# SINUMERIK 810

## Basic Version 2
## Interface Description
## Part 1: Signals

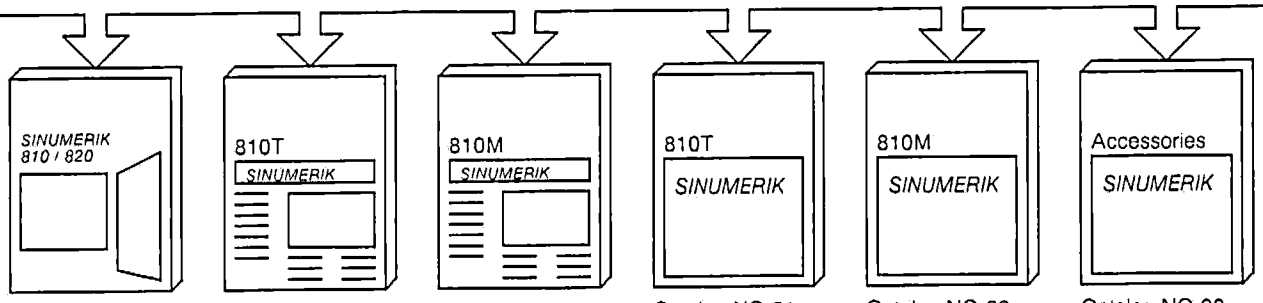
Planning Guide

SINUMERIK

Manufacturer Documentation
02.89 Edition

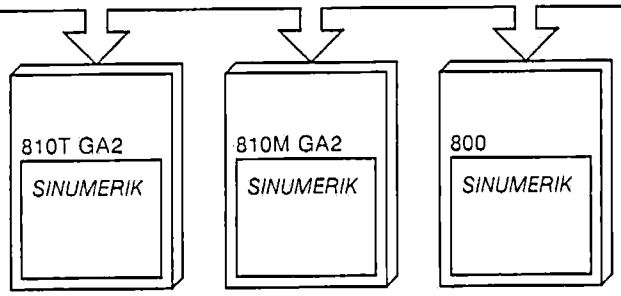
# SINUMERIK 810, Basic Version 2 (GA 2)

## General Documentation




Sales Brochure | Technical Data | Catalog NC 21 | Catalog NC 22 | Catalog NC 90

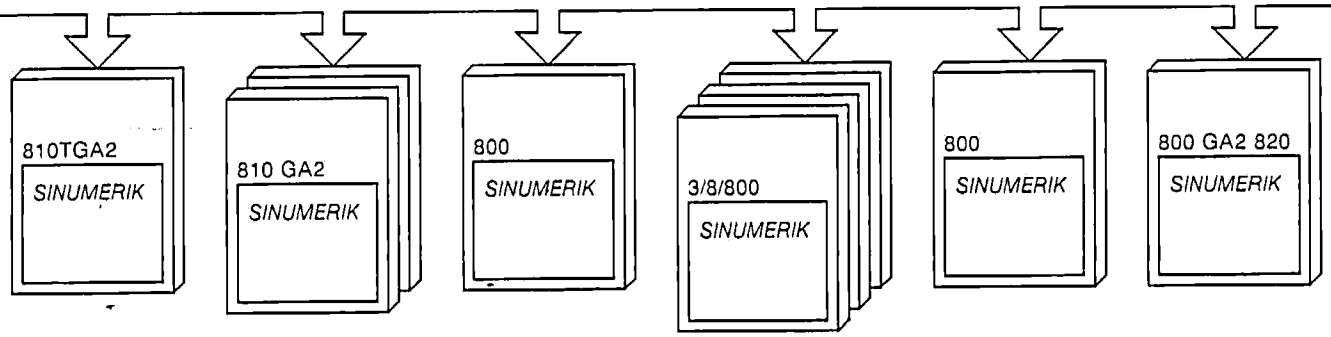
## User Documentation




User's Guide (Operating/Programming)

Contour Calculator for NC Geometry Programs

## Manufacturer Documentation




Instructions Manual

Interface:
- Signals
- Cables and Connections

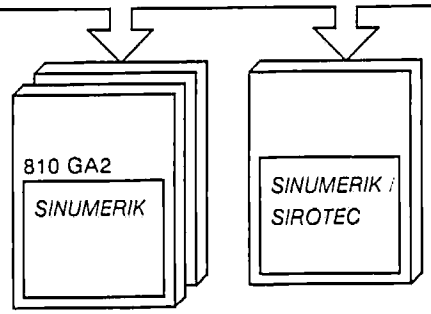
Universal Interface

Measuring Cycles:
- General
- Turning
- Milling

SINUMERIK WS 800
CL 800 Language

PLC Programming

## Service Documentation




Installation Guide
- Instructions
- Lists

Spare Parts List

# SINUMERIK 810
# Basic Version 2

# Interface Documentation
# Part 1: Signals

# Manufacturer Documentation

## Planning Guide

Valid for:

| *Control* | *Software versions* |
|---|---|
| SINUMERIK 810 T / 810 TE (GA 2) | 01 and 02 |
| SINUMERIK 810 M / 810 ME (GA 2) | 01 and 02 |

**February 1989 Edition**

## Printing history

Brief details of this edition and previous editions are listed below.

The status of each edition is shown by the code in the "Remarks" column.

*Status code in* "Remarks" *column:*

**A** . . . New documentation
**B** . . . Unrevised reprint with new Order No.
**C** . . . Revised edition with new status

| Edition | Order No. | Remarks |
|---|---|---|
| 02.89 | 6ZB5 410-0BN02-0BA0 | A |

# Introduction

## Control structure

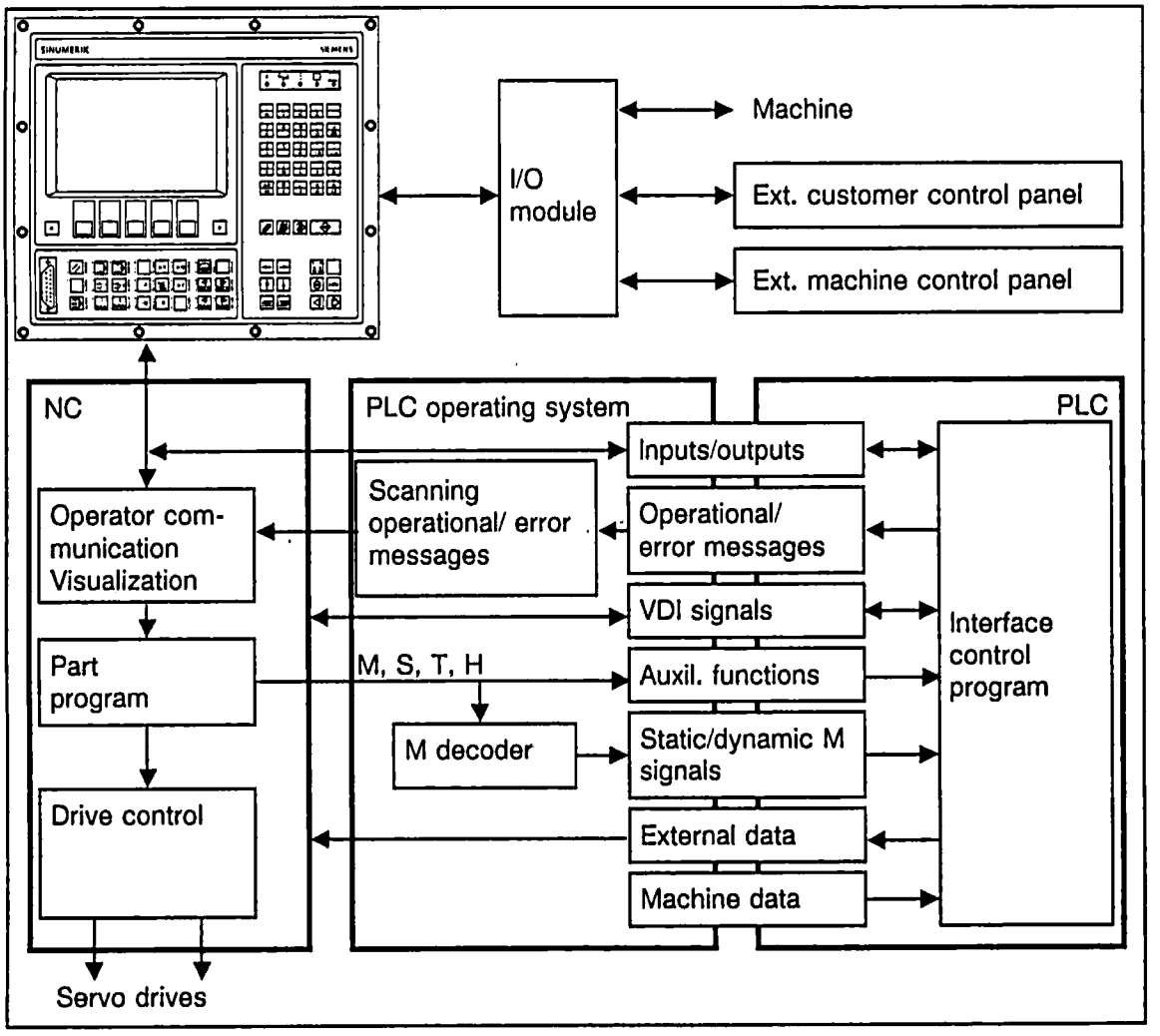
The SINUMERIK 810, Basic Version 2, contains a programmable logic controller (PLC) in the form of a software PLC without independent hardware (CPU) which is integrated in the compact CNC control unit.

Considerable relief of the PLC user memory is achieved by relocating standard functions such as

- M and S decoding,
- organization of the NC-PLC data transfer,
- organization of the displaying of fault and status messages

from the PLC user memory to the system program memory. Additional PLC programs are no longer required for such auxiliary routines.

This Interface Description covers both signals exchanged between the NC and PLC, and signals offered by the PLC operating system, e.g. in decoded form..




*SINUMERIK 810 functional structure*

## Contents

# 1 Assigned Input/Output Areas

## 1.1 Connection facilities for I/O circuits and equipment

Fig. 1.1 shows which modules can be connected to the SINUMERIK 810 as I/O devices:
The I/O submodules and the interface submodule for manual encoders (handwheels) are connected directly to the I/O bus of the SINUMERIK 810. It is also possible to connect I/O submodules or, in an expansion unit, SINUMERIK 800 and SIMATIC U I/O modules via the multiport controller (MPC) interface.

The external machine control panel or customer control panel and the inputs/outputs for machine signals are linked to the PLC via the I/O modules.

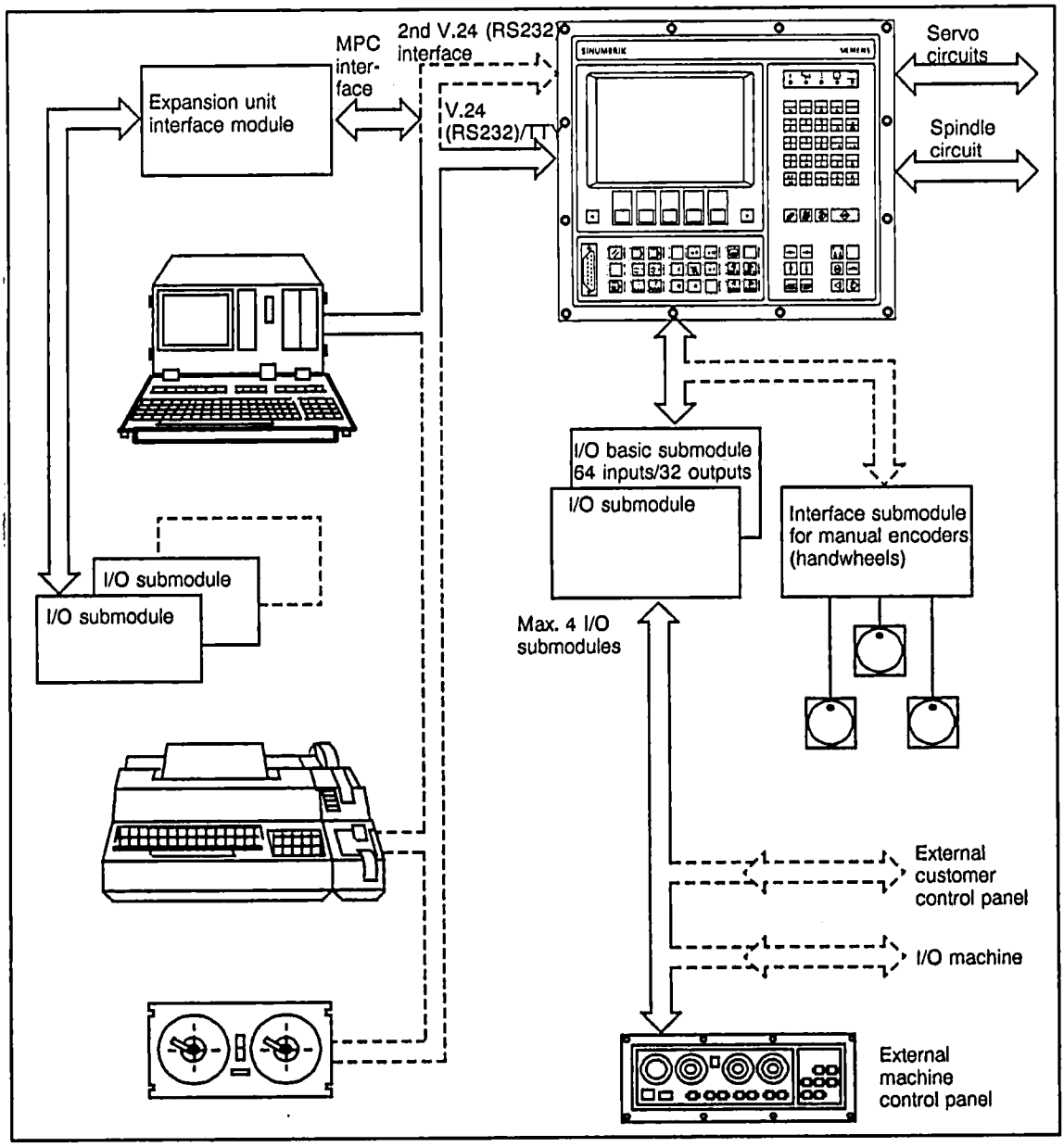


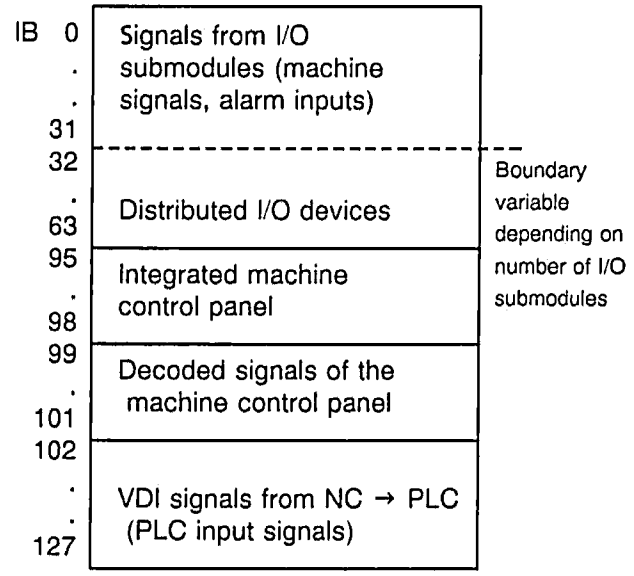

*Fig. 1.1 Link structure*

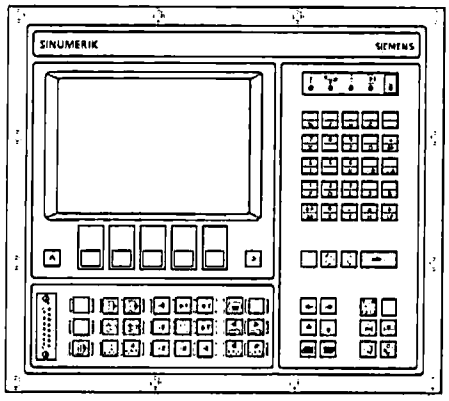
 

# 1.2 Overview PLC interface

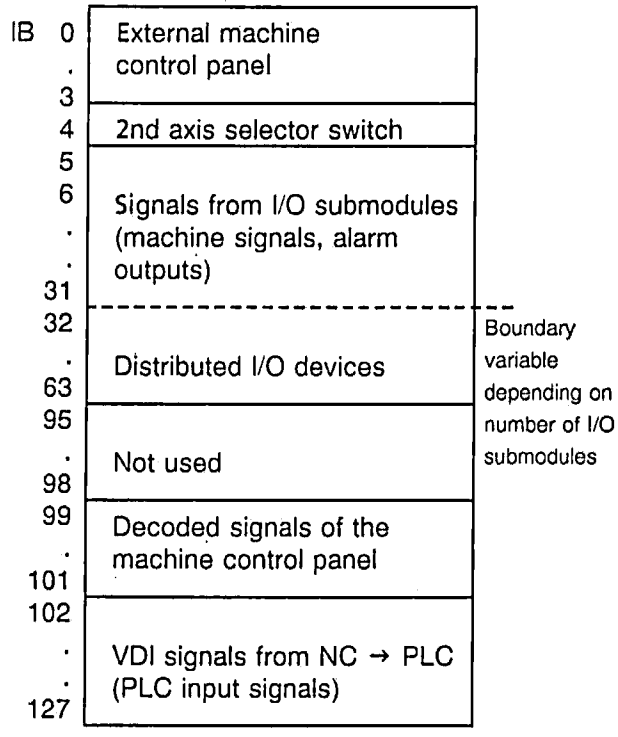
## 1.2.1 Inputs

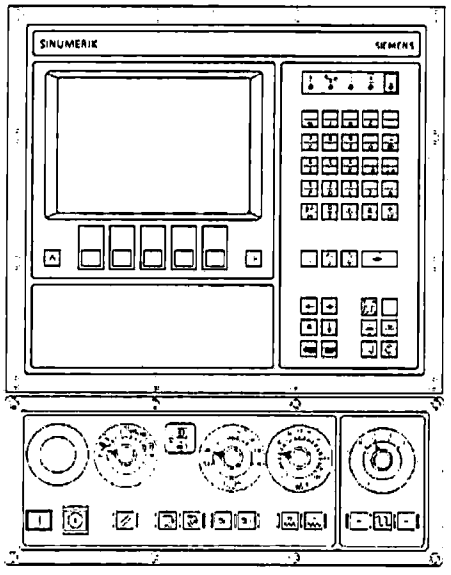
### Integrated machine control panel



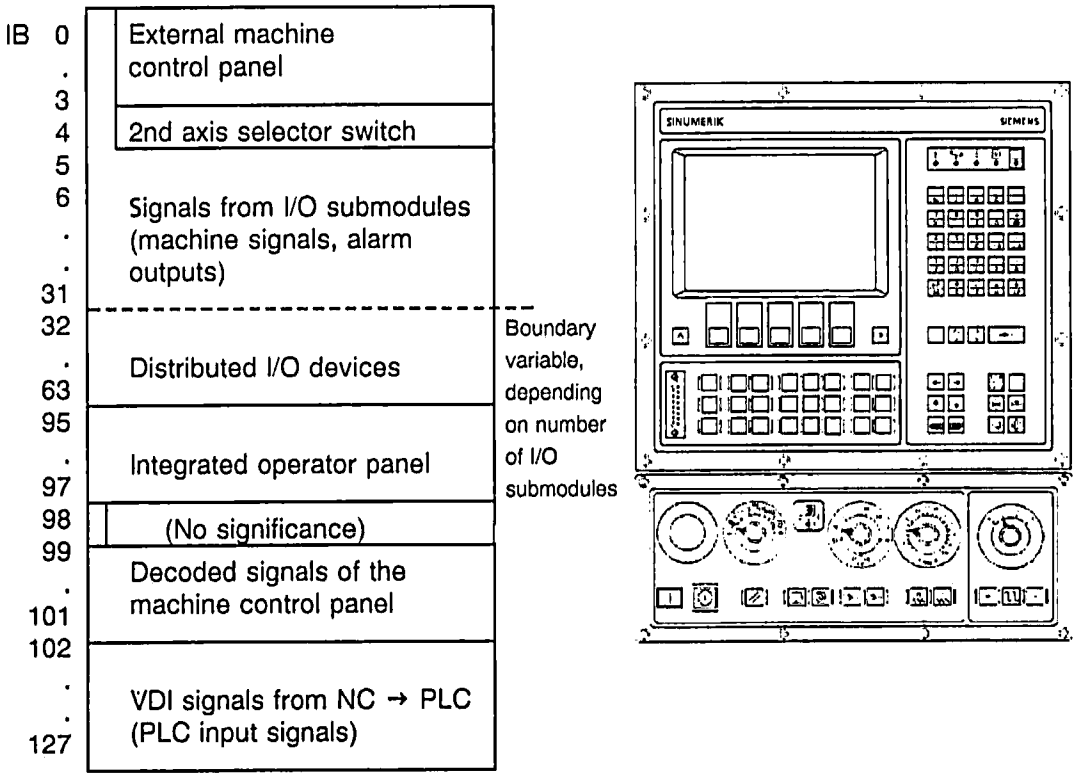




### External machine control panel, without integrated operator panel



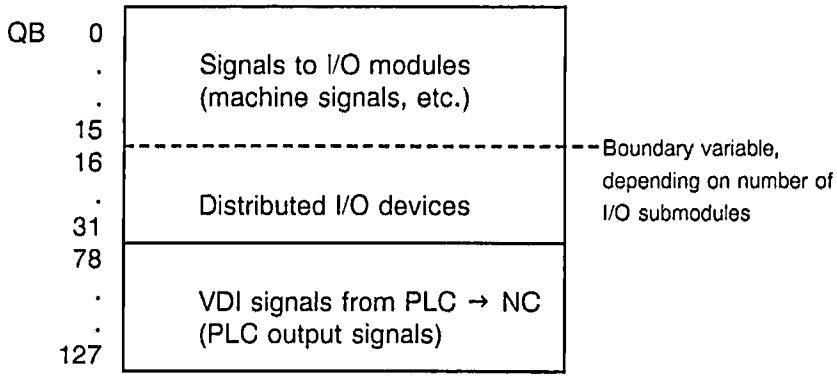
## External machine control panel, with integrated operator panel



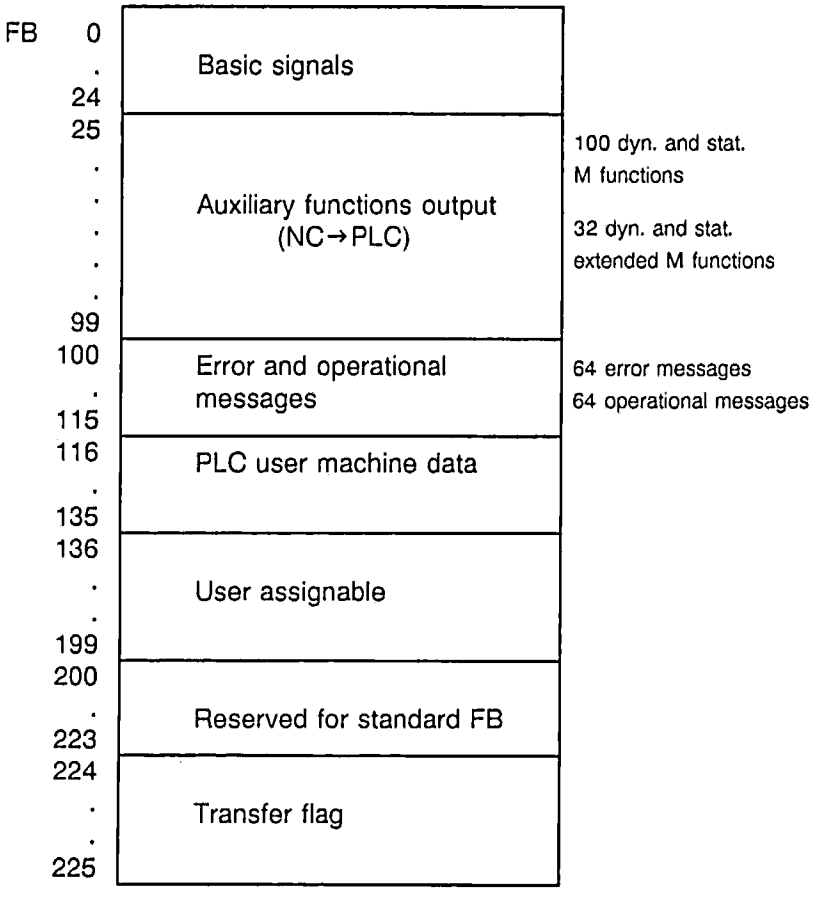

Note:

The number of the input byte for interrupt processing is determined by machine data (0-63). If the decoded signals of the machine control panel are not required, the external machine control panel can also be set to input bytes other than IB 0 to IB 3 or 4 (810M with 2nd axis selector switch).

