics simulation not active |

## 9.10 Cycle messages

| Message | Meaning |
|---|---|
| 8001 | Geometry errors in the cycle (G71, 72, 73, 74, 75)<br>This message appears when the control finds out that the pocket-contour can not be processed with the programmed tool data.<br>E.g. P14 smaller than tool radius or tool radius = 0,<br>or tool radius is not programmed. |
| 8003 | Corner radius too small |
| 8004 | Corner radius too big |
| 8005 | Invalid tool radius |
| 8006 | Sequence error |
| 8007 | Pocket radius < tool radius |
| 8008 | Pre-bore tool radius > pocket radius |
| 8009 | In-feed > pocket depth (P13) - allowance on pocket depth (P18) |
| 8010 | Invalid inner radius (P11) |
| 8011 | Invalid 1st. pocket dimension (P11) |
| 8012 | Invalid 2nd. pocket dimension (P12) |
| 8013 | Invalid pocket depth (P13) |
| 8014 | Invalid radius (P14) |
| 8015 | Invalid allowance (P15) |
| 8016 | Invalid in-feed (P16) |
| 8017 | Invalid in-feed (P17) |
| 8018 | Invalid allowance on pocket depth (P18) |
| 8019 | Invalid safety allowance (P19) |
| 8020 | Invalid fine-infeed (P20) |

## 9.10 Cycle messages (continued)

| Message | Meaning | |
|---|---|---|
| 8021 | Invalid plange in feed | (P21) |
| 8032 | Invalid feed | (P32) |
| 8033 | Invalid drilling depth | (P33) |
| 8034 | Invalid preliminary stop plane | (P34) |
| 8035 | Invalid retraction plane on pocket depth | (P35) |
| 8036 | Invalid stroking rate | (P36) |
| 8037 | Invalid parameter for 1st. stroke | (P37) |
| 8038 | Invalid safety allowance | (P38) |

## 9.10 Cycle messages (continued)

| Message | Meaning | |
|---|---|---|
| 8100 | Invalid X-coordinate X(AB) | (P100) |
| 8101 | Invalid Y-coordinate Y(AB) | (P101) |
| 8103 | Invalid angle (E1) | (P103) |
| 8104 | Invalid vector length (L1) | (P104) |
| 8105 | Invalid vector division (T1) | (P105) |
| 8106 | Invalid number of positionings (N1) | (P106) |
| 8107 | Vector division (T1) | (P105) |
| | or number of positionings (N1) is missing | (P106) |
| 8110 | Invalid X-coordinate X(AC) | (P110) |
| 8111 | Invalid Y-coordinate Y(AC) | (P111) |
| 8113 | Invalid angle (E2) | (P113) |
| 8114 | Invalid vector length (L2) | (P114) |
| 8115 | Invalid vector division (T2) | (P115) |
| 8116 | Invalid number of bores (N2) | (P116) |
| 8117 | Vector division (T2) (P115) | |
| | or number of positionings (N2) is missing | (P116) |
| 8120 | Invalid X-coordinate pitch circle centre point | (P120) |
| 8121 | Invalid Y-coordinate pitch circle centre point | (P121) |
| 8122 | Invalid pitch circle diameter (D) | (P122) |
| 8123 | Invalid starting angle (E) | (P123) |
| 8124 | Invalid travelling angle (L) | (P124) |
| 8125 | Invalid pitch angle (T) | (P125) |
| 8126 | Invalid number of bores (N) | (P126) |

## 9.10 Cycle messages (continued)

| Message | Meaning | |
|---|---|---|
| 8300 | No spindle speed programmed | (G81, G83, G84, G85) |
| 8301 | No spindle direction of rotation | (G81, G83, G84, G85) |
| 8302 | Spindle speed = 0 | (G81, G83, G84, G85) |
| 8303 | Spindle speed not reached | (G81, G83, G84, G85) |
| 8309 | Oversized pitch dimension (T1)<br>and number of positionings (N1) | (P105)<br>(P106) |
| 8310 | Oversized vector division (T1)<br>and final point B<br>(Final point B is defined by X and Y coordinate (P101 and P102)) | (P105) |
| 8311 | Oversized vector length (L1)<br>and final point B<br>(Final point B is defined by X and Y coordinate (P101 and P102)) | (P104) |
| 8313 | Oversized vector length (L1)<br>and vector part (T1) | (P104)<br>(P105) |
| 8315 | Oversized vector division (T1)<br>and number of positionings (N1) | (P105)<br>(P106) |
| 8316 | Input number of positionings with 0 | (P106) |
| 8320 | Oversized vector division (T2)<br>and final point C<br>(Final point C is defined by X and Y coordinate (P111 and P112)) | (P115) |
| 8321 | Oversized vector length (L2)<br>and final point C<br>(Final point C is defined by X and Y coordinate (P111 and P112)) | (P114) |
| 8323 | Oversized vector length (L2)<br>and vector division (T2) | (P114)<br>(P115) |
| 8325 | Oversized vector division (T2)<br>and number of positionings (N2) | (P115)<br>(P116) |
| 8326 | Input number of positionings with 0 | (P116) |

## 9.10 Cycle messages (continued)

| Message | Meaning | |
|---|---|---|
| 8332 | Wrong proportioned travelling angle L (P124) and pitch angle T (P125) | |
| 8333 | Oversized pitch angle T<br>and number of positionings N | (P125)<br>(P126) |
| 8334 | Indicate pitch angle with 0 | (P125) |
| 8335 | Indicate pitch angle with 1 | (P125) |
| 8336 | Indicate number of bores N with 0 | (P126) |
| 8337 | Indicate number of bores N with 1 | (P126) |