## 1.2.2 Outputs




## 1.2.3 Flags



## 1.2.4 Data blocks

| DB No. | DB design. | DB name | Package |
|---|---|---|---|
| 0 | | Block address list | |
| 1 | | Diagnostics DB | |
| 2 | | Reserved | |
| . | | . | |
| . | | . | |
| 20 | | Reserved | |
| 21 | | Reserved | |
| . | | . | |
| . | | . | |
| 35 | | Reserved | |
| 36 | | Interface for data transfer | |
| 37 | | Interface for serial interface | |
| 38 | | Reserved | |
| . | | . | |
| 69 | | Floppy disk drive | |
| 70 | | Status display for digital link | |
| 71 | | User assignable | |
| . | | . | |
| . | | . | |
| 79 | | User assignable | |
| 80 | | Decoding list | |
| 81 | | User assignable | |
| . | | . | |
| . | | . | |
| 255 | | User assignable | |

## 1.2.5 Function blocks

| FB No. | FB design. | FB name | Package | Flags used < FW 224 |
|---|---|---|---|---|
| 0 | | Reserved | | |
| . | | . | | |
| . | | . | | |
| 10 | | Reserved | | |
| 11 | EINR-DB | Create data blocks | | |
| 12 | | Reserved | | |
| . | | . | | |
| . | | . | | |
| 59 | | Reserved | | |
| 60 | Block-TR | Block transfer | | |
| 61 | NCD-LESE | Read NC data | | |
| 62 | NCD-SCHR. | Write NC data | | |
| 63 | | Reserved | | |
| 64 | | Reserved | | |
| 65 | M-STACK | Transfer flag in flag stack | | |
| 66 | STACK-M | Flag stack in transfer flag area | | |
| . | | | | |
| 70 | | Reserved | | |
| . | | . | | |
| . | | . | | |
| 120 | | Floppy disk drive | | |
| . | | . | | |
| . | | . | | |
| 189 | | Reserved | | |
| 190 | (K-Leit PLC) | (Link with master PLC) | | |
| 191 | | Reserved | | |
| . | | . | | |
| . | | . | | |
| 199 | | Reserved | | |
| 200 | | User assignable | | |
| . | | . | | |
| . | | . | | |
| 255 | | User assignable | | |

## 1.3 Machine control panel signals

| Signals of the integrated machine control panel 810T (Section | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **IB 95** | Spindle override switch | | | | Mode selector | | | |
| | D | C | B | A | D | C | B | A |
| **IB 96** | | | Rapid traverse override | | | | | |
| **IB 97** | | | Spindle | | Feed | | NC Start | *NC Stop |
| | | | On | *Off | On | *Off | | |
| **IB 98** | Reset | | Single block | | Feed override switch | | | |
| | | | | E | D | C | B | A |

| Decoded signals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **IB 99** | Direction keys | | | | | | | |
| | X+ | X- | Z+ | Z- | Q1+ | Q1- | Q2+ | Q2- |
| **IB 100** | Handwheel 1 | | | | | | | |
| | X | Z | Q1 | Q2 | | | | |
| **IB 101** | Handwheel 2 | | | | Handwheel 3 | | | |
| | X | Z | Q1 | Q2 | X | Z | Q1 | Q2 |

## Signals of the integrated machine control panel 810M (Section 3.2.3)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 95 | Spindle override switch | | | | Mode selector | | | |
| | D | C | B | A | D | C | B | A |
| IB 96 | | | Rapide traverse override | | | | | |
| IB 97 | | | Spindle | | Feed | | NC Start | *NC Stop |
| | | | On | Off | On | Off | | |
| IB 98 | Reset | | Single block | Feed override switch | | | | |
| | | | | E | D | C | B | A |

## Decoded signals

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 99 | Direction keys | | | | | | | |
| | X+ | X- | Y+ | Y- | Z+ | Z- | 4.+ | 4.- |
| IB 100 | Handwheel 1 | | | | | | | |
| | X | Y | Z | 4. | | | | |
| IB 101 | Handwheel 2 | | | | Handwheel 3 | | | |
| | X | Y | Z | 4. | X | Y | Z | 4. |

## Signals of the external machine control panel 810T (Section 3.3.2)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 0 | Spindle override switch | | | | Mode selector | | | |
| | D | C | B | A | D | C | B | A |
| IB 1 | Direction keys | | Rapid traverse override | Direction keys | | Aux. axis [1] | Handwheel [2] selector switch | |
| | X+ | X- | | Q+ | Q- | | Z X | C/Q |
| IB 2 | Direction keys | | Spindle | | Feed | | NC Start | *NC Stop |
| | Z+ | Z- | On | *Off | On | *Off | | |
| IB 3 | Reset | Key operated switch | Single block | Feed override switch | | | | |
| | | | | E | D | C | B | A |

## Decoded signals

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 99 | Direction keys | | | | | | | |
| | X+ | X- | Z+ | Z- | Q1+ | Q1- | Q2+ | Q2- |
| IB 100 | Handwheel 1 | | | | | | | |
| | X | Z | Q1 | Q2 | | | | |
| IB 101 | Handwheel 2 | | | | Handwheel 3 | | | |
| | X | Z | Q1 | Q2 | X | Z | Q1 | Q2 |

1) 0: Axis Q2
   1: Axis Q1
2) 10: Axis Z
   00: Axis X
   01: Axis C/Q

## Signals of the external machine control panel 810M (Section 3.3.4)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 0 | Spindle override switch | | | | Mode selector | | | |
| | D | C | B | A | D | C | B | A |
| IB 1 | Direction keys 1 | | Rapid 1 traverse override | | Axis selector switch 1 | | | |
| | + | - | | (E) | (D) | C | B | A |
| IB 2 | | | Spindle | | Feed | | NC Start | *NC Stop |
| | | | On | *Off | On | *Off | | |
| IB 3 | Reset | Key operated switch | Single block | | Feed override switch | | | |
| | | | | E | D | C | B | A |
| IB 4 | Direction keys 2 | | Rapid 2 traverse override | | Axis selector switch 2 | | | |
| | + | - | | (E) | (D) | C | B | A |

## Decoded signals

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 99 | Direction keys | | | | | | | |
| | X+ | X- | Y+ | Y- | Z+ | Z- | 4th+ | 4th- |
| IB 100 | Handwheel 1 / 1st axis selector switch | | | | 2nd axis selector switch | | | |
| | X | Y | Z | 4. | X | Y | Z | 4th |
| IB 101 | Handwheel 2 | | | | Handwheel 3 | | | |
| | X | Y | Z | 4. | X | Y | Z | 4th |

## 1.4 Signals of the integrated operator panel

| Signals of the integrated operator panel (Section 3.6) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **IB 95** | Key 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 |
| **IB 96** | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| **IB 97** | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 |

Note:

The integrated operator panel is available only when the machine is controlled from an external machine control panel and the "Integrated operator panel exists" machine data is set.

# 1.5 NC/PLC interface

## 1.5.1 PLC input signals (NC→PLC)

| Program commands channel 1 (Section 4.1.2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **IB 102** | M 00/ M 01 | M 02/ 1) M 30 | G 33/ G 63 | G 00 | G 96 | | Prog. interrupted | Prog. running |
| **IB 103** | | | | | | | | |
| **IB 104** | Softkey selection | | | | | | | |
| | Skip block selected | | DEC single block selected | Dry run feed selected | M 01 effective selected | Override for rapid traverse selected | DRF selected | |
| **IB 105** | | | | | | | | |
| **IB 106** | | | | | | | | |
| **IB 107** | | Block search active | | | | | | |

| Program commands channel 2 (Section 4.1.2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **IB 108** | M 00/ M 01 | M 02/ 1) M 30 | G 33/ G 63 | G 00 | G 96 | | Prog. interrupted | Prog. running |
| **IB 109** | | | | | | | | |
| **IB 110** | Softkey selection | | | | | | | |
| | Skip block selected | | DEC single block selected | Dry run feed selected | M 01 effective selected | Override for rapid traverse selected | | |
| **IB 111** | | | | | | | | |
| **IB 112** | | | | | | | | |
| **IB 113** | | Block search active | | | | | | |

1) Signal length equal to cycle time

## Spindle-specific signals, spindle 1 (Section 4.1.4)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 114 | Actual spindle rotat. cw | Prog. speed too high | Spindle in set range | Spindle position reached | Spindle stop | Spindle synchronized | M 19 active | Speed limit exceeded |
| IB 115 | Change gear | | | | | Set gear speed C | B | A |

## Axis-specific signals (Section 4.1.3)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 118 Axis 1 | | Axis in position control | | Reference point reached | Travel command + | Travel command - | Position reached Exact stop fine | Position reached Exact stop coarse |
| IB 119 Axis 1 | | | | | | | | |
| IB 120 Axis 2 | | Axis in position control | | Reference point reached | Travel command + | Travel command - | Position reached Exact stop fine | Position reached Exact stop coarse |
| IB 121 Axis 2 | | | | | | | | |
| IB 122 Axis 3 | | Axis in position control | | Reference point reached | Travel command + | Travel command - | Position reached Exact stop fine | Position reached Exact stop coarse |
| IB 123 Axis 3 | | | | | | | | |
| IB 124 Axis 4 | | Axis in position control | | Reference point reached | Travel command + | Travel command - | Position reached Exact stop fine | Position reached Exact stop coarse |
| IB 125 Axis 4 | | | | | | | | |
| IB 126 | | | | | | | | |
| IB 127 | | | | | | | | |

## 1.5.2 PLC output signals (PLC→NC)

**Ready signals at channels 1 and 2 (Section 4.2.1)**

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 78 | | Key-operated switch | Data in Start 2 | Data in Start 1 | Cycle disable | | Emer-gency stop | |
| QB 79 | | | | | | | | |
| QB 80 | | | | | | | | |
| QB 81 | | | | | | | | |

**Operating modes channels 1 and 2 (Section 4.2.1)**

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 82 | DRF effective | Reset | | | Operating modes D | C | B | A |

**Submodes channel 1 (Section 4.2.2)**

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 83 | Skip block | Single block | Single block decoding | Dry run feed | M 01 effective | | | |

**Feed modification channels 1 and 2 (Section 4.2.3)**

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 84 | Total feed enable | | Feed override effective | Feed override E | D | C | B | A |
| QB 85 | | | Rapid traverse override effective | Rapid traverse override (E) | (D) | C | B | A |

| Program modification channel 1 (Section 4.2.2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| QB 86 | | | | | | | | |
| QB 87 | | | Read-in enable | | Delete distance-to-go | Delete no. of subrou. passes | NC Stop | NC Start |
| QB 88 | | | | | | | | |
| QB 89 | | | | | | | | |
| QB 90 | | | | | | | | |
| QB 91 | | | | | | | | |

| Submodes channel 2 (Section 3.4) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| QB 92 | Skip block | Single block | Single block decoding | Dry run feed | M01 effective | | | |
| QB 93 | | | | | | | | |
| QB 94 | | | | | | | | |

| Program modification channel 2 (Section 4.2.2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **QB 95** | | | | | | | | |
| **QB 96** | | | Read-in enable | | Delete distance-to-go | Delete no. of subrou. passes | NC Stop | NC Start |
| **QB 97** | | | | | | | | |
| **QB 98** | | | | | | | | |
| **QB 99** | | | | | | | | |

## Signals to spindle (Section 4.2.5)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 100 | Spindle enable | Controller enable | Preset zero | Spindle speed override effective | D | Spindle speed override C | B | A |
| QB 101 | | | Spindle reset | Invert M03/M04 | Gear speed selection automatic | Actual gear speed C | B | A |
| QB 102 | | | | | | | | |
| QB 103 | Set rotation cw | Oscillation speed | Adjusting speed | Spindle position | Resynch. spindle | Ackn. M19 | | PLC spindle control |

## Signals to axis 1 (Section 4.2.4)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 108 | Mirroring | Follow-up mode | Feed enable | *Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | - |
| QB 109 | Jog + | - | Rapid traverse override | | Axis disable | Handwheel 3 active | 2 active | 1 active |
| QB 110 | | | | | | | | |
| QB 111 | | | | | | | | |

## Signals to axis 2 (Section 4.2.4)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 112 | Mirroring | Follow-up mode | Feed enable | *Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | 2nd software limit switch effective - |
| QB 113 | Jog + | Jog - | Rapid traverse override | | Axis disable | 3 active | Handwheel 2 active | Handwheel 1 active |
| QB 114 | | | | | | | | |
| QB 115 | | | | | | | | |

## Signals to axis 3 (Section 4.2.4)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 116 | Mirroring | Follow-up mode | Feed enable | *Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | 2nd software limit switch effective - |
| QB 117 | Jog + | Jog - | Rapid traverse override | | Axis disable | 3 active | Handwheel 2 active | Handwheel 1 active |
| QB 118 | | | | | | | | |
| QB 119 | | | | | | | | |

| Signals to axis 4 (Section 4.2.4) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **QB 120** | Mirroring | Follow-up mode | Feed enable | *Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | 2nd software limit switch effective - |
| **QB 121** | Jog + | Jog - | Rapid traverse override | | Axis disable | 3 active | Handwheel 2 active | Handwheel 1 active |
| **QB 122** | | | | | | | | |
| **QB 123** | | | | | | | | |
| **QB 124** | | | | | | | | |
| **QB 125** | | | | | | | | |
| **QB 126** | | | | | | | | |
| **QB 127** | | | | | | | | |

## 1.5.3 Basic signals

| PLC auxiliary signals (Section 2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **FY 0** | Flashing frequency 1 Hz | | | Channel no. 1). | | | One | Zero |
| **FY 1** | Current OB No. | | | | | | | |
| **FY 2** | Reset | | | | | OB2 | OB1 | |
| **FY 3** | Restart | | | | | OB2 | OB1 | OB20 |
| **FY 4** | | | | | | | | |
| **FY 5** | | | | | | | | |
| **FY 6** | Machining delay | | | | | OB2 | | |
| **FY 7** | | | | | | | | |
| **FY 8** | | | | | | | | Group error I/O devices |
| **FY 9** | | | | | | | | |
| **FY 10** | | | | | | | | |
| **FY 11** | | | | | | | | |

1) As from software version 02

| Signals for alarm-controlled machining (Section 2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **FY 12** | Negative edge | | | | | | | |
| | E n.7 | E n.6 | E n.5 | E n.4 | E n.3 | E n.2 | E n.1 | E n.0 |
| **FY 13** | | | | | | | | |
| **FY 14** | | | | | | | | |
| **FY 15** | | | | | | | | |
| **FY 16** | Positive edge | | | | | | | |
| | E n.7 | E n.6 | E n.5 | E n.4 | E n.3 | E n.2 | E n.1 | E n.0 |
| **FY 17** | | | | | | | | |
| **FY 18** | | | | | | | | |
| **FY 19** | | | | | | | | |

| NC Ready signals (Section 4.1.1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 20 | | | | | | | | |
| FY 21 | | | | | | | | |
| FY 22 | | | | | | | | |
| FY 23 | | | | | | | | RS 232 active |

| Individual signals (Section 4.1.1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 24 | Probe operated 1 | Probe operated 2 | | | NC-BB2 | "Tempera-ture fault (NC-BB1) | Battery fault | NC alarm |

## 1.5.4 Output of auxiliary functions (NC→PLC)

| Modification signals (Section 4.3) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **FY 25** | | | H modification | T modification | S modification | M word 3 modification | M word 2 modification | M word 1 modification |
| **FY 26** | Last auxiliary function | | | | | M word 3 not decoded | M word 2 not decoded | M word 1 not decoded |

| Decoded M signals channel 1 or 2 (M00-M99) (Section 4.3.3) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **FY 27** | Dynamic M signals | | | | | | | |
| | M07 | M06 | M05 | M04 | M03 | M02 | M01 | M00 |
| **FY 28** | Static M signals | | | | | | | |
| | M07 | M06 | M05 | M04 | M03 | M02 | M01 | M00 |
| **FY 29** | Dynamic M signals | | | | | | | |
| | M15 | M14 | M13 | M12 | M11 | M10 | M09 | M08 |
| **FY 30** | Static M signals | | | | | | | |
| | M15 | M14 | M13 | M12 | M11 | M10 | M09 | M08 |
| **FY 31** | Dynamic M signals | | | | | | | |
| | M23 | M22 | M21 | M20 | M19 | M18 | M17 | M16 |
| **FY 32** | Static M signals | | | | | | | |
| | M23 | M22 | M21 | M20 | M19 | M18 | M17 | M16 |
| **FY 33** | Dynamic M signals | | | | | | | |
| | M31 | M30 | M29 | M28 | M27 | M26 | M25 | M24 |
| **FY 34** | Static M signals | | | | | | | |
| | M31 | M30 | M29 | M28 | M27 | M26 | M25 | M24 |
| **FY 35** | Dynamic M signals | | | | | | | |
| | M39 | M38 | M37 | M36 | M35 | M34 | M33 | M32 |
| **FY 36** | Static M signals | | | | | | | |
| | M39 | M38 | M37 | M36 | M35 | M34 | M33 | M32 |
| **FY 37** | Dynamic M signals | | | | | | | |
| | M47 | M46 | M45 | M44 | M43 | M42 | M41 | M40 |
| **FY 38** | Static M signals | | | | | | | |
| | M47 | M46 | M45 | M44 | M43 | M42 | M41 | M40 |
| **FY 39** | Dynamic M signals | | | | | | | |
| | M55 | M54 | M53 | M52 | M51 | M50 | M49 | M48 |

## Decoded M signals channel 1 or 2 (M00 - M99) (Section 4.3.3)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| FY 40 | Static M signals | | | | | | | |
| | M55 | M54 | M53 | M52 | M51 | M50 | M49 | M48 |
| FY 41 | Dynamic M signals | | | | | | | |
| | M63 | M62 | M61 | M60 | M59 | M58 | M57 | M56 |
| FY 42 | Static M signals | | | | | | | |
| | M63 | M62 | M61 | M60 | M59 | M58 | M57 | M56 |
| FY 43 | Dynamic M signals | | | | | | | |
| | M71 | M70 | M69 | M68 | M67 | M66 | M65 | M64 |
| FY 44 | Static M signals | | | | | | | |
| | M71 | M70 | M69 | M68 | M67 | M66 | M65 | M64 |
| FY 45 | Dynamic M signals | | | | | | | |
| | M79 | M78 | M77 | M76 | M75 | M74 | M73 | M72 |
| FY 46 | Static M signals | | | | | | | |
| | M79 | M78 | M77 | M76 | M75 | M74 | M73 | M72 |
| FY 47 | Dynamic M signals | | | | | | | |
| | M87 | M86 | M85 | M84 | M83 | M82 | M81 | M80 |
| FY 48 | Static M signals | | | | | | | |
| | M87 | M86 | M85 | M84 | M83 | M82 | M81 | M80 |
| FY 49 | Dynamic M signals. | | | | | | | |
| | M95 | M94 | M93 | M92 | M91 | M90 | M89 | M88 |
| FY 50 | Static M signals | | | | | | | |
| | M95 | M94 | M93 | M92 | M91 | M90 | M89 | M88 |
| FY 51 | Dynamic M signals | | | | | | | |
| | | | | | M99 | M98 | M97 | M96 |
| FY 52 | Static M signals | | | | | | | |
| | | | | | M99 | M98 | M97 | M96 |

## Auxiliary function words (Section 4.3.3)

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| FY 53 | | | | | | | | |
| FY 54 | Extended M address | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |
| FY 55 | | | | | | | | |
| | M word 1 | | | | | | | |
| FY 56 | | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |
| FY 57 | | | | | | | | |
| FY 58 | Extended M address | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |
| FY 59 | | | | | | | | |
| | M word 2 | | | | | | | |
| FY 60 | | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |
| FY 61 | | | | | | | | |
| FY 62 | Extended M address | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |
| FY 63 | | | | | | | | |
| | M word 3 | | | | | | | |
| FY 64 | | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |

**Auxiliary function words (Section 4.3.2)**

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| FY 65 | | | | | | | | |
| FY 66 | Extended S address | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |
| FY 67 | | | | | | | | |
| FY 68 | | | | S word | | | | |
| FY 69 | | | | | | | | |
| | | $10^3$ | | | | $10^2$ | | |
| FY 70 | | | | | | | | |
| | | $10^1$ | | | | $10^0$ | | |

| Auxiliary function words (Section 4.3.2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **FY 71** | | | | | | | | |
| **FY 72** | | | | | | | | |
| **FY 73** | | | | | | | | |
| **FY 74** | | | | | | | | |
| **FY 75** | | $10^3$ | | T word | | $10^2$ | | |
| **FY 76** | | $10^1$ | | | | $10^0$ | | |
| **FY 77** | | | | | | | | |
| **FY 78** | | | | | | | | |
| **FY 79** | | | | | | | | |
| **FY 80** | | | | | | | | |
| **FY 81** | | $10^3$ | | H word | | $10^2$ | | |
| **FY 82** | | $10^1$ | | | | $10^0$ | | |

| Auxiliary function words (Section 4.3.2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 83 | | | | | | | | |
| FY 84 | | | | | | | | |
| FY 85 | | | | | | | | |
| FY 86 | | | | | | | | |
| FY 87 | | | | | | | | |
| FY 88 | | | | | | | | |
| FY 89 | | | | | | | | |
| FY 90 | | | | | | | | |
| FY 91 | | | | | | | | |

**32 dyn. and stat. M functions with extended address, in accordance with decoding list in DB80 (Section 4.3.2)**

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| FY 92 | Dynamic M signals | | | | | | | |
| FY 93 | Static M signals | | | | | | | |
| FY 94 | Dynamic M signals | | | | | | | |
| FY 95 | Static M signals | | | | | | | |
| FY 96 | Dynamic M signals | | | | | | | |
| FY 97 | Static M signals | | | | | | | |
| FY 98 | Dynamic M signals | | | | | | | |
| FY 99 | Static M signals | | | | | | | |

## 1.6 Error and operational messages (PLC→NC)

| Error messages (Section 5.2) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 100 | 6007 | 6006 | 6005 | 6004 | 6003 | 6002 | 6001 | 6000 |
| FY 101 | 6015 | 6014 | 6013 | 6012 | 6011 | 6010 | 6009 | 6008 |
| FY 102 | 6023 | 6022 | 6021 | 6020 | 6019 | 6018 | 6017 | 6016 |
| FY 103 | 6031 | 6030 | 6029 | 6028 | 6027 | 6026 | 6025 | 6024 |
| FY 104 | 6039 | 6038 | 6037 | 6036 | 6035 | 6034 | 6033 | 6032 |
| FY 105 | 6047 | 6046 | 6045 | 6044 | 6043 | 6042 | 6041 | 6040 |
| FY 106 | 6055 | 6054 | 6053 | 6052 | 6051 | 6050 | 6049 | 6048 |
| FY 107 | 6063 | 6062 | 6061 | 6060 | 6059 | 6058 | 6057 | 6056 |

| Operational messages (Section 5.3) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 108 | 7007 | 7006 | 7005 | 7004 | 7003 | 7002 | 7001 | 7000 |
| FY 109 | 7015 | 7014 | 7013 | 7012 | 7011 | 7010 | 7009 | 7008 |
| FY 110 | 7023 | 7022 | 7021 | 7020 | 7019 | 7018 | 7017 | 7016 |
| FY 111 | 7031 | 7030 | 7029 | 7028 | 7027 | 7026 | 7025 | 7024 |
| FY 112 | 7039 | 7038 | 7037 | 7036 | 7035 | 7034 | 7033 | 7032 |
| FY 113 | 7047 | 7046 | 7045 | 7044 | 7043 | 7042 | 7041 | 7040 |
| FY 114 | 7055 | 7054 | 7053 | 7052 | 7051 | 7050 | 7049 | 7048 |
| FY 115 | 7063 | 7062 | 7061 | 7060 | 7059 | 7058 | 7057 | 7056 |

## 1.7 PLC machine data

| Machine data bits MD 3000 - 3003 (Section 6) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 116 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| FY 117 | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 |
| FY 118 | Bit 23 | Bit 22 | Bit 21 | Bit 20 | Bit 19 | Bit 18 | Bit 17 | Bit 16 |
| FY 119 | Bit 31 | Bit 30 | Bit 29 | Bit 28 | Bit 27 | Bit 26 | Bit 25 | Bit 24 |

| Machine data words MD 1000 - 1007 (Section 6) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 120 | | | | Word 1 | | | | |
| FY 121 | | | | | | | | |
| FY 122 | | | | Word 2 | | | | |
| FY 123 | | | | | | | | |
| FY 124 | | | | Word 3 | | | | |
| FY 125 | | | | | | | | |

| Machine data words MD 1000 - 1007 (Section 6) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FY 126 | | | | Word 4 | | | | |
| FY 127 | | | | | | | | |
| FY 128 | | | | Word 5 | | | | |
| FY 129 | | | | | | | | |
| FY 130 | | | | Word 6 | | | | |
| FY 131 | | | | | | | | |
| FY 132 | | | | Word 7 | | | | |
| FY 133 | | | | | | | | |
| FY 134 | | | | Word 8 | | | | |
| FY 135 | | | | | | | | |

## 1.8 Data transfer interface

## Data transfer PLC/NC (DB36)

| Status data transfer (Section 4.4.2) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. Interface byte | Byte No. | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| | | Bit No. 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 1 | DL 0 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |
| 2 | DR 0 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |
| 3 | DL 1 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |
| 4 | DR 1 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |
| 5 | DL 2 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |
| | | | | | | | | | |
| 62 | DR 30 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |
| 63 | DL 31 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |
| 64 | DR 31 | Error Value 1- Value 3 / Num. format | | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |

| Status data transfer (Section 4.4.2) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. interface byte | Byte No. | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| | | Bit No. | | | | | | | |
| | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 65 | DL 32 | Error Value 1-Value 3 | Error Num. format | Access disabled message | Data transfer ended | Data transfer assigned | Data transfer busy | Fifo assigned | Data transfer requested |

Notes:

1) If the PLC goes into the stop state because of a parameterizing error, the number of the interface byte is entered in the high-order byte of ACCU 2.
2) If several jobs are entered in the buffer for data transfer, a job with the number 65 is processed before the others.
3) Data transfer is effected by function blocks FB61 (READ) and FB62 (WRITE).

## 1.9 Serial interface (DB 37) (as from software version 02)

**Interface signals (Section 4.5)**

| Byte No. | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|---|
| | Bit No. | | | | | | | |
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| DL 0 | | | | | | | | RS 232 active |
| DR 0 | | | | | | | | |

**Signals for data transfer (Section 4.5)**

| Byte No. | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|---|
| | Bit No. | | | | | | | |
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| DL 1 | | | | | | RS 232 abort | Data start output | Data start input |
| DR 1 | | | | | | | Data transfer fault | Data transfer ended |
| DW 2 | Data type for data output | | | | | | | |
| DW 3 | Data type for data output | | | | | | | |
| DW 4 | Start No. | | | | | | | |
| DW 5 | End No. | | | | | | | |
| DL 6 | Channel No. | | | | | | | |

| DATA TYPE FOR DATA OUTPUT (DB37;DW2,3) (KC) | MEANING | START NO. (DB37;DW4) (BCD) | END NO. (DB37;DW5) (BCD) | CHANNEL NO. (DB37;DL6) (BCD) |
|---|---|---|---|---|
| MPF | Part program | 0 - 9999 | 0 - 9999 | - |
| SPF | Subroutine | 1 - 999 | 1 - 999 | - |
| TOA | Tool offsets | 1 - 99 | 1 - 99 | - |
| RPA | R parameters | | | |
| | - channel-specific | 0 - 499 | 0 - 499 | 1 - 2 |
| | - central | 900 - 999 | 900 - 999 | 0 |
| TEA1 | NC machine data | - | - | - |
| TEA2 | PLC machine data | - | - | - |
| ZOA | Zero offsets | - | - | 0 |
| | (G54 - G57) | - | - | |
| | Angular offset | - | - | 1 - 2 |
| SEA | NC setting data | - | - | - |

## 1.10 Digital link (DB 70)
## SIMODRIVE staus messages (as from software version 02)

| Byte No. | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|---|
| | Bit No. | | | | | | | |
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| DL 0 | | | | | | Spindle requested 2 | 1 | Axis requested 6 |
| DR 0 | Axis requested 5 | 4 | 3 | 2 | 1 | Device requested 3 | 2 | |
| DL 1 | | | | | | Spindle acknowledged 2 | 1 | Axis acknowl. 6 |
| DR 1 | Axis acknowledged 5 | 4 | 3 | 2 | 1 | Device acknowledged 3 | 2 | 1 |
| DW 2 | Status device 1 | | | | | | | |
| DW 3 | Status device 2 | | | | | | | |
| DW 4 | Status device 3 | | | | | | | |
| DW 5 | Status axis 1 | | | | | | | |
| DW 6 | Status axis 2 | | | | | | | |
| DW 7 | Status axis 3 | | | | | | | |
| DW 8 | Status axis 4 | | | | | | | |
| DW 9 | Status axis 5 | | | | | | | |
| DW 10 | Status axis 6 | | | | | | | |

**Note:**
For detailed information on the signals refer to "Reference Manual and Installation Guide SIMODRIVE" (6SC6101-D SW02 with digital link to 810GA2/820 SW02).

| | | |
|---|---|---|
| DW 11 | Status spindle 1 word 1 | |
| DW 12 | Status spindle 1 word 2 | |
| DW 13 | Status spindle 2 word 1 | |
| DW 14 | Status spindle 2 word 2 | |

# 2 Description of Basic Signals

### ZERO

Flag with defined zero signal.

The flags are used to switch FB parameters which are not required but must assume a certain signal state, or to produce a defined result of logic operation (RLO).

### ONE

Flag with defined one signal.

### CHANNEL NO.

| F0.3 | F0.2 | Channel No. |
|---|---|---|
| 0 | 1 | 1 |
| 1 | 0 | 2 |
| 1 | 1 | 3 |

The channel no. indicates the channel to which the screen display is set.

### FLASHING FREQUENCY, 1 Hz

The PLC operating system provides a flashing frequency of 1 Hz. The pulse/no-pulse ratio is 1:1.

Example of application:

Flashing displays of error messages.

### ACTUAL OB No.

OB No. from which a branch was made into the user program (fixed-point number).

| No. | Allocated OBs | |
|---|---|---|
| 1 | OB 1 | Cyclic program (user) |
| 2 | OB 2 | Alarm-controlled program |

### RESET (OB1, OB2)

1 signal: a) After warm restart (e.g. by Power On)
0 signal: b) After first complete processing of the plane concerned.

Application note:

Using this signal, program parts can be put into a defined initial state after Power On.

### RESTART (OB 20, OB 1, OB 2)

1 signal: After PLC operator initiates the cold restart.
0 signal: After first complete processing of the applicable organization block.

Application note:

Using this signal, program parts can be put into a defined initial state after Restart.

### PROCESSING TIME DELAY (OB 2)

If the alarm-controlled processing is called again before it has been completed, the corresponding bit is set in FY6.

### GROUP ERROR I/O DEVICES

This flag is set if the PLC does not go into the STOP state when a PLC error occurs. Evaluate data word 1 DW8!

### NEGATIVE EDGE

1 signal: A change in signal state from 1 to 0 has occurred at the corresponding bit in the alarm input byte.
0 signal: Otherwise

### POSITIVE EDGE

1 signal: A change in signal state from 0 to 1 has occurred at the corresponding bit in the alarm input byte.
0 signal: Otherwise

# 3 Description of Machine Control Panel Signals

## 3.1 Versions of machine control panel

The 810 T/M controls can be used with different versions of control panel; the input bytes must be assigned as in Section 1.3.

A) Using the integrated machine control panel:

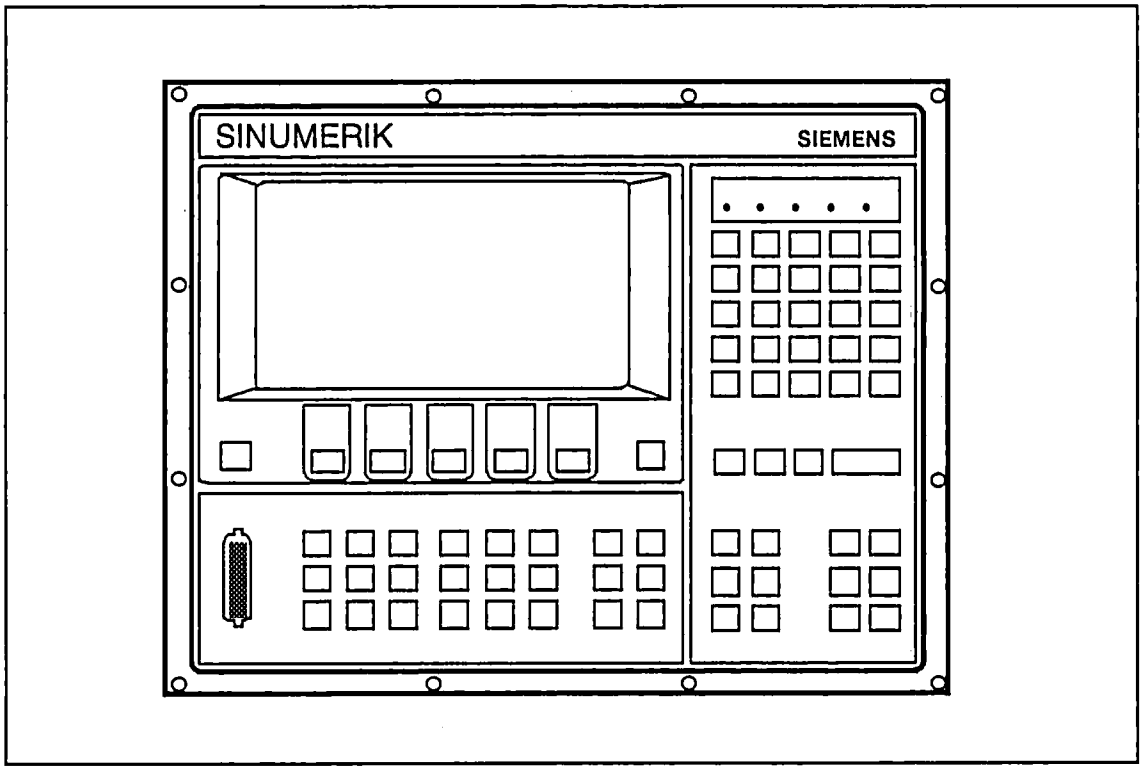



*Fig.3.1*

B) Using an external machine control panel without the integrated operator panel:

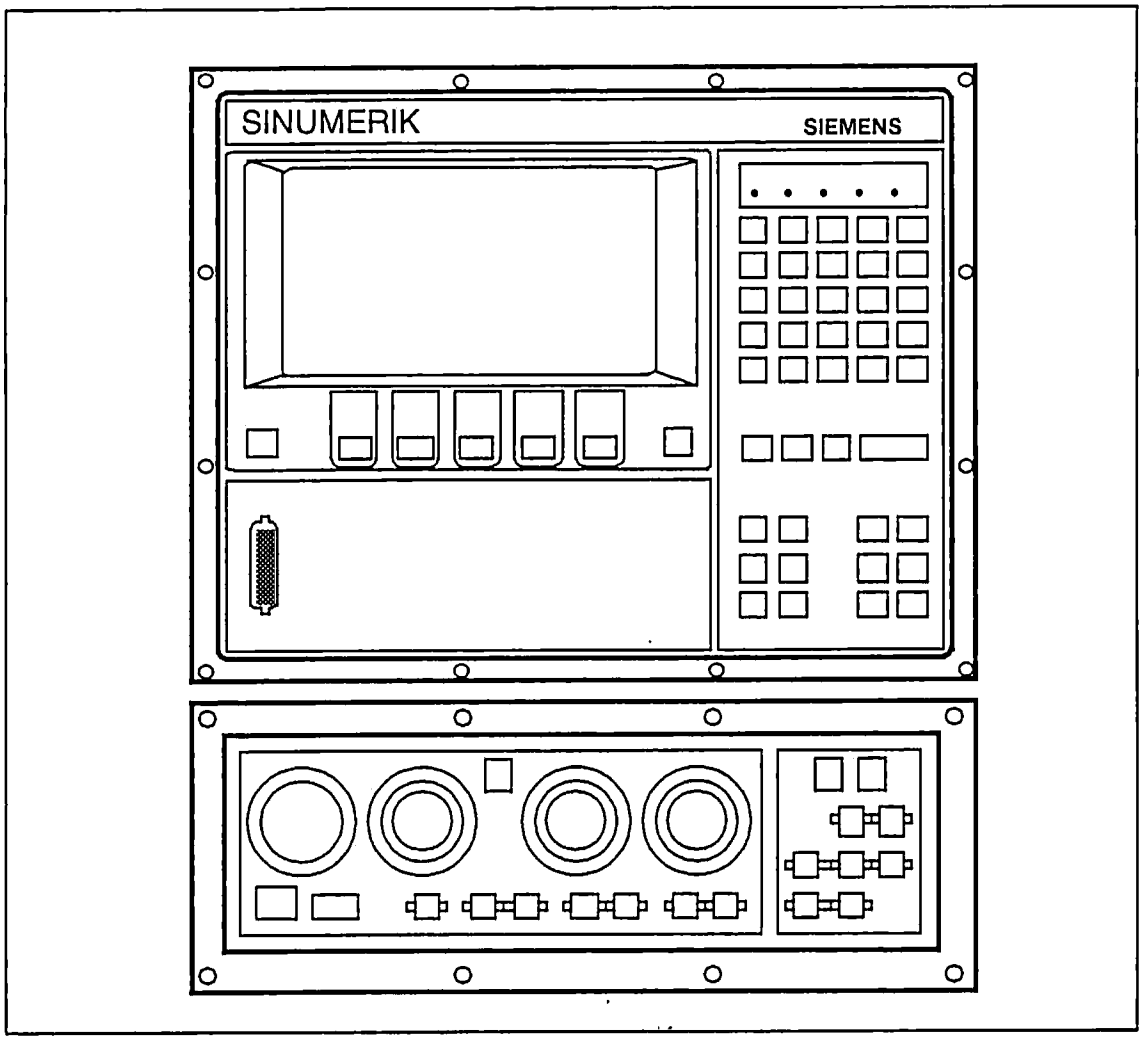



*Fig. 3.2*

C) Connection of an external machine control panel using the integrated operator panel as a freely assignable keyboard:

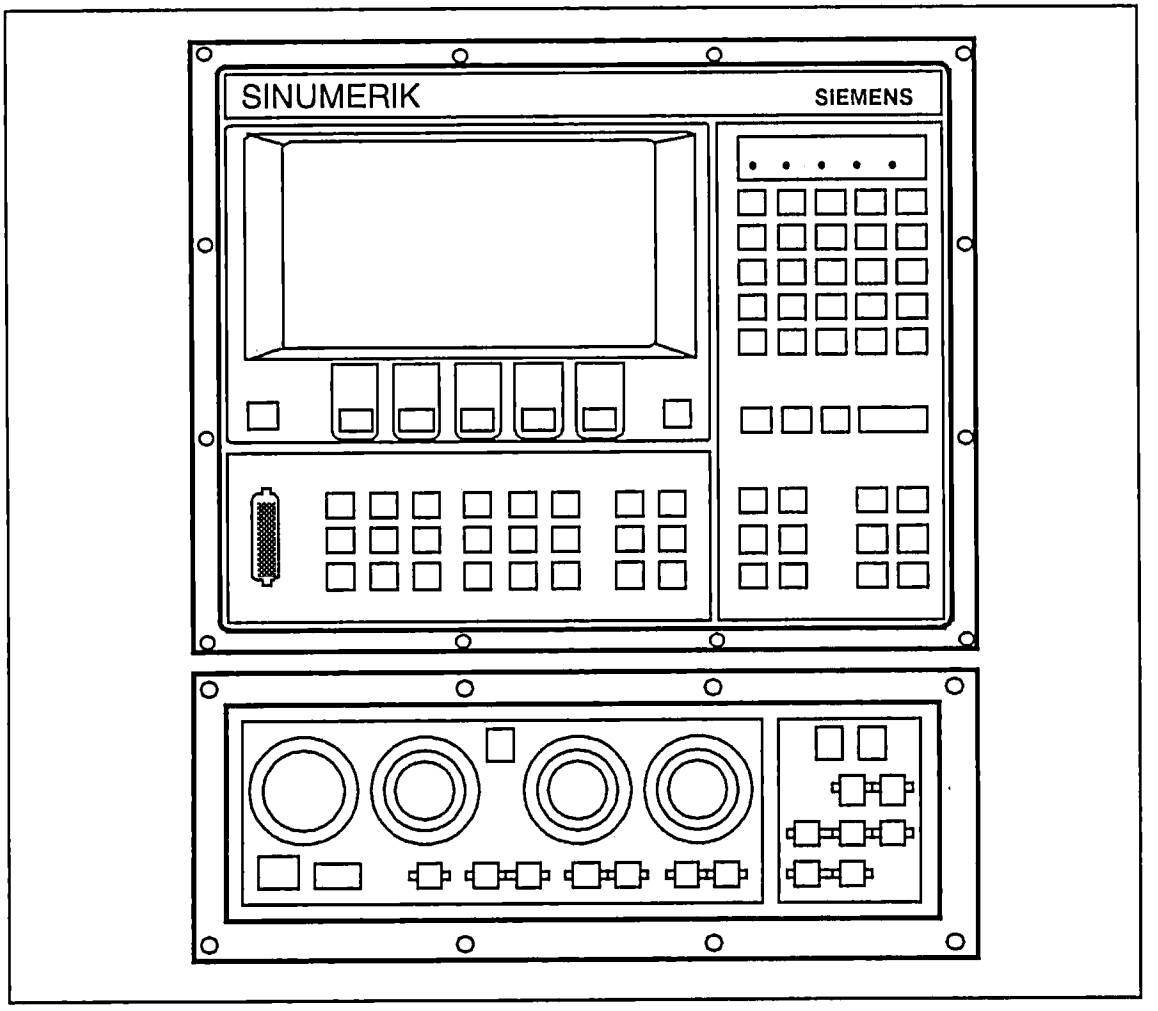



*Fig. 3.3*

## 3.2 Integrated machine control panel

### 3.2.1 Description of integrated machine control panel

If the integrated machine control panel is used, the function keys are assigned according to the figure below:

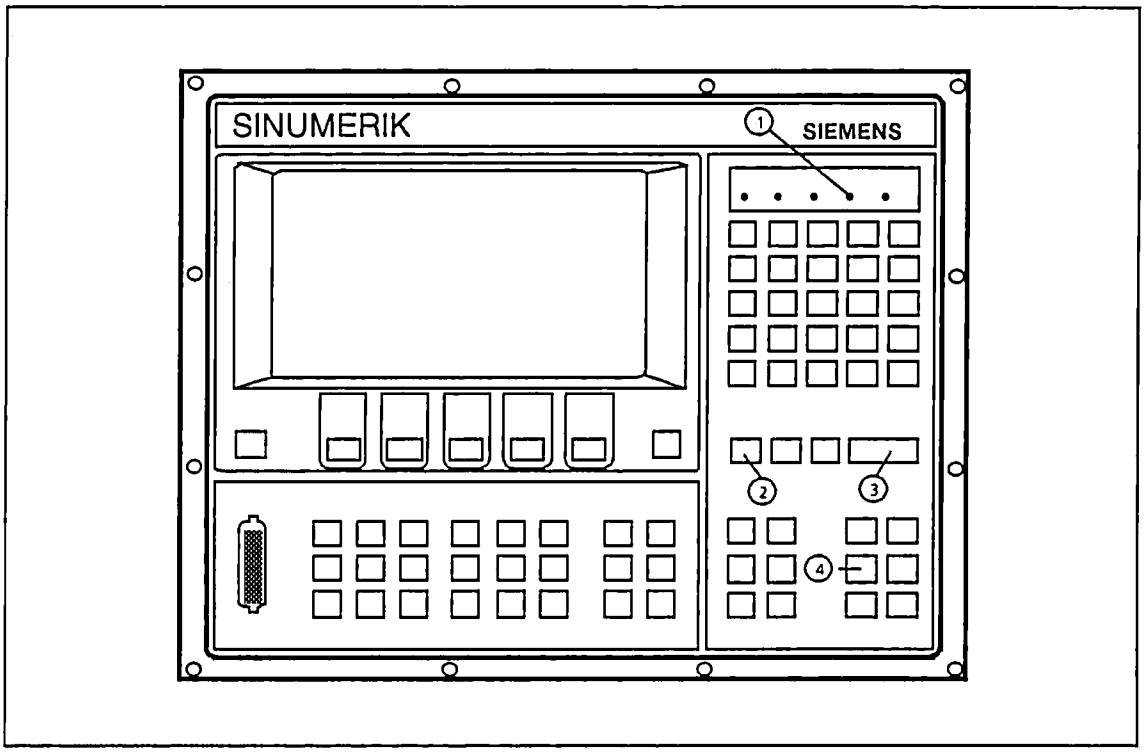



*Fig. 3.4*

1: PROGRAM RUNNING lamp (Section 4.1.2)
2: CANCEL key (Section 4.3.1.3)
3: INPUT key (Section 4.3.1.3)
4: ACKNOWLEDGE ALARM key (Section 5.2)

## 3.2.2 Numbering of keys on the integrated machine control panel

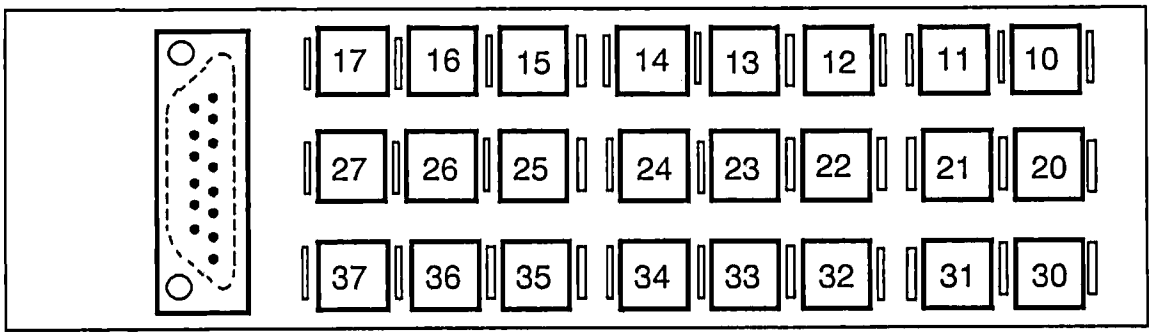



*Fig.3.5*

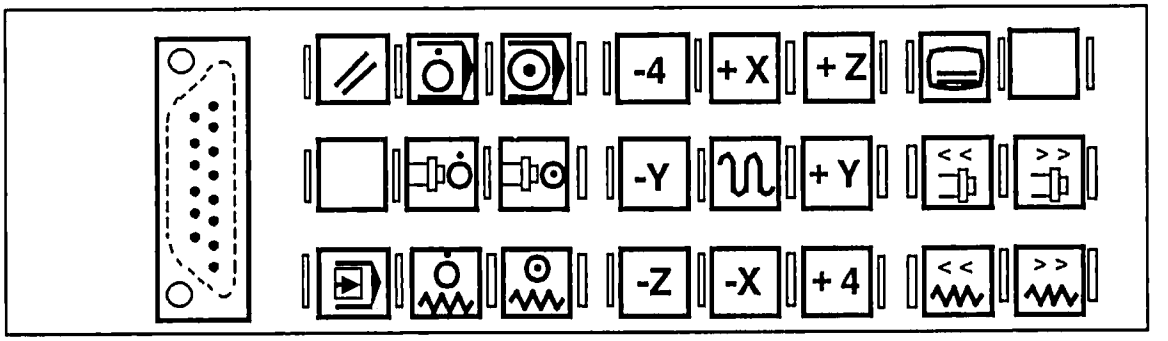


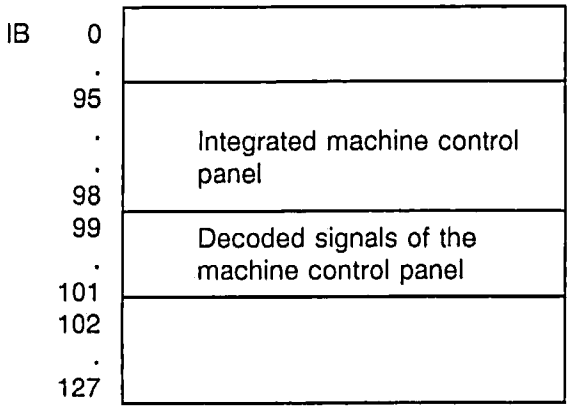

*Fig.3.6*

Operator controls for SINUMERIK 810 T and 810 M:

| Key | Assignment |
|---|---|
| 10 | Reserved |
| 11 | Mode selection |
| 12 | Direction key |
| 13 | Direction key |
| 14 | Direction key |
| 15 | NC Start |
| 16 | NC Stop |
| 17 | Reset |
| 20 | Spindle speed override increase |
| 21 | Spindle speed override decrease |
| 22 | Direction key |
| 23 | Rapid traverse override |
| 24 | Direction key |
| 25 | Spindle ON |
| 26 | Spindle OFF |
| 27 | Reserved |
| 30 | Feed override increase |
| 31 | Feed override decrease |
| 32 | Direction key |
| 33 | Direction key |
| 34 | Direction key |
| 35 | Feed ON |
| 36 | Feed OFF |
| 37 | Single block |

## 3.2.3 Signals of the integrated machine control panel SINUMERIK 810 T/M




### SPINDLE OVERRIDE SWITCH

The spindle override switch is simulated by the two spindle speed override INCREASE/ DECREASE keys on the integrated machine control panel. In input byte 95, the following value is displayed on the CRT display in percent (Gray code):

| Position | Code D | C | B | A | Correction value in percent |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | 50 |
| 2 | 0 | 0 | 1 | 1 | 55 |
| 3 | 0 | 0 | 1 | 0 | 60 |
| 4 | 0 | 1 | 1 | 0 | 65 |
| 5 | 0 | 1 | 1 | 1 | 70 |
| 6 | 0 | 1 | 0 | 1 | 75 |
| 7 | 0 | 1 | 0 | 0 | 80 |
| 8 | 1 | 1 | 0 | 0 | 85 |
| 9 | 1 | 1 | 0 | 1 | 90 |
| 10 | 1 | 1 | 1 | 1 | 95 |
| 11 | 1 | 1 | 1 | 0 | 100 |
| 12 | 1 | 0 | 1 | 0 | 105 |
| 13 | 1 | 0 | 1 | 1 | 110 |
| 14 | 1 | 0 | 0 | 1 | 115 |
| 15 | 1 | 0 | 0 | 0 | 120 |

Notes:

1) The percentage values given in the table are standard values which are stored as machine data. If necessary, they can be changed. The screen always displays the value defined in corresponding machine data (e.g. it is also possible to set 77% for a "switch" setting and to display it).

2) The codings of the spindle override can be transferred unchanged from input byte 95 to the PLC/NC interface (QB 100, see Section 4.2.5).

3) If both keys (INCREASE/DECREASE) are pressed simultaneously, the override instantly jumps to the first value (50%).

### MODE SELECTOR

When the MODE selector key of the integrated machine control panel is pressed, the softkey menu for mode selection is displayed on the CRT. The operating mode can then be selected by these softkeys.

| Position | Code D | C | B | A | Operating mode |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | PRESET |
| 2 | 0 | 0 | 1 | 1 | (no output) |
| 3 | 0 | 0 | 1 | 0 | MDA |
| 4 | 0 | 1 | 1 | 0 | JOG |
| 5 | 0 | 1 | 1 | 1 | INCR 1 |
| 6 | 0 | 1 | 0 | 1 | " 10 |
| 7 | 0 | 1 | 0 | 0 | " 100 |
| 8 | 1 | 1 | 0 | 0 | " 1000 |
| 9 | 1 | 1 | 0 | 1 | " 10000 |
| 10 | 1 | 1 | 1 | 1 | REPOS |
| 11 | 1 | 1 | 1 | 0 | (no output) |
| 12 | 1 | 0 | 1 | 0 | AUT |
| 13 | 1 | 0 | 1 | 1 | REF |

Note:

The codings for the operating modes can be transferred unchanged from input byte 95 to the PLC/NC interface (QB 82, see Section 3.5).

### RAPID TRAVERSE OVERRIDE

1 signal: RAPID TRAVERSE OVERRIDE key is pressed.

Note:

The signal is output only if the JOG or REPOS modes are active.

### SPINDLE ON

1 signal: Spindle ON key pressed.

### SPINDLE *OFF

0 signal: Spindle *OFF key pressed.
1 signal: Spindle *OFF key not pressed.

**FEED ON**

1 signal: Feed ON key pressed.

**FEED *OFF**

0 signal: Feed *OFF key pressed.
1 signal: Feed *OFF key not pressed.

**NC START**

1 signal: NC START key pressed.

***NC STOP**

0 signal: *NC STOP key pressed.
1 signal: *NC STOP key not pressed.

**RESET**

signal 1: RESET key pressed.

**SINGLE BLOCK**

0 signal: SINGLE BLOCK key pressed the first time.
(Setting of the self-retaining SINGLE BLOCK signal).
1 signal: SINGLE BLOCK key pressed the second time.
(Reset of the self-retaining SINGLE BLOCK signal).

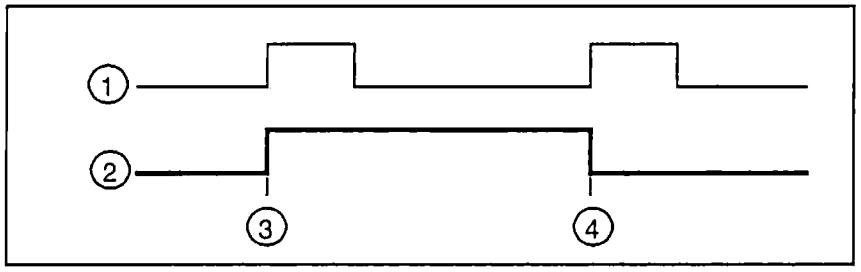



*Fig.3.7*

1: SINGLE BLOCK key pressed.
2: SINGLE BLOCK signal, self-retaining
3: Setting the SINGLE BLOCK signal
4: Resetting the SINGLE BLOCK signal

Note:

The SINGLE BLOCK key and the self-retaining function of the SINGLE BLOCK signal simulate the SINGLE BLOCK switch on the machine control panel which otherwise acts statically.

## FEED OVERRIDE SWITCH

The feed override switch is simulated by means of the two INCREASE/DECREASE feed override keys on the integrated machine control panel. In input byte 98, the following code (Gray code) is shown in accordance with the override value displayed in percent:

| Position | Code E | D | C | B | A | Override value in percent |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 0 | 1 | 1 | 1 |
| 3 | 0 | 0 | 0 | 1 | 0 | 2 |
| 4 | 0 | 0 | 1 | 1 | 0 | 4 |
| 5 | 0 | 0 | 1 | 1 | 1 | 6 |
| 6 | 0 | 0 | 1 | 0 | 1 | 8 |
| 7 | 0 | 0 | 1 | 0 | 0 | 10 |
| 8 | 0 | 1 | 1 | 0 | 0 | 20 |
| 9 | 0 | 1 | 1 | 0 | 1 | 30 |
| 10 | 0 | 1 | 1 | 1 | 1 | 40 |
| 11 | 0 | 1 | 1 | 1 | 0 | 50 |
| 12 | 0 | 1 | 0 | 1 | 0 | 60 |
| 13 | 0 | 1 | 0 | 1 | 1 | 70 |
| 14 | 0 | 1 | 0 | 0 | 1 | 75 |
| 15 | 0 | 1 | 0 | 0 | 0 | 80 |
| 16 | 1 | 1 | 0 | 0 | 0 | 85 |
| 17 | 1 | 1 | 0 | 0 | 1 | 90 |
| 18 | 1 | 1 | 0 | 1 | 1 | 95 |
| 19 | 1 | 1 | 0 | 1 | 0 | 100 |
| 20 | 1 | 1 | 1 | 1 | 0 | 105 |
| 21 | 1 | 1 | 1 | 1 | 1 | 110 |
| 22 | 1 | 1 | 1 | 0 | 1 | 115 |
| 23 | 1 | 1 | 1 | 0 | 0 | 120 |

Notes:

1) The percentage values given in the table are standard values which are stored as machine data. If necessary, they can be changed (except code 00001).
   The CRT always displays the value which has been assigned for the corresponding machine data (e.g. it is also possible to assign 77% for a "switch" setting and to display this).

2) The codings of the feed override can be transferred unchanged from input byte 98 to the PLC/NC interface (QB 84, see Section 4.2.3).

3) If both keys (INCREASE/DECREASE) are pressed simultaneously, the override jumps immediately to the first value (0%).

## 3.2.4 Decoded signals of the machine control panel SINUMERIK 810 T/M

### DIRECTION KEYS

The signals of all direction keys are prepared in input byte 99.

## 3.3 External machine control panel SINUMERIK 810 T/M

## 3.3.1 Description of external machine control panel

### SINUMERIK 810 T

1 signal: The corresponding direction key of the X, Z, Q1 or Q2 axis is pressed.
0 signal: The corresponding direction key of the X, Z, Q1 or Q2 axis is not pressed.

### SINUMERIK 810 M

1 signal: The corresponding direction key of the X, Y, Z or 4th axis is pressed.
0 signal: The corresponding direction key of the X, Y, Z or 4th axis is not pressed.

### HANDWHEEL SELECTION 1 (2, 3)

The axes are assigned to the handwheels by the setting data for axes and the softkey function and the associated bit is set in input byte IB 100 (101).

1 signal: Handwheel is to be active in the corresponding axis.
0 signal: Handwheel operation for the corresponding axis not selected.

Note:

Only one axis can be active at a time for a handwheel.
If a second axis is active for the handwheel, the first axis is automatically deactivated.
When using the external machine control panel, the function key and switch assignments shown in Figs. 3.8 and 3.9 apply.

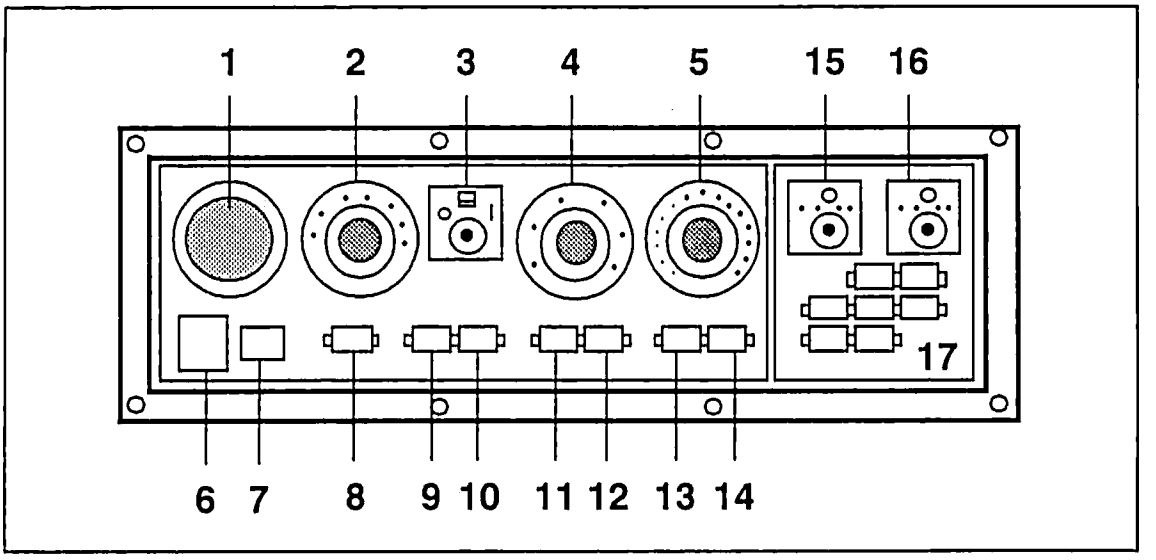



*Fig. 3.8 External machine control panel SINUMERIK 810 T*

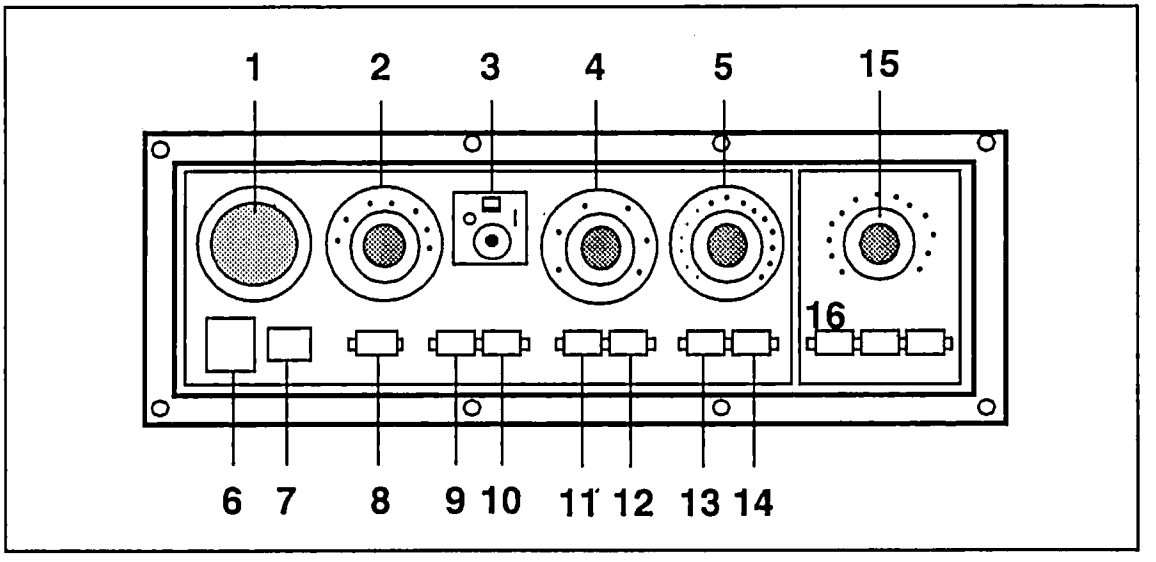



*Fig 3.9 External machine control panel SINUMERIK 810 M*

## Operator controls for SINUMERIK 810 T and 810 M

| Number | Operator control element |
|---|---|
| 1 | EMERGENCY STOP switch |
| 2 | Mode selector |
| 3 | SINGLE BLOCK switch |
| 4 | Spindle override switch |
| 5 | Feed override switch/rapid traverse override |
| 6 | NC ON key |
| 7 | Key-operated switch |
| 8 | RESET key |
| 9 | NC STOP key |
| 10 | NC START key |
| 11 | Spindle OFF key |
| 12 | Spindle ON key |
| 13 | Feed OFF key |
| 14 | Feed ON key |

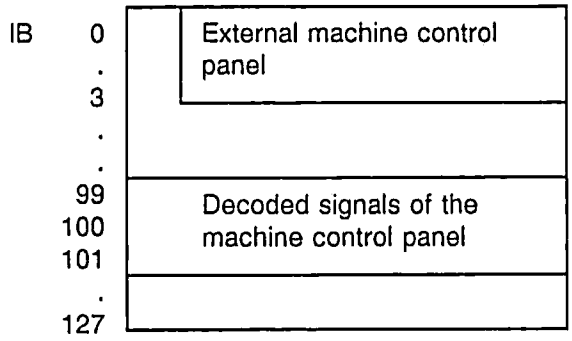
## Operator control elements for 810 T

| Number | Operator control element |
|---|---|
| 15 | Reserved |
| 16 | AUXILIARY AXIS selector |
| 17 | Direction keys, rapid traverse override |

## Operator control elements for 810 M

| Number | Operator control element |
|---|---|
| 15 | AXIS selector |
| 16 | Direction keys, rapid traverse override |

## 3.3.2 Signals of the external machine control panel SINUMERIK 810 T




### SPINDLE OVERRIDE SWITCH

The spindle override switch on the external machine control panel transfers the following code to input byte 0 in accordance with the set position (Gray code):

| Position | Code D | C | B | A | Override value in % |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | 50 |
| 2 | 0 | 0 | 1 | 1 | 55 |
| 3 | 0 | 0 | 1 | 0 | 60 |
| 4 | 0 | 1 | 1 | 0 | 65 |
| 5 | 0 | 1 | 1 | 1 | 70 |
| 6 | 0 | 1 | 0 | 1 | 75 |
| 7 | 0 | 1 | 0 | 0 | 80 |
| 8 | 1 | 1 | 0 | 0 | 85 |
| 9 | 1 | 1 | 0 | 1 | 90 |
| 10 | 1 | 1 | 1 | 1 | 95 |
| 11 | 1 | 1 | 1 | 0 | 100 |
| 12 | 1 | 0 | 1 | 0 | 105 |
| 13 | 1 | 0 | 1 | 1 | 110 |
| 14 | 1 | 0 | 0 | 1 | 115 |
| 15 | 1 | 0 | 0 | 0 | 120 |
| 16 | 1 | 0 | 0 | 0 | 120 |

Notes:

1) The percentage values given in the table are standard values which are stored as machine data. If necessary, they can be changed.

2) The codings of the spindle override can be transferred unchanged from input byte 0 to the PLC/NC interface (QB 100, see Section 4.2.5).

## MODE SELECTOR

The mode selector on the external machine control panel transfers the following code (Gray code) to input byte 0 in accordance with the set position:

| Position | Code D | C | B | A | Mode |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | PRESET |
| 2 | 0 | 0 | 1 | 1 | MDA |
| 3 | 0 | 0 | 1 | 0 | MDA |
| 4 | 0 | 1 | 1 | 0 | JOG |
| 5 | 0 | 1 | 1 | 1 | INCR 1 |
| 6 | 0 | 1 | 0 | 1 | " 10 |
| 7 | 0 | 1 | 0 | 0 | " 100 |
| 8 | 1 | 1 | 0 | 0 | " 1000 |
| 9 | 1 | 1 | 0 | 1 | " 10000 |
| 10 | 1 | 1 | 1 | 1 | REPOS |
| 11 | 1 | 1 | 1 | 0 | AUT |
| 12 | 1 | 0 | 1 | 0 | AUT |
| 13 | 1 | 0 | 1 | 1 | REF |
| 14 | 1 | 0 | 0 | 1 | (REF) |
| 15 | 1 | 0 | 0 | 0 | (REF) |
| 16 | 1 | 0 | 0 | 0 | (REF) |

Note:

The codings of the modes can be transferred unchanged from input byte 0 to the PLC/NC interface (QB 82, see Section 4.2.2).

## DIRECTION KEYS X+, X-

1 signal: X+ or X- key pressed.
0 signal: X+ or X- key not pressed.

## RAPID TRAVERSE OVERRIDE

1 signal: RAPID TRAVERSE OVERRIDE key pressed.
0 signal: RAPID TRAVERSE OVERRIDE key not pressed.

## DIRECTION KEYS Q+, Q-

1 signal: Q+ or Q- key pressed.
0 signal: Q+ or Q- key not pressed.

**AUXILIARY AXIS**

1 signal: Auxiliary axis selector in position Q1.
0 signal: Auxiliary axis selector in position Q2.

Note:

In connection with the codings for the handwheel, this signal serves
a) to select the auxiliary axis in which the handwheel is to be effective,
b) to select in which auxiliary axis the Q+ and Q- direction keys are to be active.
(See also decoded signals.)

**DIRECTION KEYS Z+, Z-**

1 signal: Z+ or Z- key pressed.
0 signal: Z+ or Z- key not pressed.

**SPINDLE ON**

1 signal: Spindle ON key pressed.

**SPINDLE *OFF**

1 signal: Spindle *OFF key pressed.
0 signal: Spindle *OFF key not pressed.

**FEED ON**

1 signal: Feed ON key pressed.

**FEED *OFF**

1 signal: Feed *OFF key pressed.
0 signal: Feed *OFF key not pressed.

***NC-STOP**

0 signal: *NC STOP key pressed.
1 signal: *NC STOP key not pressed.

**RESET**

1 signal: RESET key pressed.

**KEY-OPERATED SWITCH**

1 signal: Key-operated switch in position 1.

**SINGLE BLOCK**

1 signal: SINGLE BLOCK switch at 1.

## FEED OVERRIDE SWITCH

The feed override switch on the external machine control panel transfers the following code to input byte 3 in accordance with the set position:

| Position | Code E | D | C | B | A | Override value in % |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 0 | 1 | 1 | 1 |
| 3 | 0 | 0 | 0 | 1 | 0 | 2 |
| 4 | 0 | 0 | 1 | 1 | 0 | 4 |
| 5 | 0 | 0 | 1 | 1 | 1 | 6 |
| 6 | 0 | 0 | 1 | 0 | 1 | 8 |
| 7 | 0 | 0 | 1 | 0 | 0 | 10 |
| 8 | 0 | 1 | 1 | 0 | 0 | 20 |
| 9 | 0 | 1 | 1 | 0 | 1 | 30 |
| 10 | 0 | 1 | 1 | 1 | 1 | 40 |
| 11 | 0 | 1 | 1 | 1 | 0 | 50 |
| 12 | 0 | 1 | 0 | 1 | 0 | 60 |
| 13 | 0 | 1 | 0 | 1 | 1 | 70 |
| 14 | 0 | 1 | 0 | 0 | 1 | 75 |
| 15 | 0 | 1 | 0 | 0 | 0 | 80 |
| 16 | 1 | 1 | 0 | 0 | 0 | 85 |
| 17 | 1 | 1 | 0 | 0 | 1 | 90 |
| 18 | 1 | 1 | 0 | 1 | 1 | 95 |
| 19 | 1 | 1 | 0 | 1 | 0 | 100 |
| 20 | 1 | 1 | 1 | 1 | 0 | 105 |
| 21 | 1 | 1 | 1 | 1 | 1 | 110 |
| 22 | 1 | 1 | 1 | 0 | 1 | 115 |
| 23 | 1 | 1 | 1 | 0 | 0 | 120 |
| 24 | 1 | 0 | 1 | 0 | 0 | |
| 25 | 1 | 0 | 1 | 0 | 1 | |
| 26 | 1 | 0 | 1 | 1 | 1 | |
| 27 | 1 | 0 | 1 | 1 | 0 | |
| 28 | 1 | 0 | 0 | 1 | 0 | |
| 29 | 1 | 0 | 0 | 1 | 1 | |
| 30 | 1 | 0 | 0 | 0 | 1 | |
| 31 | 1 | 0 | 0 | 0 | 0 | |

Notes:

1) The percentage values given in the table are stored as machine data. As standard, only the machine data for positions 1 to 23 are entered; the machine data not assigned can, however, be entered later. Accordingly, it is possible to evaluate the codes of positions 24 to 31 which are supplied by a connected coding switch or a PLC program.

2) The codings of the feed override can be transferred unchanged from input byte 3 to the PLC/NC interface (QB 84, see Section 4.2.3).

## 3.3.3 Decoded signals of the external machine control panel SINUMERIK 810T

### DIRECTION KEYS

The signals of all direction keys are held additionally decoded in input byte 99. The decoding evaluates:

- the AUXILIARY AXIS signal
- the X, Q, Z DIRECTION KEY signals.

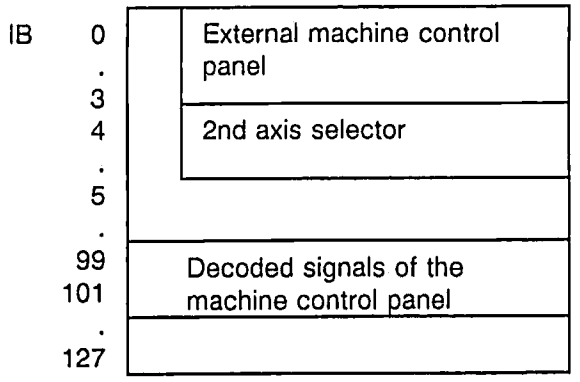
1 signal: The corresponding direction key of the X, Z, Q, or Q2 axis is pressed.
0 signal: The corresponding direction key of the X, Z, Q, or Q2 axis is not pressed.

Note:

The decoding function checks whether invalid key combinations have been operated (e.g. X+ and X- pressed together). Only valid bit combinations are held in input byte 99; in the case of invalid key combinations, IB99 is assigned the value 0.

## 3.3.4 Signals of the external machine control panel SINUMERIK 810 M




### SPINDLE OVERRIDE SWITCH

The spindle override switch on the external machine control panel transfers the following code to input byte 0 in accordance with the set position (Gray code):

| Position | Code D | C | B | A | Override value in % |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | 50 |
| 2 | 0 | 0 | 1 | 1 | 55 |
| 3 | 0 | 0 | 1 | 0 | 60 |
| 4 | 0 | 1 | 1 | 0 | 65 |
| 5 | 0 | 1 | 1 | 1 | 70 |
| 6 | 0 | 1 | 0 | 1 | 75 |
| 7 | 0 | 1 | 0 | 0 | 80 |
| 8 | 1 | 1 | 0 | 0 | 85 |
| 9 | 1 | 1 | 0 | 1 | 90 |
| 10 | 1 | 1 | 1 | 1 | 95 |
| 11 | 1 | 1 | 1 | 0 | 100 |
| 12 | 1 | 0 | 1 | 0 | 105 |
| 13 | 1 | 0 | 1 | 1 | 110 |
| 14 | 1 | 0 | 0 | 1 | 115 |
| 15 | 1 | 0 | 0 | 0 | 120 |
| 16* | 1 | 0 | 0 | 0 | 120 |

* Position 16 is assigned the same override value as position 15l

Notes:

1) The percentage values given in the table are standard values which are stored as machine data. If necessary, they can be changed.

2) The codings of the spindle offset can be transferred unchanged from input byte 0 to the PLC/NC interface (QB 100, see Section 4.2.5).

## MODE SELECTOR 1

The mode selector 1 on the external machine control panel transfers the following code (Gray code) to input byte 0 in accordance with the set position:

| Position | Code D | C | B | A | Mode |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | PRESET |
| 2 | 0 | 0 | 1 | 1 | MDA |
| 3 | 0 | 0 | 1 | 0 | MDA |
| 4 | 0 | 1 | 1 | 0 | JOG |
| 5 | 0 | 1 | 1 | 1 | INCR 1 |
| 6 | 0 | 1 | 0 | 1 | " 10 |
| 7 | 0 | 1 | 0 | 0 | " 100 |
| 8 | 1 | 1 | 0 | 0 | " 1000 |
| 9 | 1 | 1 | 0 | 1 | " 10000 |
| 10 | 1 | 1 | 1 | 1 | REPOS |
| 11 | 1 | 1 | 1 | 0 | AUT |
| 12 | 1 | 0 | 1 | 0 | AUT |
| 13 | 1 | 0 | 1 | 1 | REF |
| 14 | 1 | 0 | 0 | 1 | (REF) |
| 15 | 1 | 0 | 0 | 0 | (REF) |
| 16 | 1 | 0 | 0 | 0 | (REF) |

Note:

The codings of the modes can be transferred unchanged from input byte 0 to the PLC/NC interface (QB 82, see Section 4.2.2).

## DIRECTION KEYS 1, +, -

The 1st axis selection submodule on the external machine control panel transfers the signals of the two direction keys.

1 signal: Direction key + or - pressed.
0 signal: Direction key + or - not pressed.

## RAPID TRAVERSE OVERRIDE

1 signal: RAPID TRAVERSE OVERRIDE 1 key pressed.
0 signal: RAPID TRAVERSE OVERRIDE 1 key not pressed.

## AXIS SELECTOR 1

The axis selector 1 supplies the following code (Gray code) in accordance with the set position:

| Position | Code E | D | C | B | A |
|---|---|---|---|---|---|
| X axis | 0 | 0 | 0 | 1 | 1 |
| (i) | 0 | 0 | 0 | 1 | 0 |
| Y axis | 0 | 0 | 1 | 1 | 0 |
| (i) | 0 | 0 | 1 | 1 | 1 |
| Z axis | 0 | 0 | 1 | 0 | 1 |
| (i) | 0 | 0 | 1 | 0 | 0 |
| 4th axis | 0 | 1 | 1 | 0 | 0 |
| (i) | 0 | 1 | 1 | 0 | 1 |
| (unassigned) | 0 | 1 | 1 | 1 | 1 |
| (i) | 0 | 1 | 1 | 1 | 0 |
| (unassigned) | 0 | 1 | 0 | 1 | 0 |
| (i) | 0 | 1 | 0 | 1 | 1 |
| (unassigned) | 0 | 1 | 0 | 0 | 1 |
| (i) | 0 | 1 | 0 | 0 | 0 |
| (unassigned) | 1 | 1 | 0 | 0 | 0 |

(i) = intermediate position of the selector on the standard machine control panel; although these positions exist electrically, the selector does not click into place. The intermediate positions are not evaluated.

Notes:

a) These signals serve to select the axis in which the direction keys 1 + and 1 - are to act.
b) In order for the system program to convert the standard axis selector correctly into the decoded signals, machine data MD 5008.3 must be 0.
c) If the machine data MD 5008.3 is set to 1, it is possible to connect and evaluate another axis selector supplying the following code (Gray code):

| Position | Code E | D | C | B | A |
|---|---|---|---|---|---|
| X axis | 0 | 0 | 0 | 0 | 1 |
| Y axis | 0 | 0 | 0 | 1 | 1 |
| Z axis | 0 | 0 | 0 | 1 | 0 |
| 4th axis | 0 | 0 | 1 | 1 | 0 |

**SPINDLE ON**

1 signal: Spindle ON key pressed.

**SPINDLE *OFF**

1 signal: Spindle *OFF key pressed.
0 signal: Spindle *OFF key not pressed.

**FEED ON**

1 signal: Feed ON key pressed.
0 signal: Feed ON key not pressed.

**FEED *OFF**

1 signal: Feed *OFF key pressed.
0 signal: Feed *OFF key not pressed.

**NC START**

1 signal: NC START key pressed.

***NC STOP**

1 signal: *NC STOP key pressed.
0 signal: *NC STOP key not pressed.

**RESET**

1 signal: RESET key pressed.

**KEY-OPERATED SWITCH**

1 signal: Key-operated switch in position 1.

**SINGLE BLOCK**

1 signal: SINGLE BLOCK switch at 1.

## FEED OVERRIDE SWITCH

The feed override switch on the external machine control panel transfers the following code to input byte 3 in accordance with the set position (Gray code):

| Position | Code E | D | C | B | A | Override value in % |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 0 | 1 | 1 | 1 |
| 3 | 0 | 0 | 0 | 1 | 0 | 2 |
| 4 | 0 | 0 | 1 | 1 | 0 | 4 |
| 5 | 0 | 0 | 1 | 1 | 1 | 6 |
| 6 | 0 | 0 | 1 | 0 | 1 | 8 |
| 7 | 0 | 0 | 1 | 0 | 0 | 10 |
| 8 | 0 | 1 | 1 | 0 | 0 | 20 |
| 9 | 0 | 1 | 1 | 0 | 1 | 30 |
| 10 | 0 | 1 | 1 | 1 | 1 | 40 |
| 11 | 0 | 1 | 1 | 1 | 0 | 50 |
| 12 | 0 | 1 | 0 | 1 | 0 | 60 |
| 13 | 0 | 1 | 0 | 1 | 1 | 70 |
| 14 | 0 | 1 | 0 | 0 | 1 | 75 |
| 15 | 0 | 1 | 0 | 0 | 0 | 80 |
| 16 | 1 | 1 | 0 | 0 | 0 | 85 |
| 17 | 1 | 1 | 0 | 0 | 1 | 90 |
| 18 | 1 | 1 | 0 | 1 | 1 | 95 |
| 19 | 1 | 1 | 0 | 1 | 0 | 100 |
| 20 | 1 | 1 | 1 | 1 | 0 | 105 |
| 21 | 1 | 1 | 1 | 1 | 1 | 110 |
| 22 | 1 | 1 | 1 | 0 | 1 | 115 |
| 23 | 1 | 1 | 1 | 0 | 0 | 120 |
| 24 | 1 | 0 | 1 | 0 | 0 | |
| 25 | 1 | 0 | 1 | 0 | 1 | |
| 26 | 1 | 0 | 1 | 1 | 1 | |
| 27 | 1 | 0 | 1 | 1 | 0 | |
| 28 | 1 | 0 | 0 | 1 | 0 | |
| 29 | 1 | 0 | 0 | 1 | 1 | |
| 30 | 1 | 0 | 0 | 0 | 1 | |
| 31 | 1 | 0 | 0 | 0 | 0 | |

Notes:

1) The percentage values given in the table are stored as machine data. As standard, only the machine data for positions 1 to 23 are entered; the machine data not assigned can, however, be entered later. Accordingly, it is possible to evaluate the codes of positions 24 to 31 which are supplied by a connected coding switch or a PLC program.

2) The codings of the feed override can be transferred unchanged from input byte 3 to the PLC/NC interface (QB 84, see Section 4.2.3).

### 2nd axis selector submodule

### DIRECTION KEYS 2, +, -

The 2nd axis selection submodule on the external machine control panel transfers the signals of the two direction keys.

1 signal: Direction key + or - pressed.
0 signal: Direction key + or - not pressed.

### RAPID TRAVERSE OVERRIDE 2

1 signal: RAPID TRAVERSE OVERRIDE 2 key pressed.
0 signal: RAPID TRAVERSE OVERRIDE 2 key not pressed.

### AXIS SELECTOR 2

A second axis selector is set by means of PLC machine data 2002.1 = 1. This additional selector is interpreted together with axis selector 1 (see "Decoded signals").
The standard axis selector 2 supplies the following code (Gray code) in accordance with the set position:

| Position | Code E | D | C | B | A |
|---|---|---|---|---|---|
| X axis | 0 | 0 | 0 | 1 | 1 |
| (i) | 0 | 0 | 0 | 1 | 0 |
| Y axis | 0 | 0 | 1 | 1 | 0 |
| (i) | 0 | 0 | 1 | 1 | 1 |
| Z axis | 0 | 0 | 1 | 0 | 1 |
| (i) | 0 | 0 | 1 | 0 | 0 |
| 4th axis | 0 | 1 | 1 | 0 | 0 |
| (i) | 0 | 1 | 1 | 0 | 1 |
| unassigned | 0 | 1 | 1 | 1 | 1 |
| (i) | 0 | 1 | 1 | 1 | 0 |
| unassigned | 0 | 1 | 0 | 1 | 0 |
| (i) | 0 | 1 | 0 | 1 | 1 |
| unassigned | 0 | 1 | 0 | 0 | 1 |
| (i) | 0 | 1 | 0 | 0 | 0 |
| unassigned | 1 | 1 | 0 | 0 | 0 |

(i) = intermediate position of the selector on the standard machine control panel; although these positions exist electrically, the selector does not click into place. The intermediate positions are not evaluated.

Notes:

1) This code serves to select the axis in which the direction keys 1 + and 1- are to act.
2) In order for the system program to convert the standard axis selector correctly into the decoded signals, machine data MD 5008.3 must be 0.
3) If the machine data MD 5008.3 is set to 1, it is possible to connect and evaluate another axis selector supplying the following code (Gray code):

| Position | Code E | D | C | B | A |
|---|---|---|---|---|---|
| X axis | 0 | 0 | 0 | 0 | 1 |
| Y axis | 0 | 0 | 0 | 1 | 1 |
| Z axis | 0 | 0 | 0 | 1 | 0 |
| 4th axis | 0 | 0 | 1 | 1 | 0 |

## 3.3.5 Decoded signals of the external machine control panel SINUMERIK 810 M

### DIRECTION KEYS

The signals of all direction keys are decoded and provided in input byte 99, if the codings of the axis selector are available in input bytes 1 and 4. The decoding interprets:

- the axis selector 1 and 2
- the signals of the DIRECTION KEYS 1 +, 1-, 2 +, 2-

1 signal: The corresponding direction key of the set X, Y, Z or 4th axis is pressed.
0 signal: The corresponding direction key of the set X, Y, Z or 4th axis is not pressed.

Note:

The decoding checks whether illegal key combinations have been set and operated (for instance a simultaneous pressing of X+ and X- or in the case of two axis selectors: simultaneous pressing of X1 + and X2-). In input byte 99, only permissible bit combinations are prepared:

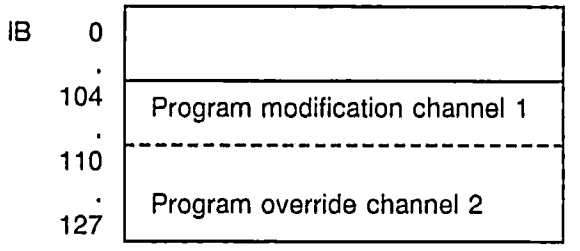
- only axis selector 1 available:
  in the case of illegal key combinations; IB 99 is reset to zero;
- axis selector 1 and 2 (option) available:
  the direction keys of axis selector 1 have priority over those of axis selector 2.

### HANDWHEEL SELECTION, 1st AND 2nd AXIS SELECTOR

In the case of internal handwheel selection MD 5008.2 = 1, the handwheels for the respective axes are activated in input bytes 100 and 101.

1 signal: The handwheel is to be active in the corresponding axis.
0 signal: Handwheel operation in the corresponding axis not selected.

## 3.4 Program modification signals




The signals for program modification (submodes) can be selected with the softkeys on the operator panel (except single block). For channels 1 and 2, these signals are always set or reset together.

### SKIP BLOCK, CHANNEL 1 AND 2

1 signal: The SKIP BLOCK submode is selected.
0 signal: The SKIP BLOCK submode is not selected.

### SINGLE BLOCK DECODING, CHANNEL 1 AND 2

1 signal: The SINGLE BLOCK DECODING submode is selected.
0 signal: The SINGLE BLOCK DECODING submode is not selected.

### DRY RUN FEED, CHANNEL 1 AND 2

1 signal: The DRY RUN FEED submode is selected.
0 signal: The DRY RUN FEED submode is not selected.

### M01 EFFECTIVE, CHANNEL 1 AND 2

1 signal: The M01 ACTIVE submode is selected.
0 signal: The M01 ACTIVE submode is selected.

### SINGLE BLOCK, CHANNEL 1 AND 2

Depending on MD 5008.0 and 5008.1, either key 37 (single block on integrated machine control panel) or switch 3 (single block on external machine control panel) is evaluated.

1 signal: The SINGLE BLOCK submode is selected.
0 signal: No effect.

### OVERRIDE EFFECTIVE FOR RAPID TRAVERSE

If there is no separate rapid traverse override switch (MD 5004.4 = 0), the feed override switch is effective for rapid traverse.

1 signal: Feed override switch effective for rapid traverse selected.
0 signal: Feed override switch not effective.

## 3.5 Transfer of machine control panel signals

### 3.5.1 Transfer of the machine control panel signals to the interface

A system program which is run before the cyclic user program (depending on the machine data 2003.3, see Description of the PLC interface control) permits all signals of the integrated or external machine control panel to be transferred from the input image to the output image (interface range PLC → NC, PLC output signals). The subsequent PLC program must therefore serve only those signals on the interface which are to be modified in a defined way.

Example:
The "HANDWHEEL 1 ACTIVE" signal is set by the system program, if the handwheel has been selected for the X axis.

| Byte No. | Bit: 2 | 1 | 0 |
|---|---|---|---|
| QB 102 | | Handwheel | |
| | 3 active | 2 active | 1 active |

However, if handwheel 2 is to be permanently assigned to the X axis, the "1 active" bit must be reset in a defined way and the "2 active" bit set depending on the handwheel selection.

The system program transfers the signals marked in the following with "#" into the output image; in the following example the external machine control has been used:

**Example**

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 0 | Spindle override switch # | | | | Mode selector # | | | |
| | D | C | B | A | D | C | B | A |
| IB 1 | Direction keys | | Rapid # traverse override | Direction keys | | Auxiliary axis | | |
| | X+ | X- | | Q+ | Q- | | | |
| IB 2 | Direction keys | | Spindle # | | Feed # | | NC Start # | *NC Stop # |
| | Z+ | Z- | On | *Off | On | *Off | | |
| IB 3 | Reset # | Key operated switch # | Single block # | Feed override switch # | | | | |
| | | | | E | D | C | B | A |
| IB 4 | Direction keys 2 | | Rapid traverse override | Axis selector | | | | |
| | + | - | | (E) | (D) | C | B | A |

## Decoded signals

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 99 | Direction keys # | | | | | | | |
| | X+ | X- | Z+ | Z- | Q1+ | Q1- | Q2+ | Q2- |
| IB 100 | Handwheel 1 / 1st axis selector | | | | 2nd axis selector | | | |
| | X | Z | Q1 | Q2 | X | Z | Q1 | Q2 |
| IB 101 | Handwheel 2 | | | | Handwheel 3 | | | |
| | X | Z | Q1 | Q2 | X | Z | Q1 | Q2 |

## Program modification signals

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 104 Channel 1 | # Skip block | | # Dec. single block | # Dry run feed | # M01 effective | #Override for rapid traverse | # DRF selected | |
| IB 110 Channel 2 | # Skip block | | # Dec. single block | # Dry run feed | # M01 effective | #Override for rapid traverse | # DRF selected | |

The control panel signals are either transferred 1 : 1 to outputs having the same name, as for instance the spindle override switch and the RESET key, or they are distributed to axis-specific or channel-specific output signals:

- Spindle override switch → Spindle override
- Mode selector → Operating modes
- Feed override switch → Feed override
- Feed override switch → Rapid traverse override, if there is no separate switch

- Spindle ON → Set SPINDLE ENABLE
- Spindle *OFF → Reset SPINDLE ENABLE

- Feed ON → Set FEED ENABLE TOTAL
- Feed *OFF → Reset FEED ENABLE TOTAL

- NC START → NC START channel 1 only
- *NC STOP → NC STOP channel 1 only

- RESET key → RESET
- Key operated switch → KEY-OPERATED SWITCH

- SINGLE BLOCK → SINGLE BLOCK channel 1 and 2
- RAPID TRAVERSE OVERRIDE → RAPID TRAVERSE OVERRIDE channels 1 - 4

- DIRECTION KEYS X+, X- → JOG +,- axis 1
- DIRECTION KEYS Z+, Z- → JOG +,- axis 2
- DIRECTION KEYS Q1+, Q1- → JOG +,- axis 3
- DIRECTION KEYS Q2+, Q2- → JOG +,- axis 4

- Handwheel 1 (2, 3) X → HANDWHEEL 1 (2, 3) active AXIS X
- Handwheel 1 (2, 3) Z → HANDWHEEL 1 (2, 3) active AXIS Z
- Handwheel 1 (2, 3) Q1 → HANDWHEEL 1 (2, 3) active AXIS Q1
- Handwheel 1 (2, 3) Q2 → HANDWHEEL 1 (2, 3) active AXIS Q2

- Skip block, chann. 1&2 → SKIP BLOCK, chan. 1&2
- Dec. single block, chan. 1&2 → DEC. SINGLE BLOCK, chan. 1 & 2
- Dry run feed, chan. 1&2 → DRY RUN FEED, chan. 1 & 2
- M01 effective → M01 EFFECTIVE, chan.1 & 2
- Override for rapid traverse → Override for rapid traverse, chan. 1 & 2 effective
- DRF selected → DRF EFFECTIVE

## 3.5.2 PLC OUTPUT SIGNALS (PLC→NC)

### Ready signals

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 78 | | #Key-op. switch | Data in Start 2 | Data in Start 1 | Cycle inhibit | | *Emergency stop | |

### Operating modes channels 1 and 2

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 82 | # DRF effective | # Reset | | | Operating modes # D | C | B | A |

### Program modification channel 1

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 88 | | | Read-in enable | | Delete distance to go | Delete no. of subrout. passes | # NC Stop | # NC Start |

### Submodes channel 1

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 83 | # Skip block | # Single block | # Single block decoding | # Dry run feed | # M01 effective | | | |

### Program modification channel 2

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 96 | | | Read-in enable | | Delete distance to go | Delete no. of subrou. passes | # NC Stop | # NC Start |

### Submodes channel 2

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 92 | # Skip block | # Single block | # Single block decoding | # Dry run feed | # M01 effective | | | |

## Feed modification

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 84 | #Feed enable total | | #Feed override effective | Feed override # E | D | C | B | A |
| QB 85 | | | #Rapid traverse override effective | Rapid traverse override # (E) | (D) | C | B | A |

## Axis-specific signals

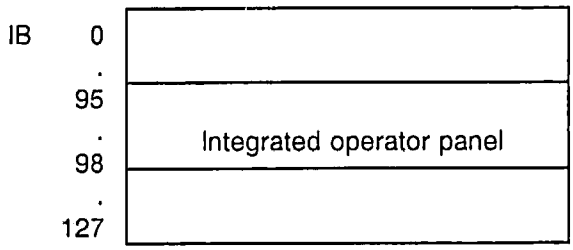
| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| QB 108 Axis 1 | Mirroring | Follow-up operation | Feed enable | # Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | - |
| QB 109 Axis 1 | Jog # + | - | # Rapid traverse override | | Axis inhibit | 3 active | Handwheel 2 active | 1 active |
| QB 112 Axis 2 | Mirroring | Follow-up operation | Feed enable | # Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | + |
| QB 113 Axis 2 | Jog # + | - | # Rapid traverse override | | Axis inhibit | 3 active | Handwheel 2 active | 1 active |
| QB 116 Axis 3 | Mirroring | Follow-up operation | Feed enable | # Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | + |
| QB 117 Axis 3 | Jog # + | - | # Rapid traverse override | | Axis inhibit | 3 active | Handwheel 2 active | 1 active |
| QB 120 Axis 4 | Mirroring | Follow-up operation | Feed enable | # Decel-eration | Parking axis | Controller enable | 2nd software limit switch effective + | + |
| QB 121 Axis 4 | Jog # + | - | # Rapid traverse override | | Axis inhibit | 3 active | Handwheel 2 active | 1 active |

| Spindle modification | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte No.** | **Bit: 7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **QB 100** | # Spindle enable | Controller enable | Preset zero setpoint | #Spindle override effective | D | #, Spindle override C | B | A |
| **QB 101** | | | Spindle reset | Reverse spindle rotation | | Actual gear speed C | B | A |
| **QB 103** | Set direction of rotation clockw. | Oscillation speed (revs.) | Adjusting speed (revs.) | Spindle positioning | Resynch. spindle * | Acknowledge M19 | | PLC spindle control |

* Automatic gear selection

## 3.6 Signals of the integrated operator panel




If an external machine control panel is used, the integrated operator panel (if available) can be used as freely assignable key block.
The signals of the keys are only transferred to the input image IB 95 - 98, decoding and transfer to the output image no longer take place (IB 99 - 101 are only active for the external machine control panel).
The keys of the operator panel are not numbered consecutively but organized in rows to facilitate finding the bit which corresponds to the key in the input image. For example, bit 0 of the 1st byte of the operator panel signals (IB 95) is assigned to key 10 (see Fig. 3.10).

The keyboard assignment shown is valid as from software version 02.

| Byte No. | Bit: 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| IB 95 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 |
| IB 96 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| IB 97 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 |

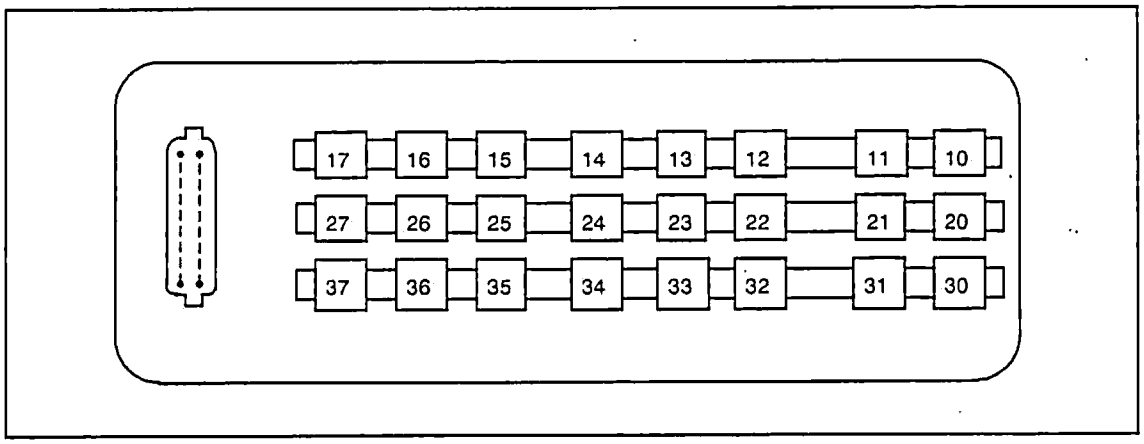
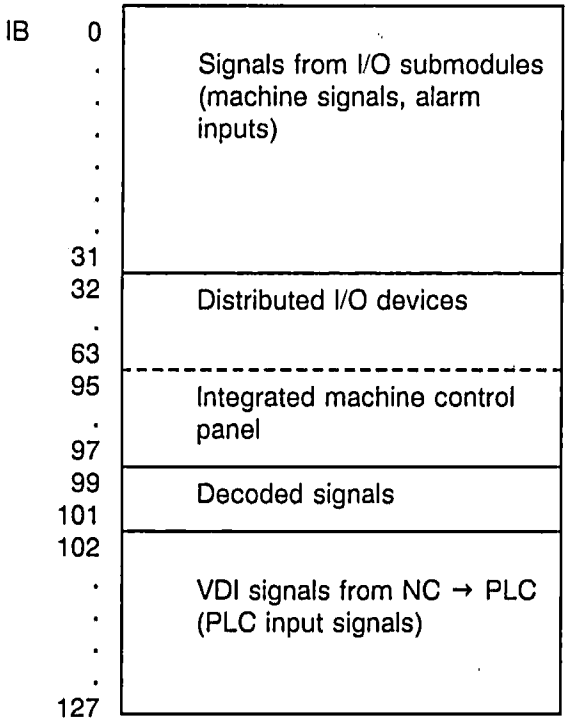



*Fig. 3.10*

# 4 Description of NC/PLC Interface

## 4.1 PLC input signals (NC→PLC)

### 4.1.1 Ready signals of the NC




**DRF SELECTED**

1 signal: Differential resolver function (DRF) is selected via manual encoder (handwheel) (by means of softkey in the corresponding display).
0 signal: Differential resolver function not selected.

Note:

The DRF SELECTED signal is transmitted by a PLC system program to the DRF EFFECTIVE interface signal (Q 82.7, see Section 4.2.2), if the corresponding machine data is set (see Section 3.5.2).

## TOUCH SENSOR ACTIVATED, 1 and 2

1 signal: Touch sensor activated ($t_{v2}$ approx. 40-140 ms)
0 signal: Touch sensor not or no longer activated ($t_{v2}$ approx. 40-140 ms).

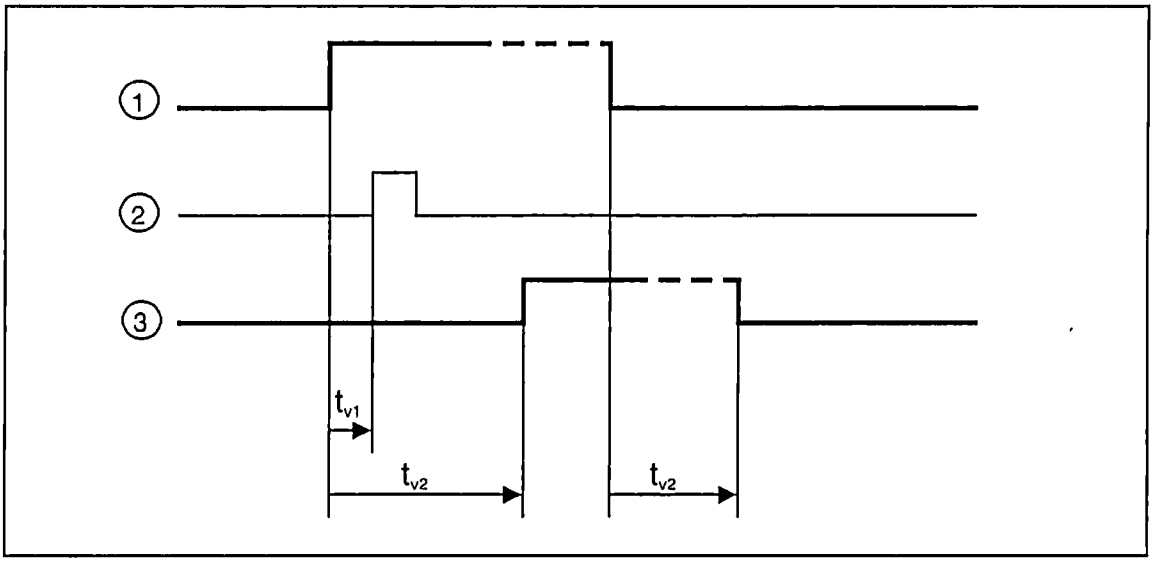



*Bild 4.1*

1: Touch sensor signal at the NC input
2: Recognition of the touch sensor signals in the NC (storage of actual value)
$t_{v1}$ min. 300 ns
3: TOUCH SENSOR ACTIVATED signal at the interface ($t_{v2}$ approx. 40-140 ms)

Note:

For the interface signal to be output, the touch sensor must output a signal existing longer than 20ms at the NC input. The touch sensor signal effects the following:
a) Delete distance to go
b) The current position of the axis is stored without delay in the buffer and transferred from there to an R parameter.

The touch sensor is enabled in the NC program by an alpha function. The touch sensors only effect "Delete distance to go" in the channel for the programmed axes for which they were enabled. The measurement may only be enabled in one channel at a time.

Application example:

To check whether the touch sensor is in reset state before starting the measuring process.

### V.24 RUNNING

1 signal: Data transfer running on the universal interface (V.24) from or to the NC.
0 signal: No data transfer from or to the NC.

Note:

The V.24 RUNNING signal indicates only the transfer of NC data (part programs, machine data, etc.)

Application example:

In the case of simple DNC, for instance, the successful start of reading-in for a new NC program can be checked by means of the V.24 RUNNING signal.

### NC READY 1 (NC-BB1)

1 signal: After POWER ON and build-up of all voltages.
0 signal: Temperature limit in the SINUMERIK exceeded and alarm 2 present.

Application example:

Cancellation of the read-in enable by the 0 signal; execution of the current NC block is completed. The next program block is not executed.

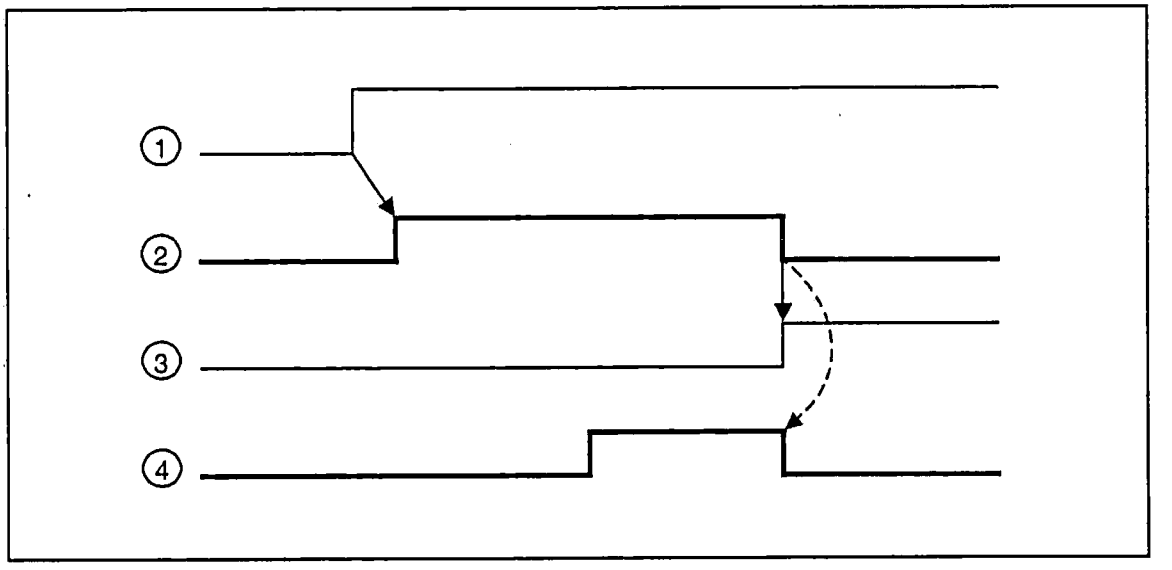



*Fig. 4.2*

1: Operating voltage
2: NC READY 1
3: Warning signal (NC alarm)
4: Read-in enable

## BATTERY FAULT

After POWER ON, the voltage of the built-in battery is cyclically checked for a permissible lower limit. This serves to detect in good time a failure of the battery during long NC operation times.
1 signal: Battery voltage has fallen below the limit value.
0 signal: Battery voltage is above the lower limit.

Note:

Change the battery only when the NC is under power to avoid data loss.

## NC READY 2 (NC-BB2)

1 signal: After POWER ON and building-up of all voltages.
0 signal: Fault in the measuring circuit.

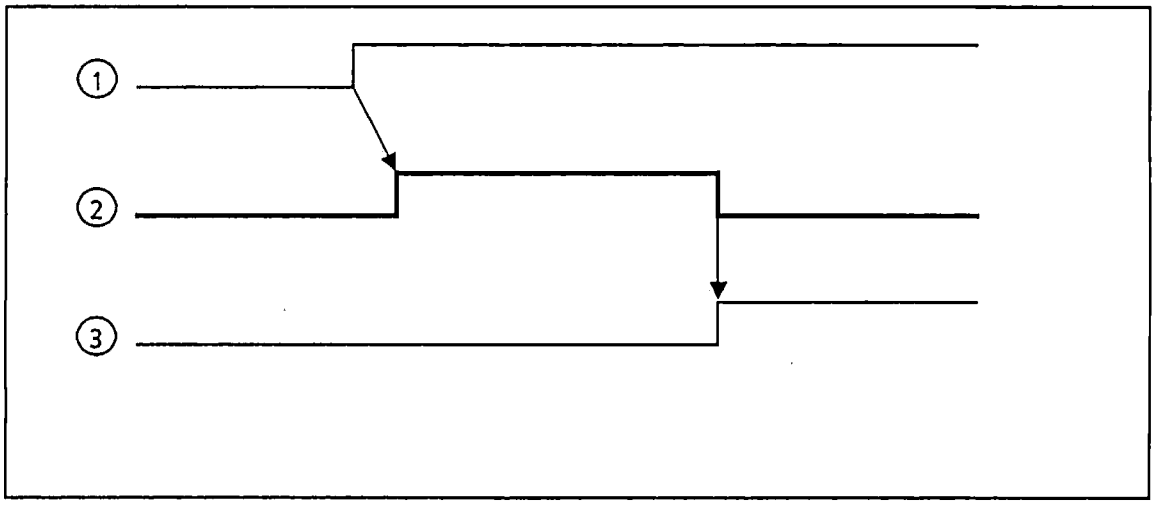



*Fig. 4.3*

1: Operating voltage
2: NC READY 2
3: Fault message

Notes:

1) If NC READY 2 changes to "0", then:
   a) the feed drives and the spindle drive are stopped by active rapid braking (i.e. with maximum brake current) and
   b) all signals which are transmitted from the NC to the PLC are reset to the inactive state (reset status).
2) All commands which have been sent to the NC must be cancelled if NC READY 2 has a 0 signal.
3) NC READY 2 changes to "1" after correction of the fault only if the RESET key of the NC is pressed or if the NC is switched off and on again.
4) All functions stored in the buffer memory of the NC are cleared.

## NC ALARM

1 signal: An NC alarm exists.
0 signal: No NC alarm exists.

Application example:

Energizing of a lamp which indicates for example, that an error has caused the machine to stop.

## 4.1.2 Program commands

### M00 / M01; PROGRAMMED STOP

1 signal: Block executed, auxiliary functions output and
a) M00 in main memory or
b) M01 in main memory and
M01 EFFECTIVE specified (see Section 4.2.2) .

0 signal: a) With NC Start
b) Program abort by RESET

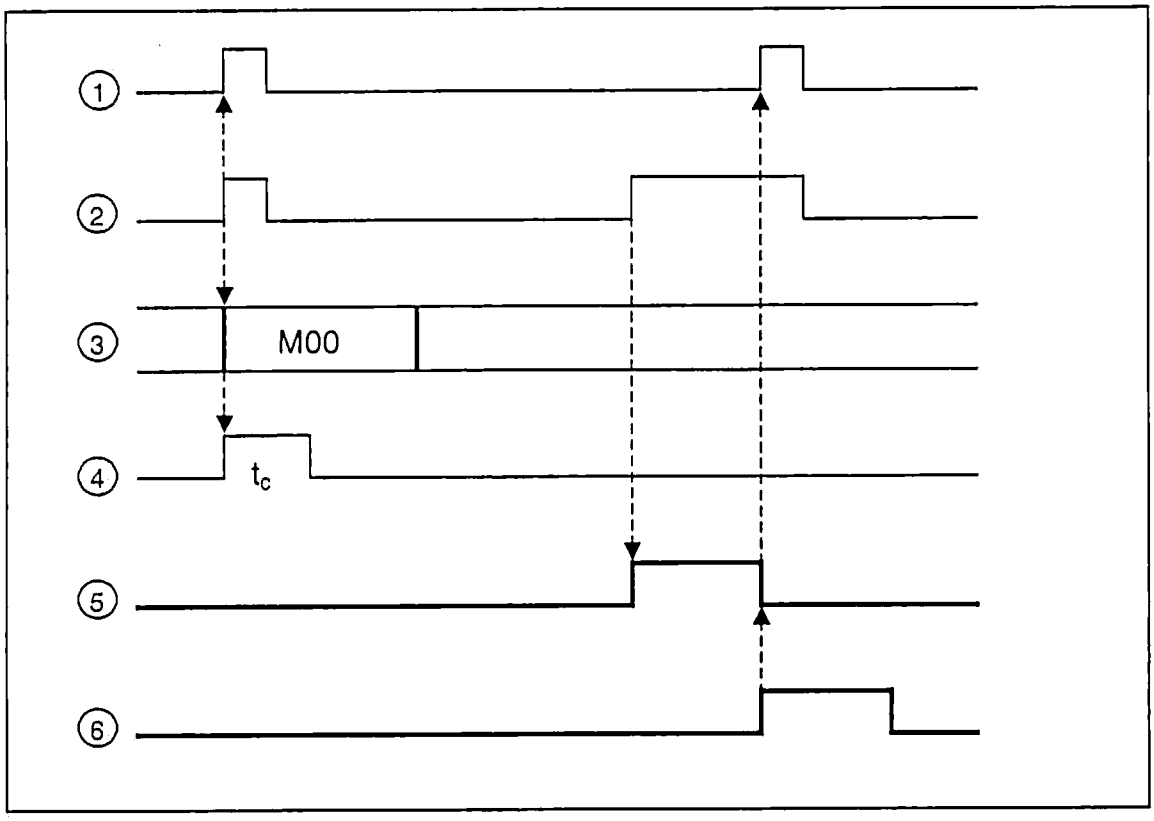



*Fig. 4.4*

1: Data transfer into main memory
2: Block executed
3: NC block with M word M00
4: M modification signal ($t_c$ = PLC cycle time)
5: Signal M00/M01
6: NC Start

Note:

If the operating mode is changed while the M00/M01 signal is "1", this status continues until the NC START or RESET signal arrives.

Application example:

Stopping the main spindle, e.g. when checks are to be made.

## M02 / M30; PROGRAM END, PROGRAM ABORT

1 signal: a) A complete NC block including M02/M30 has been executed; if this block contains traversing movements, the signal is output only after reaching the target position.
b) Program aborted by RESET

0 signal: No program end or abort

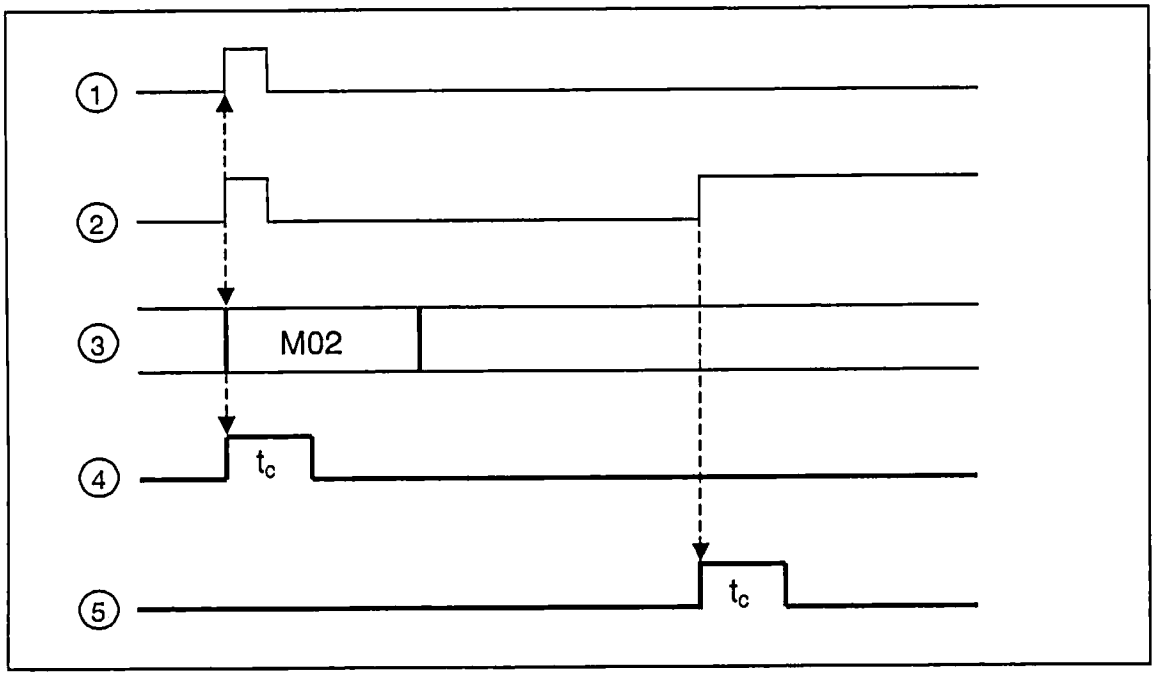



*Fig. 4.5*

1: Data transfer into main memory
2: Block executed
3: NC block with M word M02
4: M modification signal ($t_c$ = PLC cycle time)
5: Signal M02/M30

Notes:

1) M02/M30 have the same function in the NC.
2) The M02/M30 signal only exists for one scan.
3) The M02/M30 signal is not suited for automatic sequential functions such as: Workpiece counting, bar feed, opening of protective guards, etc.
   For these functions
   a) M02/M30 must be written in a block of its own and
   b) the BCD word M02/M30 or the decoded M02/M30 signal must be used (see auxiliary function output).
4) In the last block of the program it is not allowed
   a) to write auxiliary functions which disable read-in or
   b) to write S values intended to be effective beyond M02/M30.

Application example:

Deleting functions initiated by M, T and H words.

## G33/G63; THREAD CUTTING

1 signal: Thread cutting selected with G33 or G63

0 signal: a) Thread cutting deselected by G00, G01, G02, G03, G10 and G11
b) Program completed or aborted.

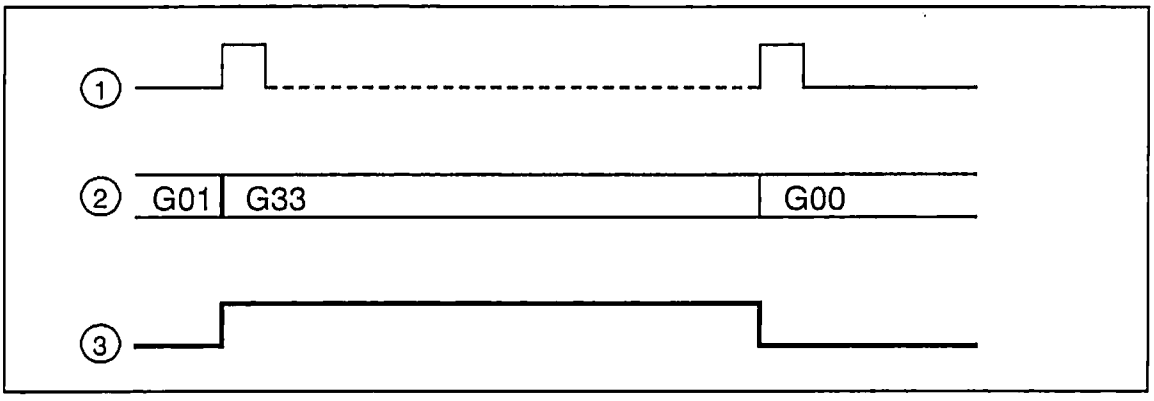



*Fig. 4.6*

1: Data transfer into main memory
2: Contents of main memory
3: G33/G63 signal

Notes:

1) The following are ineffective with G33:
   a) Feed override switch,
   b) Feed stop;
      (FEED ENABLE TOTAL signal is not evaluated),
   c) Single block;
      Stopping occurs only at the end of the next block.
2) The following are ineffective with G63:
   a) Feed override switch.

While G33 (thread cutting) is effective, FEED STOP can be obtained indirectly by removing the SPINDLE ENABLE signal by combining G33 and FEED ENABLE TOTAL.
In the case of G63, the NC reacts directly to the FEED ENABLE TOTAL signal.

## G00; RAPID TRAVERSE

AUT, MDA modes

1 signal: Rapid traverse selected with G00.
0 signal: Rapid traverse block completed or aborted.

JOG, REPOS modes

1 signal: Keys for rapid traverse and direction pressed at the same time.
0 signal: Key for rapid traverse or direction not pressed.

Application example:

Activation of the bed lubrication

### G96; CONSTANT CUTTING SPEED

1 signal: Constant cutting speed selected with G96.
0 signal: No constant cutting speed selected.

### BLOCK SEARCH ACTIVE

1 signal: Block search started.
0 signal: No block search started or block search completed.

### PROGRAM INTERRUPTED

AUT, MDA modes

1 signal: Program interruption by means of NC STOP or mode change.
0 signal: a) Program not started.
b) Program ended or aborted with RESET.
c) Program was restarted after NC STOP or mode change.

Note:

The PROGRAM INTERRUPTED signal means that the program can be continued after a restart.

### PROGRAM RUNNING

AUT, MDA modes

1 signal: Program has started (NC START)
0 signal: a) Program interrupted by:
- programmed stop (M00/M01)
- NC STOP or
- mode change.
b) Block executed during single block operation.
c) Program end reached (M02/M30).
d) Program abort by RESET.
e) No further block in the memory (e.g. in MDA mode).
f) Current block not executable.

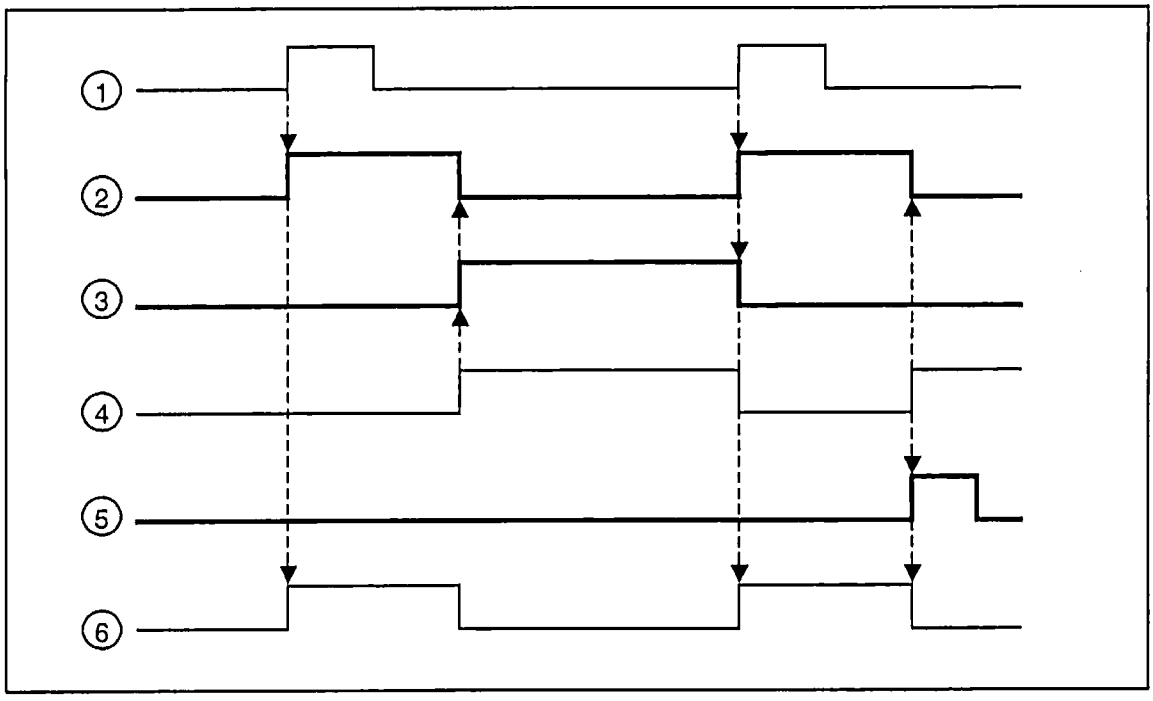



*Fig. 4.7*

1: NC START signal
2: PROGRAM RUNNING signal
3: M00/M01 signal
4: Arrival at position to be reached
5: M02/M30 signal
6: "PROGRAM RUNNING" lamp lights up

Notes:

The PROGRAM RUNNING signal does not change to 0 if workpiece machining is stopped by following events:

- removal of TOTAL FEED ENABLE, of axis-specific FEED ENABLE or SPINDLE ENABLE,
- removal of READ-IN ENABLE,
- FEED OVERRIDE set to "0%",
- reaching the software limit switches or working area limits,
- response of the spindle or axis monitors,
- selection of position setpoints in the NC program for axes in FOLLOW-UP OPERATION, for axes without CONTROLLER ENABLE or for PARKING AXES,
- EMERGENCY STOP.

## 4.1.3 Axis-specific signals (NC→PLC)

### AXIS IN POSITION CONTROL

1 signal: The respective axis is in position control.
0 signal: The axis is not in position control.
This signal can be used to operate the brake axes no longer in the position control loop.

### REFERENCE POINT REACHED

1 signal: Reference point reached and axis synchronized.
The signal exists until the power supply is switched off.
0 signal: Exists before synchronization of the axis.

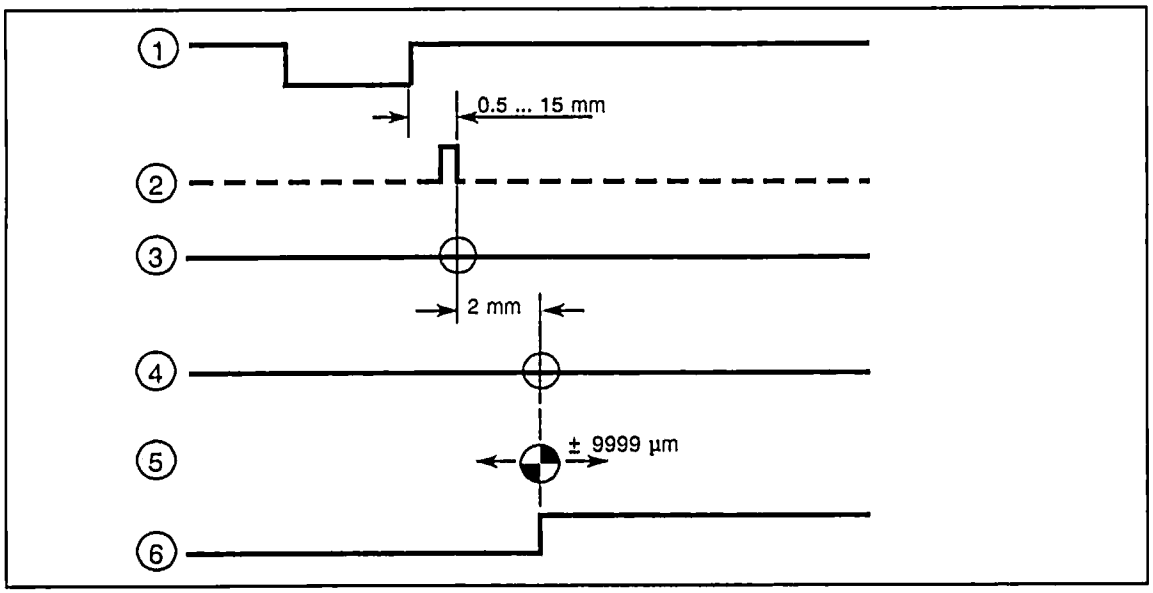



*Fig. 4.8*

1: *DECELERATION signal
2: Zero point measuring system signal
3: Zero point of the measuring system
4: Zero point plus a distance of 2 mm in approach direction of the reference point
5: Reference point in the range: Zero point plus 2 mm ± 9999 µm
6: REFERENCE POINT REACHED signal

Note:

The reference point can be shifted by means of the "Reference point shift" machine data in the range of ± 9999 µm, referred to the 2 mm point. After reaching the reference point position, the actual value memory for the axis is set to the reference point value (fixed in the machine data) and the "REFERENCE POINT REACHED" signal is output.

Application example:

Suppression of the start signal if, for instance, a parking axis has not yet been synchronized upon activation.

## POSITION REACHED

AUT mode

Exact stop (coarse):

1 signal : a) The axis has reached the programmed setpoint up to the tolerance of the coarse exact stop window (machine data) or
b) is already within the fine exact stop window.
0 signal: The axis is outside the coarse exact stop window.

Exact positioning (fine):

1 signal: The axis has reached the programmed setpoint up to the tolerance of the fine exact stop window (machine data).
0 signal: The axis is outside the fine exact stop window.

Note:

The coarse or fine POSITION REACHED signals are also at "1" if the automatic mode has been interrupted by RESET, NC Alarm or mode change (AUT INTERRUPTED).

Application example:

Enabling of tool change after the axis has reached the change position.

JOG/INCR/REPOS mode

Exact stop (coarse):

1 signal: a) The axis has reached the specified setpoint up to the tolerance of the coarse exact stop window (machine data) or
b) is already situated within the fine exact stop window; no direction key and no handwheel has been operated.
0 signal: The axis is outside the coarse exact stop window; a direction key or a handwheel has been operated.

Exact positioning (fine):

1 signal: The axis has reached the specified setpoint up to the tolerance of the fine exact stop window (machine data); no direction key and no handwheel has been operated.
0 signal: The axis is outside the fine exact stop window; a direction key or a handwheel has been operated.

## TRAVEL COMMANDS +,-

AUT/MDA mode

1 signal: Exists if a movement is to take place in the respective axis direction, for instance after transfer of a block into the main store which contains a coordinate value for the respective axis.

0 signal:
a) Block executed, (i.e. distance to go = 0),
b) Axis disable exists,
c) Abort by RESET.

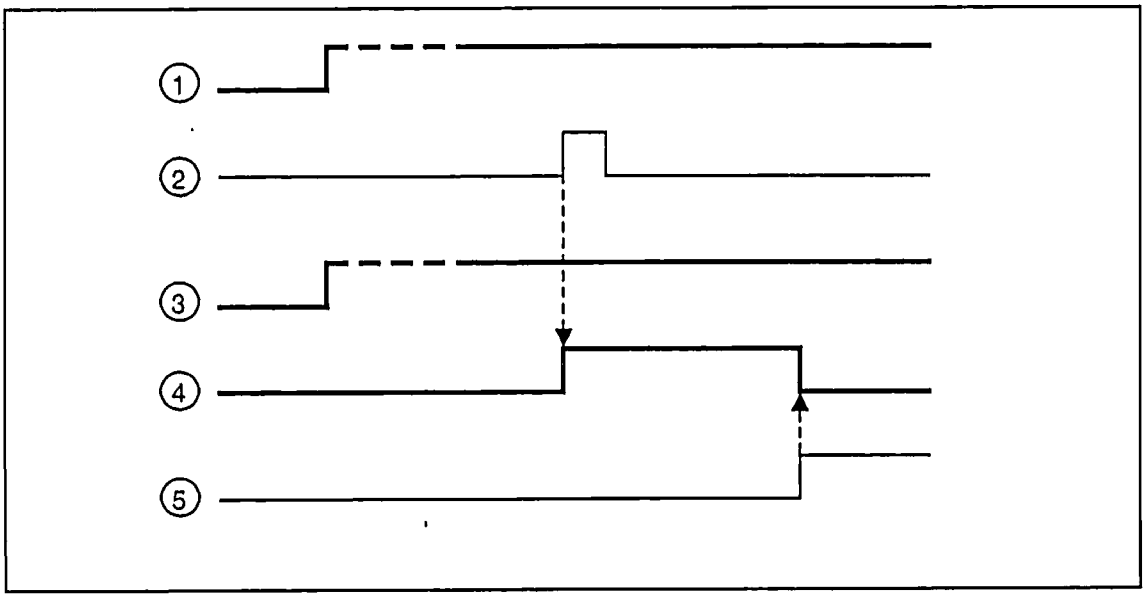



*Fig. 4.9*

1: READ-IN ENABLE signal
2: Data transfer into the main memory
3: TOTAL FEED ENABLE signal
4: TRAVEL COMMAND signal (e.g. X+)
5: Block executed

JOG/INCR mode

1 signal: Axis selected and direction key pressed.

0 signal:
a) Direction key no longer pressed and output of the interpolator is 0,
b) Traversing via handwheel,
c) In the INCR mode, if traversed with incremental feed,
d) Abortion by RESET.

REF mode

1 signal:
a) Approach to reference point without automatic detection of direction: pressing the direction key in the direction of reference point to be approached.
b) Approach of reference point with automatic detection of direction: a direction key is pressed.

0 signal: Reference point has been reached.

Note:

In the case of axes with clamp, no continuous path control is possible if the clamp is only released with the traversing command. Jogging with handwheel is possible only if the clamp has been released before operating the handwheel.

Application example:

Clamp release for axes with clamp (e.g. rotary tables).

## 4.1.4 Spindle signals (NC→PLC)

### ACTUAL DIRECTION OF SPINDLE ROTATION CW

1 signal: Actual direction of rotation CW
0 signal: Actual direction of rotation CCW

Notes:

1) The signal is derived from the rotational direction of the pulse encoder. With the spindle at rest, the signal corresponds to the last direction of rotation.
2) If the spindle is not equipped with a pulse encoder, the signal remains undefined.

### PROGRAMMED SPEED TOO HIGH

1 signal: The programmed speed or the calculated speed at v = const. (G96) is too high.
0 signal: The programmed speed or the calculated speed at v = const. is below the permitted limits.

Notes:

1) The calculated speed at v = const. can be limited via G92 S...
2) If the programmed speed or the calculated speed at v = const. exceeds preset limits (as machine data or for the selected gear speed), the value output as setpoint is the speed which corresponds to the lowest limit.
3) When limit values are checked, SPINDLE OVERRIDE is taken into account.

## PROGRAMMED SPEED TOO HIGH

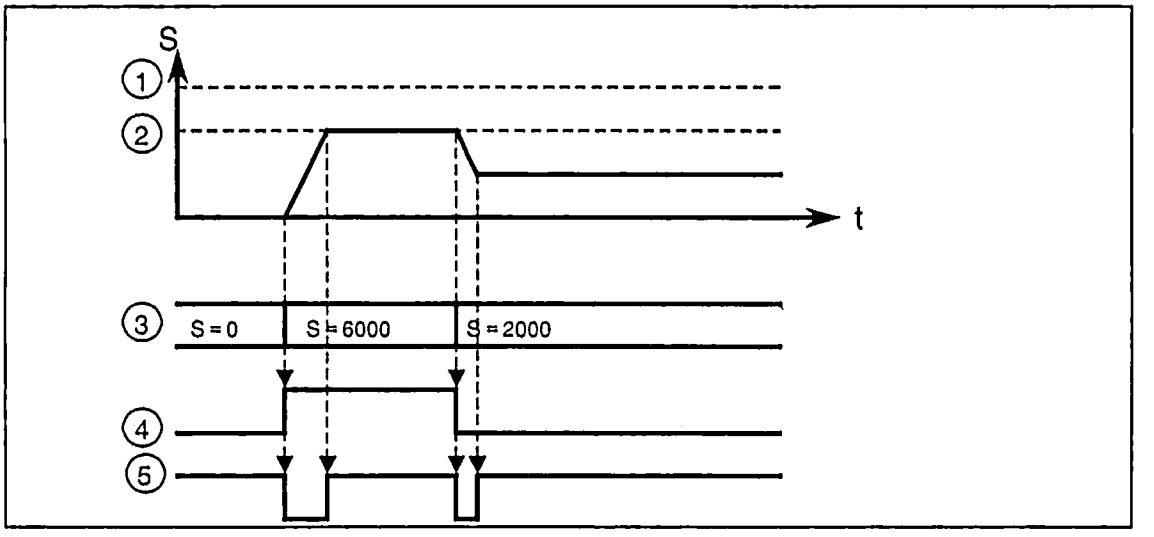



*Fig. 4.10*

1: Speed limit of the selected gear speed, e.g. 5000
2: Speed limit in the machine data (e.g. permitted limit speed of the chuck = 4000)
3: Programmed S values in the main memory
4: PROGRAMMED SPEED TOO HIGH signal
5: SPINDLE WITHIN SET RANGE signal

Application example:

The PROGRAMMED SPEED TOO HIGH signal can disable further processing of the NC program and cause a corresponding message to be output.

## SPINDLE WITHIN SET RANGE

1 signal: Actual speed is within set range (window). (See above figure.)
0 signal: Actual speed is not within set range (the spindle override is taken into account).

Application example:

Enabling of axis movements, e.g. via TOTAL FEED ENABLE after speed change by setting a new S value or by changing gear.

## SPINDLE POSITION REACHED

1 signal: Actual spindle position is within the positional tolerance during oriented spindle stop.
0 signal: Actual spindle position is beyond the positional tolerance during oriented spindle stop.

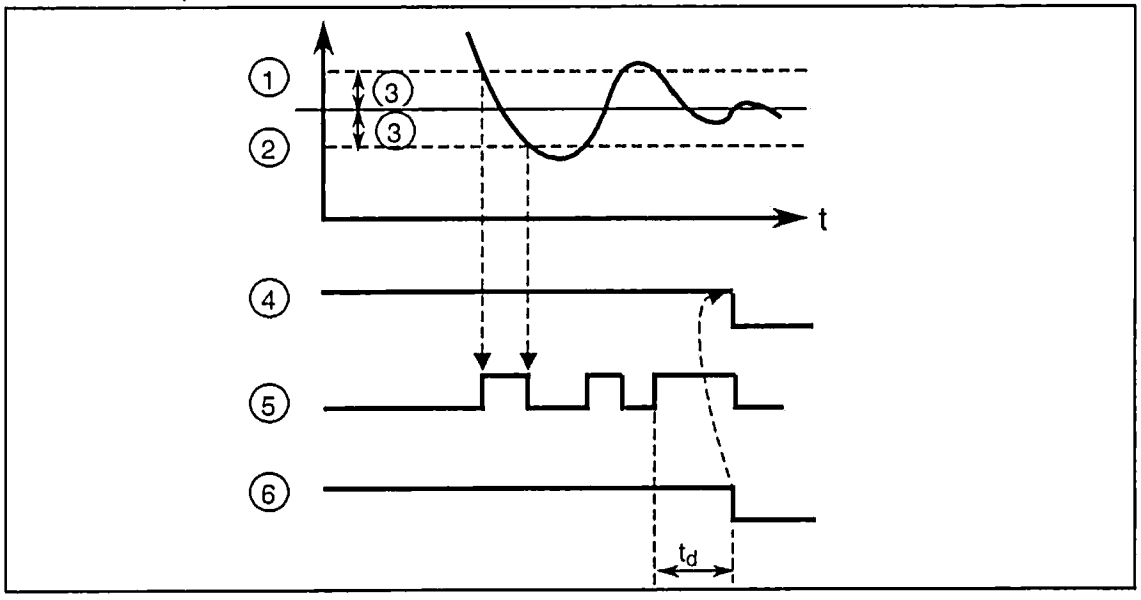



*Fig. 4.11*

1: Actual spindle position
2: Set position
3: Positional tolerance
4: Position control switched on
5: SPINDLE POSITION REACHED signal
6: SPINDLE ENABLE signal (output by the PLC, $t_d$ = deceleration time)

Notes:

1) In the case of overshooting beyond the positional tolerance, the SPINDLE POSITION REACHED signal is cancelled (e.g., in the case of overshooting due to incorrect optimization of the spindle controller).
2) The SPINDLE ENABLE signal may be cancelled by the PLC only after the spindle has settled into the set position (e.g., after a deceleration period $t_d$ programmed by the user).

Application example:

Tool change enable for milling machines.

## SPINDLE STOP

1 signal: Actual speed is in the zero-speed range.
0 signal: Actual speed is greater than the zero-speed range.

Application example:

Enable for opening protective guard.

## SPINDLE SYNCHRONIZED

1 signal: The spindle has reached the measuring system zero. The spindle is synchronized.
0 signal : The spindle is not synchronized.

## M 19 ACTIVE

1 signal: The M 19 function is active.
0 signal: The M 19 function is not active.

## SPEED LIMIT EXCEEDED

1 signal: The spindle speed has exceeded the following limits by the permitted tolerance:
a) Maximum speed of the chuck (on lathes) or the tool (on milling machines) fixed by machine data.
b) Maximum speed of the selected gear.

0 signal: a) The spindle speed is below the permitted limits.
b) After RESET.

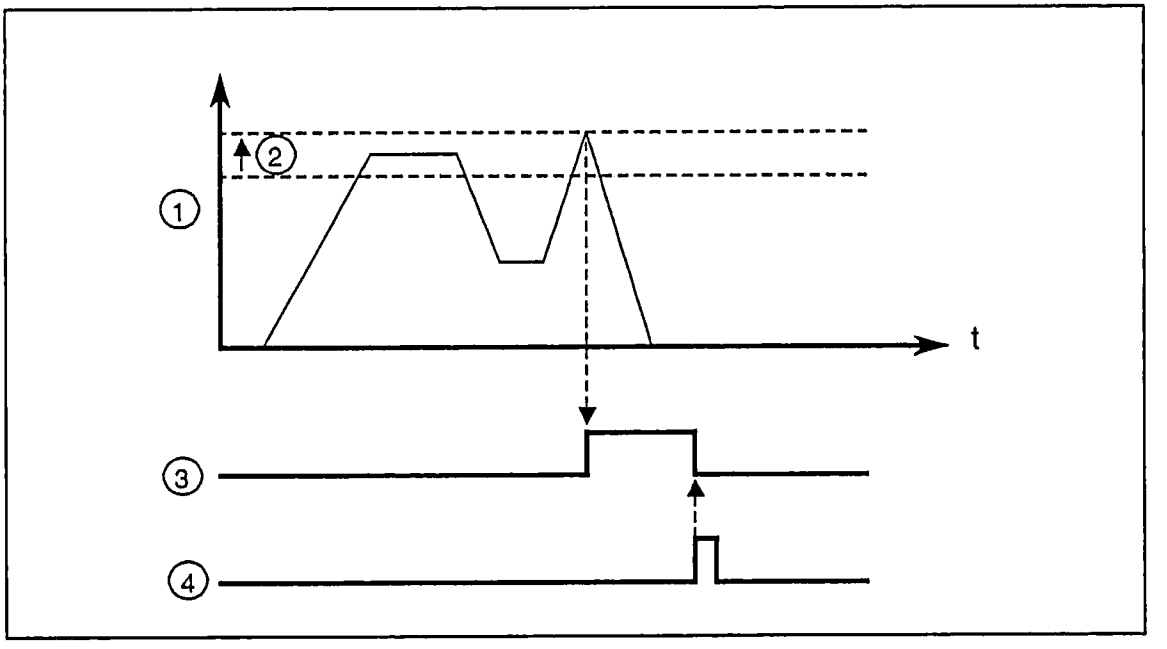



*Fig. 4.12*

1: Preset maximum speed
2: Permitted tolerance of the spindle speed
3: SPEED LIMIT EXCEEDED signal
4: RESET signal

Note:

If the spindle speed exceeds one of the limits, the spindle and all axes of the NC are stopped and an alarm is output. The SPEED LIMIT EXCEEDED signal is modal and must be reset by means of RESET.

## CHANGE GEAR

The CHANGE GEAR signal is output only if automatic gear changing has been activated (machine data) and enabled (AUTOMATIC GEAR CHANGING signal).

1 signal: Start of gear change; the new gear speed is valid and supplied to the interface.
0 signal: End of gear change.

Note:

The spindle accelerates or decelerates (although the "Change gear" bit is set) in the actual gear speed if an S value has been programmed and M03/M04 is active.

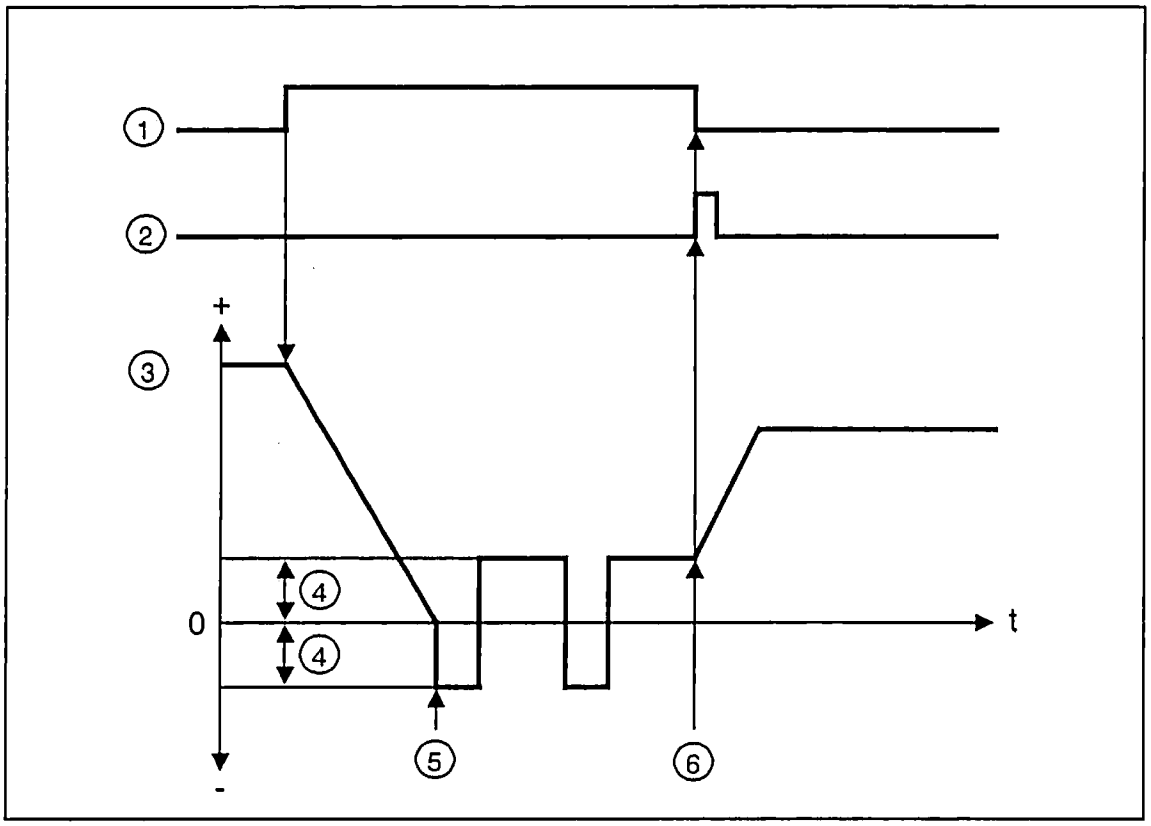



*Fig. 4.13*

1: CHANGE GEAR signal
2: "Gear engaged" checkback signal from the gear to the PLC
3: Actual speed of the spindle motor
4: Oscillating speed setpoint
5: Oscillation, change gear
6: Gear engaged, accelerate spindle motor

Sequence:

1. CHANGE GEAR signal changes from 0 to 1; the set gear speed is output to the interface.

Controlled by the PLC program:

2. Spindle motor decelerates to zero speed. (Reset spindle enable.)
3. Motor accelerates to oscillating speed. (Set oscillating speed + spindle enable.)
4. Motor rotation is switched from clockwise to counterclockwise direction (oscillation) to facilitate the engagement of the gear.
5. As soon as the gear is engaged, the PLC is informed, e.g. by means of the "Gear engaged" signal. This signal must be programmed in the user program to reset the CHANGE GEAR signal. The NC detects the end of gear changing when a new gear speed has been entered in QB 101.
6. The spindle is again enabled by the PLC and the spindle motor accelerates to the new rotational speed of the gear.

Note:

At the end of the gear changing, the CHANGE GEAR signal must be reset **by the PLC user program.**

**SET GEAR SPEED**

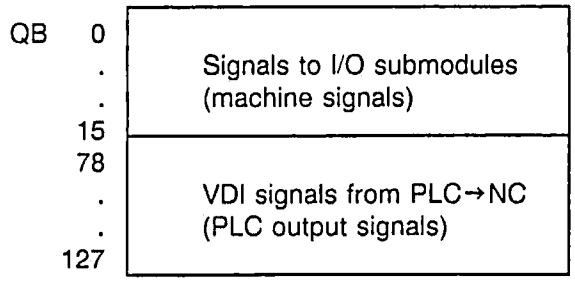
In the case of automatic gear speed selection (see Section 4.2.5 AUTOMATIC GEAR SPEED SELECTION signal), the SET GEAR SPEED is output in coded form as follows simultaneously with the CHANGE GEAR signal:

| Gear speed | Code C | B | A |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 1 |
| 3 | 0 | 1 | 0 |
| 4 | 0 | 1 | 1 |
| 5 | 1 | 0 | 0 |
| 6 | 1 | 0 | 1 |
| 7 | 1 | 1 | 0 |
| 8 | 1 | 1 | 1 |

## 4.2 PLC output signals (PLC→NC)

### 4.2.1 Ready signals of the PLC (PLC→NC)




**RESET**

1 signal: The NC is reset when a positive edge is encountered, the reset states are set (e.g. with G functions)
0 signal: The NC is not reset.

Note:

The RESET signal can originate either from the RESET key or from the PLC program.

**KEY-OPERATED SWITCH**

0 signal: Input via the keyboard of the NC operator panel is disabled according to the preset machine data.
1 signal: Input via the keyboard of the NC operator panel is enabled.

Note:

The KEY-OPERATED SWITCH signal can originate either from the key-operated switch of the machine control panel or from the PLC program.

**CYCLE INHIBIT**

1 signal: All protected cycles (subroutines of the manufacturer) cannot be input, changed, displayed or output.
0 signal: Access to the protected cycles is possible.

Note:

For maintenance purposes, a program should be provided for cancelling cycle inhibit.

***EMERGENCY STOP**

The EMERGENCY STOP button is located either on the standard machine control panel or on the customer operator panel at an easily accessible position. It is designed as a normally closed switch whose signal is wired to an input of the PLC input/output submodules.

1 signal: Operational state of the control; EMERGENCY STOP button has not been operated.
0 signal Emergency stop state of the control; EMERGENCY STOP button has been operated

Notes:

1) 0 signal causes rapid deceleration with maximum brake current of the feed drives and the spindle drive. After a period fixed by machine data has elapsed, the position control loops are opened and the NC goes into follow-up mode. The actual positional values are then also followed-up in the emergency stop state.
2) The feed and spindle drive converters should remain under power until completion of the braking process.
3) If the NC was not switched voltage-free in the EMERGENCY STOP state, the axes need not be resynchronized (reference point approach) after cancelling the EMERGENCY STOP state.

**DATA IN START 1 AND 2**

1 signal: Start of data input via the 1st or 2nd universal interface (e.g. NC part programs etc.).
0 signal: No start of data input.

Note:

The DATA IN START signal must exist for at least one PLC scan.

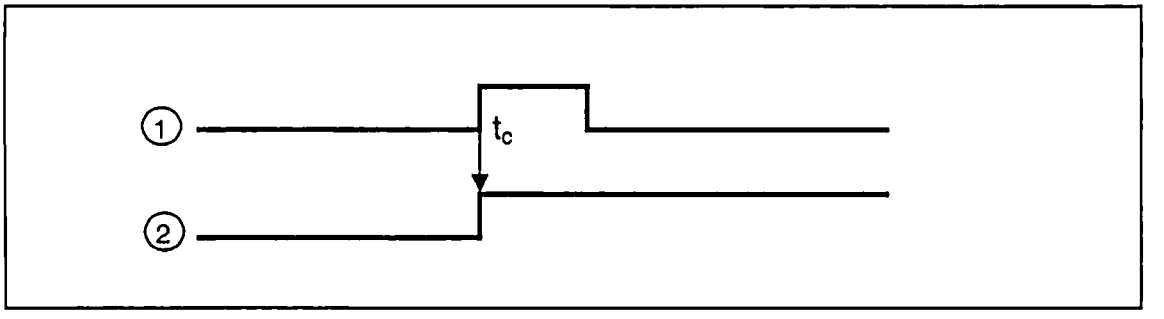



*Fig. 4.14*

1: DATA IN START signal ($t_c$ = PLC scan)
2: V.24 RUNNING signal

## 4.2.2 Program modification (PLC→NC)

### DRF EFFECTIVE

1 signal: During the AUT or MDA modes, handwheel operation is effective as well (differential resolver function).
0 signal: No handwheel operation is possible during the AUT or MDA modes.

Note:

In the AUT or MDA modes, a permanent contour offset (corresponding to the smallest input increment defined) can be set via 1 to 3 handwheels which are activated, for instance, by means of a key-operated switch. The offset is displayed separately and is retained even after unconditional blocks.

### MODES

The modes can be specified as follows with the selector on the external machine control panel or the integrated machine control panel:

| Position | Code D | C | B | A | Mode |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | PRESET |
| 2 | 0 | 0 | 1 | 1 | MDA |
| 3 | 0 | 0 | 1 | 0 | MDA |
| 4 | 0 | 1 | 1 | 0 | JOG |
| 5 | 0 | 1 | 1 | 1 | INCR 1 |
| 6 | 0 | 1 | 0 | 1 | " 10 |
| 7 | 0 | 1 | 0 | 0 | " 100 |
| 8 | 1 | 1 | 0 | 0 | " 1000 |
| 9 | 1 | 1 | 0 | 1 | " 10000 |
| 10 | 1 | 1 | 1 | 1 | REPOS |
| 11 | 1 | 1 | 1 | 0 | AUT |
| 12 | 1 | 0 | 1 | 0 | AUT |
| 13 | 1 | 0 | 1 | 1 | REF |
| 14 | 1 | 0 | 0 | 1 | (REF) |
| 15 | 1 | 0 | 0 | 0 | (REF) |
| 16 | 1 | 0 | 0 | 0 | (REF) |

Note:

The signals of the mode selector, for instance from the integrated machine control panel, are stored in input byte 95. From there, the mode codings can be transferred unmodified to the PLC/NC interface.
If required, the modes can also be specified directly by the PLC program.

## READ-IN ENABLE

AUT/MDA modes:

1 signal: Data transfer for the next block into main memory is enabled.
0 signal: Data transfer for the next block into the main memory is disabled.

JOG, INC or AUT mode interrupted:

1 signal: Activation of the auxiliary functions input via the NC operator panel with NC START is enabled.
0 signal: Activation of the input auxiliary functions is disabled.

Note:

If execution of the auxiliary function must have been completed before processing the next NC block (when changing tools for instance), the automatic block change must be prevented by cancellation of READ-IN ENABLE.

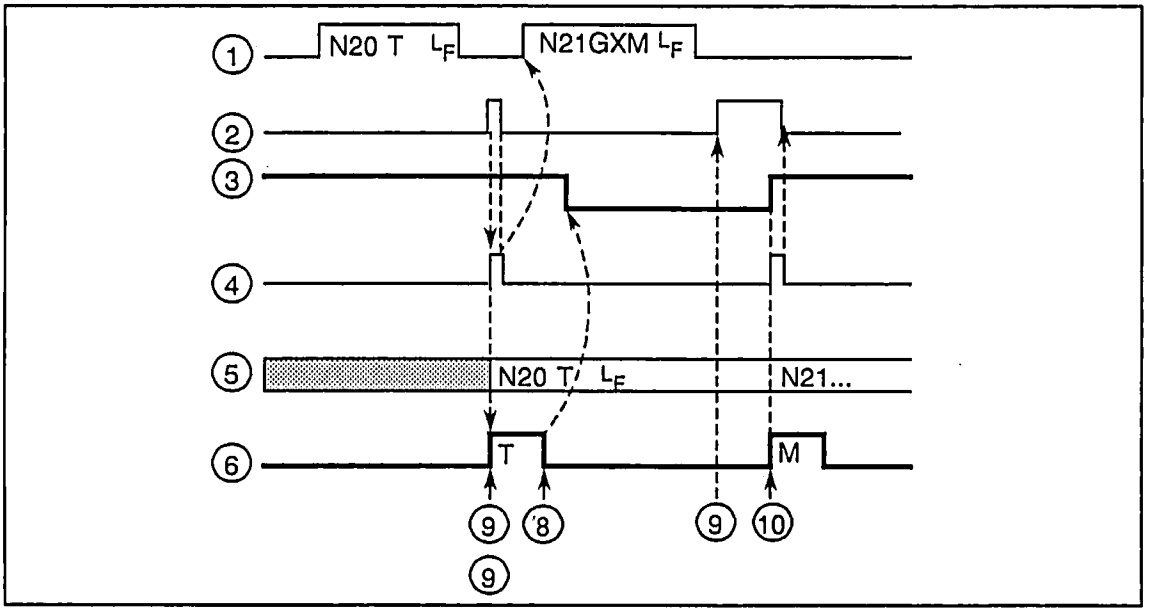



*Fig. 4.15*

1: Read-in into buffer memory
2: Block executed
3: READ-IN ENABLE signal
4: Data transfer to main memory
5: Contents of main memory
6: Output of auxiliary functions
8: Disable read-in for tool change
9: Point of scanning read-in enable signal on NC side
10: Reset READ-IN ENABLE

## DELETE DISTANCE TO GO

0/1 changeover : The distances to go (differences between set and actual positions) of all axes are deleted. Any following error is corrected. If a dwell block is active, it is aborted.
1/0 changeover: No effect.

Notes:

1) The DELETE DISTANCE TO GO signal must exist for at least one PLC scan.
2) After DELETE DISTANCE TO GO a program block containing G90 must follow at least for the deleted axis.

## DELETE NUMBER OF SUBROUTINE PASSES

1 signal: The actual number of remaining subroutine passes is deleted.
0 signal: No effect.

Notes:

1) By deleting the remaining number of subroutine passes, the NC can be synchronized with a machine position signalled from outside.
2) The subroutine currently running is executed normally up to M17.
3) The1 signal must exist up to the end of the subroutine and must be cancelled with M17.
4) To abort the subroutine execution deliberately, it is necessary to program @ 714 (clear buffer) in the last block before M17.

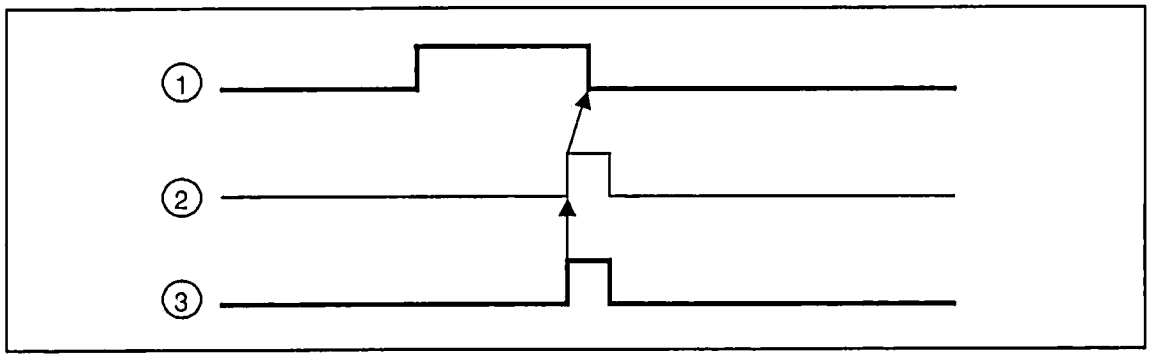



*Fig. 4.16*

1: DELETE NUMBER OF SUBROUTINE PASSES signal
2: Valid M17 decoded
3: M modification signal

## NC STOP

0/1 changeover: The current NC program is stopped immediately and the current block is not executed further. Distances to go are traversed only after restart.
1/0 changeover: No effect.

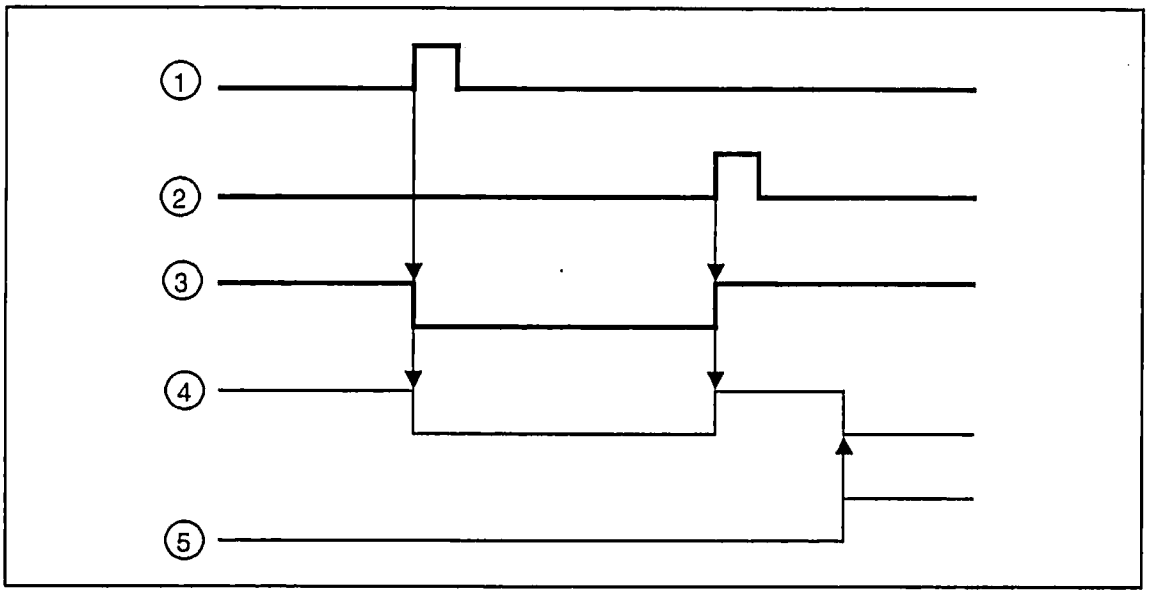



*Fig. 4.17*

1: signal NC STOP
2: signal NC START
3: signal PROGRAMM RUNNING
4: Axis moving
5: Block executed

Notes:

1) If the NC program has been stopped, additional auxiliary functions (for example) can be put into memory. They are executed at the next NC START.
2) The program is continued from the point of interruption with NC START. If additional auxiliary functions have been put into memory while a program was interrupted, only these are effective with the first Start signal. The program is then continued with the second NC Start.
3) The NC STOP signal must exist for at least one PLC scan.

## NC START, CHANNEL 1

AUT mode:

0/1 changeover: The selected NC program is started or continued. The programmed auxiliary functions are output.
1/0 changeover: No effect.

MDA mode:

0/1 changeover: The input block information is released for execution.
1/0 changeover: No effect.

JOG, INC modes:

0/1 changeover: The input M, S, T, H functions are released for execution.
1/0 changeover: No effect.

Notes:

1) The NC START signal must exist for at least one PLC scan.
2) Subroutines can also be selected and started directly (without part program).

## NC START, CHANNEL 2

AUT mode:

0/1changeover: The selected NC program is started or continued. The programmed auxiliary functions are output.
1/0changeover: No effect.

Notes:

1) The NC START signal must exist for at least one PLC scan.
2) The subroutines in channel 2 can be supplied and started only via the PLC (as external data). Calling and starting from channel 1 is not possible.

## SKIP BLOCK

1 signal : The blocks identified with / (slash) in the workpiece program are skipped, i.e. not processed.
If there is a series of blocks to be skipped, this signal is only effective if it exists before decoding of the first block in this series, preferably before NC Start.

0 signal : No effect.
If there is a series of blocks to be skipped, they are executed only if the signal is zero before decoding of the first block in this series, preferably before NC Start.

Note:

Since several blocks are decoded in advance (in pure calculation blocks the number is unlimited), the decision as to whether or not a block will be skipped can be made many blocks before processing proper. In order to make sure that the blocks to be skipped are in fact skipped at the right time, @714 "STOP DEC" must be programmed before each skippable block in the NC part program. If there are several skippable blocks in succession, the command must be programmed only before the first skippable block.

## SINGLE BLOCK

1 signal: In the AUT mode the program is executed in single block operation.
0 signal : No effect.

Notes:

1) If a contour definition is contained in a program block, only one contour element is executed with every start in the SINGLE BLOCK mode. If cutter radius compensation has been selected, intermediate blocks are inserted if required.
2) If there is a series of G33 blocks, SINGLE BLOCK is only effective if DRY RUN FEED has been selected.
3) Calculation blocks are not executed in single block mode.

## SINGLE BLOCK DECODING

1 signal: In the AUT mode, all program blocks are executed in single block mode.
0 signal: No effect.

Note:

In single block mode, normally only those blocks are executed block-by-block which contain traverse movements and/or auxiliary functions. Pure calculation blocks can also be tested in single block mode using the SINGLE BLOCK DECODING signal.

## DRY RUN FEED

1 signal: The dry run feed specified by setting data is effective instead of the programmed feed (with G01, G02, G03). The dry run feed is also effective instead of the feed per revolution and the feed for thread cutting.
0 signal: The programmed feed is effective.
If the signal changed to zero within a G33 block, the programmed feedrate becomes effective only at the end of the block.

Application example:

Test of the part program with increased feedrate.

## M01 EFFECTIVE

1 signal: M01 in the part program causes a programmed stop.
0 signal: M01 in the part program does not cause a programmed stop.

## 4.2.3 Feed modification (PLC→NC)

### FEED ENABLE TOTAL

1 signal: Causes feed enable of all axes.
0 signal : Causes feed enable of all axes, provided there is G33 (thread cutting).

Note:

On removing FEED ENABLE, the moving axes are stopped without deviating from the path contour. Position control is maintained, i.e. the following error is corrected.

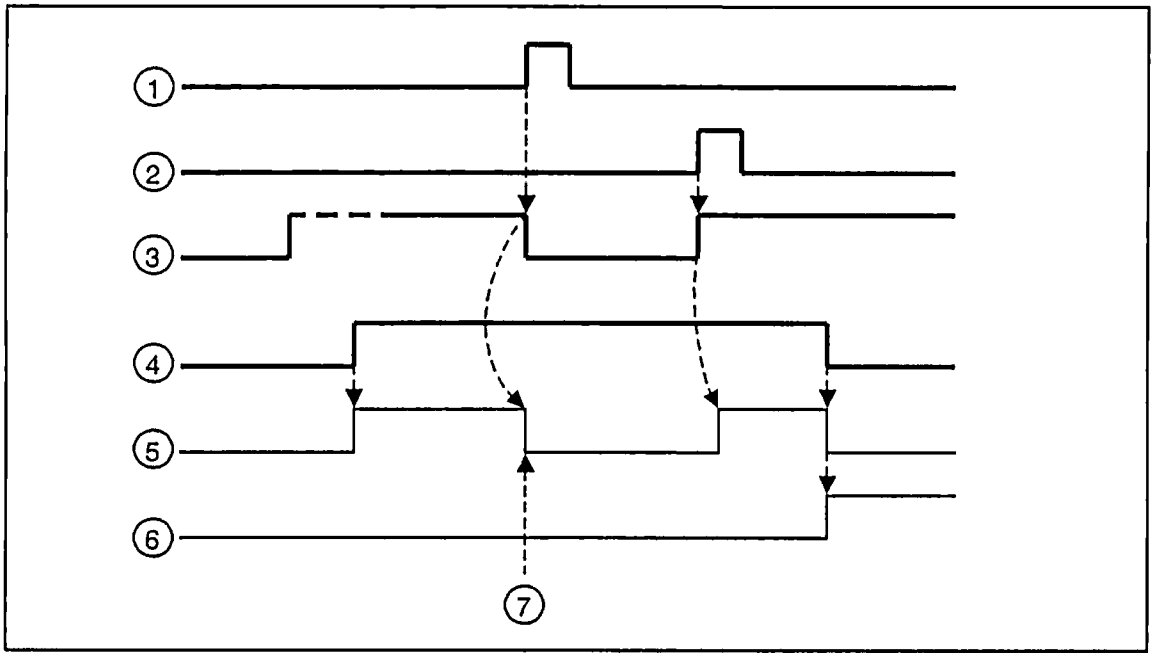



*Fig. 4.18*

1: Feed OFF signal
2: Feed ON signal
3: FEED ENABLE TOTAL signal
4: Travel command (e.g. X+)
5: (X-) axis moving
6: Block executed
7: Controlled approach

Application example:

Stopping machining by issuing a feed OFF signal from the operator panel.

## FEED OVERRIDE EFFECTIVE

1 signal: The feed override set on the machine control panel is effective.
0 signal : The feed override values set on the machine control panel are not effective; an override value of 100% is preset.

Application example:

By means of the FEEDRATE OVERRIDE EFFECTIVE signal, the feed override switch can be enabled during initial execution of a new NC program , for instance by means of the key-operated switch.

## FEED OVERRIDE

The feed override can be specified by means of the selector switch on the external machine control panel or via the integrated machine control panel as follows:

| Position | Code E | D | C | B | A | Override value in % |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 0 | 1 | 1 | 1 |
| 3 | 0 | 0 | 0 | 1 | 0 | 2 |
| 4 | 0 | 0 | 1 | 1 | 0 | 4 |
| 5 | 0 | 0 | 1 | 1 | 1 | 6 |
| 6 | 0 | 0 | 1 | 0 | 1 | 8 |
| 7 | 0 | 0 | 1 | 0 | 0 | 10 |
| 8 | 0 | 1 | 1 | 0 | 0 | 20 |
| 9 | 0 | 1 | 1 | 0 | 1 | 30 |
| 10 | 0 | 1 | 1 | 1 | 1 | 40 |
| 11 | 0 | 1 | 1 | 1 | 0 | 50 |
| 12 | 0 | 1 | 0 | 1 | 0 | 60 |
| 13 | 0 | 1 | 0 | 1 | 1 | 70 |
| 14 | 0 | 1 | 0 | 0 | 1 | 75 |
| 15 | 0 | 1 | 0 | 0 | 0 | 80 |
| 16 | 1 | 1 | 0 | 0 | 0 | 85 |
| 17 | 1 | 1 | 0 | 0 | 1 | 90 |
| 18 | 1 | 1 | 0 | 1 | 1 | 95 |
| 19 | 1 | 1 | 0 | 1 | 0 | 100 |
| 20 | 1 | 1 | 1 | 1 | 0 | 105 |
| 21 | 1 | 1 | 1 | 1 | 1 | 110 |
| 22 | 1 | 1 | 1 | 0 | 1 | 115 |
| 23 | 1 | 1 | 1 | 0 | 0 | 120 |
| 24 | 1 | 0 | 1 | 0 | 0 | |
| 25 | 1 | 0 | 1 | 0 | 1 | |
| 26 | 1 | 0 | 1 | 1 | 1 | |
| 27 | 1 | 0 | 1 | 1 | 0 | |
| 28 | 1 | 0 | 0 | 1 | 0 | |
| 29 | 1 | 0 | 0 | 1 | 1 | |
| 30 | 1 | 0 | 0 | 0 | 1 | |
| 31 | 1 | 0 | 0 | 0 | 0 | |

Notes:

The percentage values given in the table are stored as machine data. Only the machine data for positions 1 to 23 are entered as standard; the machine data not assigned can, however, be stored subsequently if required. Thus, it is also possible to evaluate the codes in positions 24 to 31 which are supplied by a connected coding switch or PLC program.

## RAPID TRAVERSE OVERRIDE EFFECTIVE

This signal is only effective if there is a separate rapid traverse override switch, e.g. on the customer operator panel.

1 signal: The rapid traverse override set on the customer operator panel is effective; (prerequisite: MD 5004 = 1).
0 signal: The rapid traverse override values set on the customer operator panel are not effective. An offset value of 100% is preset.

Application example:

The rapid traverse override switch can be enabled when installing a new NC program, by means of the key-operated switch for example, using the RAPID TRAVERSE OVERRIDE EFFECTIVE signal.

## RAPID TRAVERSE OVERRIDE

The rapid traverse override can be specified by means of the selector switch on the external customer operator panel as follows:

| Position | Code C | B | A | Override value in % |
|---|---|---|---|---|
| 1 | 0 | 0 | 1 | 1 |
| 2 | 0 | 1 | 1 | 10 |
| 3 | 0 | 1 | 0 | 50 |
| 4 | 1 | 1 | 0 | 100 |
| 5 | 1 | 1 | 1 | |
| 6 | 1 | 0 | 1 | |
| 7 | 1 | 0 | 0 | |

Notes:

1) The percentage values given in the table are stored as machine data. Only the machine data for positions 1 to 4 are standard; the machine data not assigned can be stored at a later time. Thus, it is also possible to evaluate the codes of positions 5 to 7 which are supplied by a connected coding switch or PLC program.
2) The values given in the table are effective only if the "Rapid traverse override switch available" machine data (5004.4) is set.
   If the bit is not set, rapid traverse override is determined by the setting of the feed override switch, limited to 100%.

## 4.2.4 Axis-specific signals (PLC→NC)

### MIRRORING ON SINUMERIK 810 T

The mirroring function is possible in the axes X and Z (all combinations).
For the axis X:

| | | |
|---|---|---|
| 1 signal: | Mirroring of | - programmed values<br>- tool nose radius compensation<br>- tool length compensation<br>- position of the tool nose |
| | **No mirroring of** | - zero offsets. |
| 0 signal: | Mirroring not effective. | |

Note:

When mirroring in the X axis, the **axis** is always mirrored.

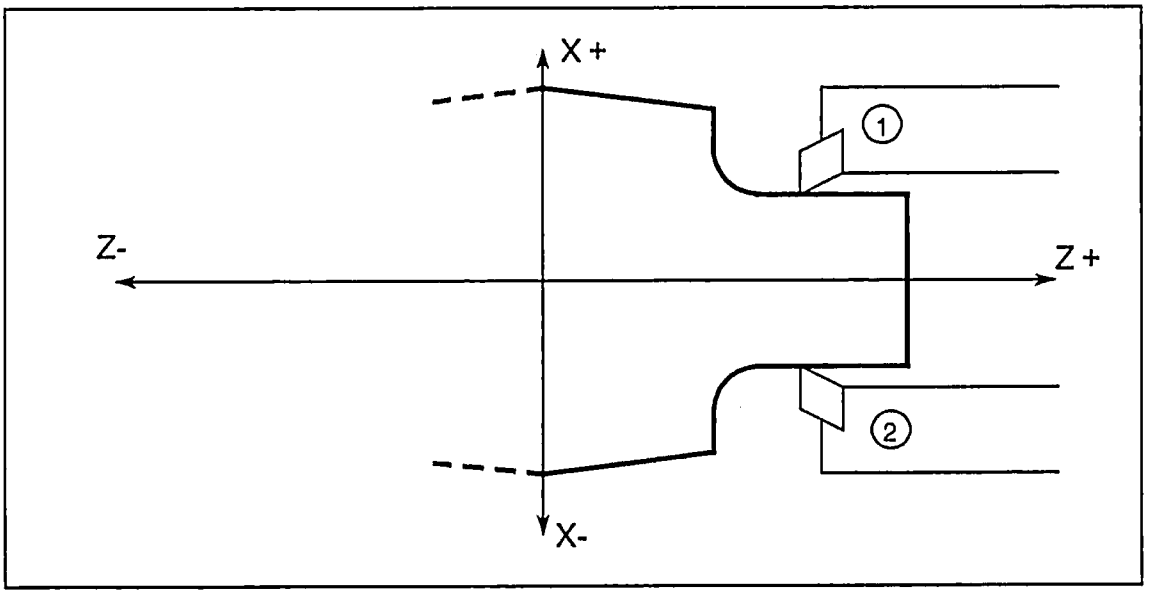



*Fig. 4.19 Mirroring in the X axis*

1: Normal: machining behind the turning centre
2: Mirrored: machining before the turning centre

For the axis Z:

| | | |
|---|---|---|
| 1 signal: | Mirroring of | - programmed values<br>- tool nose radius compensation (G41, G42) |
| | **No mirroring** of | - zero offset<br>- tool length compensation<br>- position of the tool nose |
| 0 signal: | Mirroring not effective. | |

Note:

When mirroring in the Z axis, the **workpiece** is always mirrored.

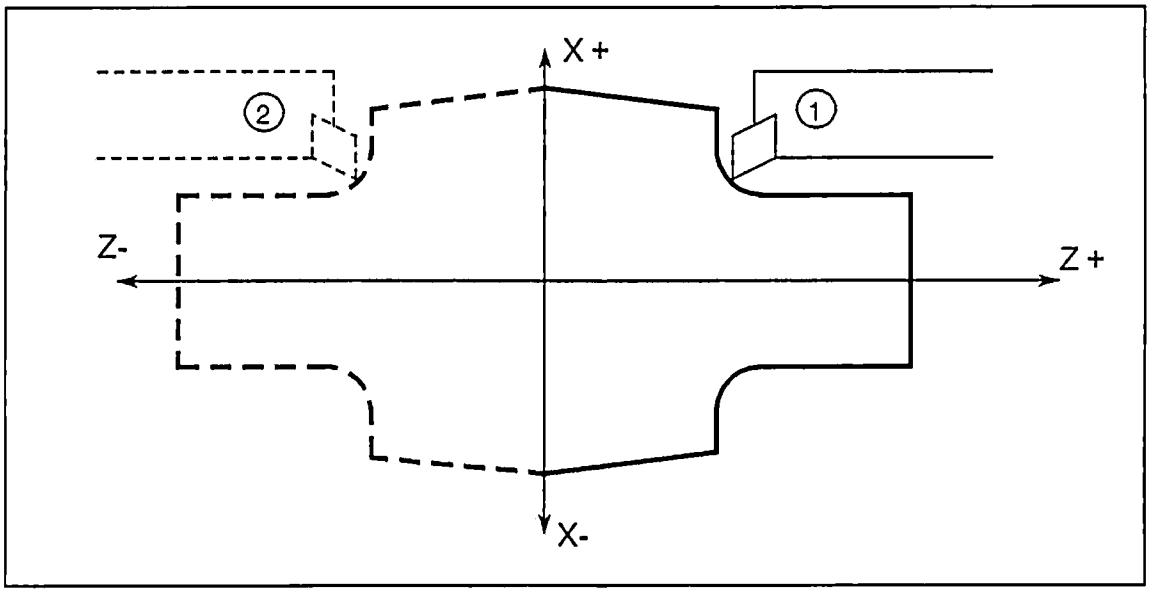



*Fig. 4.20 Mirroring in the Z axis*

1: Normal machining
2: Mirrored workpiece

## MIRRORING ON SINUMERIK 810 M

Mirroring is possible in the X, Y and Z axis (all combinations).
The following applies to the main axes:

1 signal: Mirroring of
- programmed values
- cutter radius compensation (G41, G42)

**No mirroring** of
- zero offset
- tool length compensation

Note:

When mirroring in the main axes X, Y and Z, the **workpiece** is always mirrored.

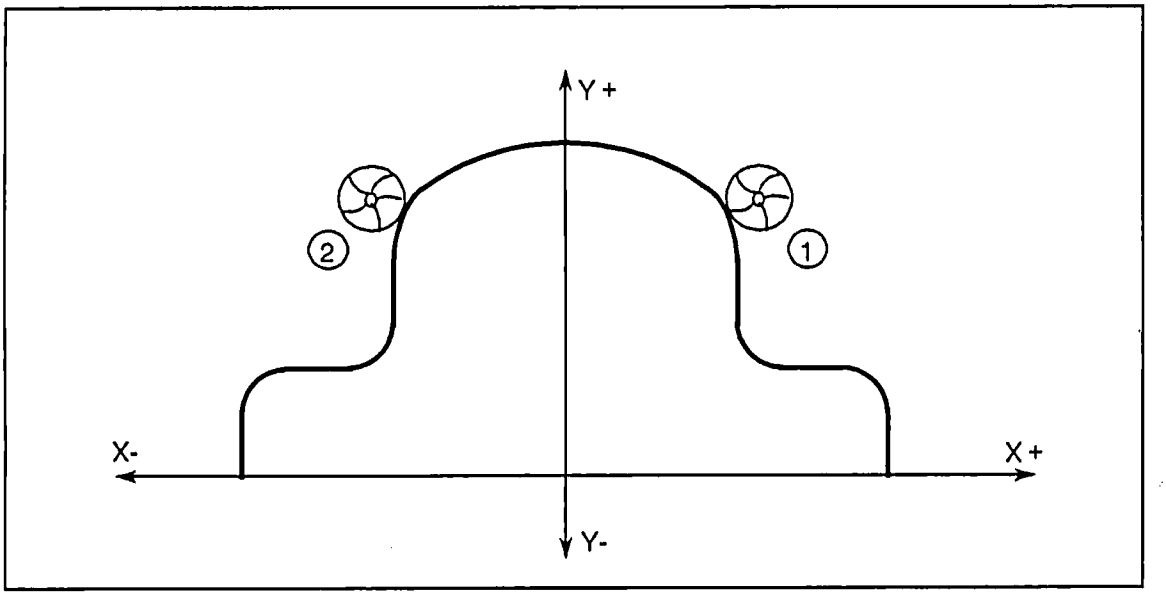



*Fig. 4.21 Mirroring in the X axis*

1: Normal machining
2: Workpiece mirrored in X

## FOLLOW-UP OPERATION

1 signal: NC position control loop is open; the drives are controlled by an external set speed value.
0 signal: Normal state, the NC position control loops are closed.

Notes:

1) A 1 signal opens the position control loop if the axis is stopped.
2) If the axis is moving, a 1 signal causes rapid braking with max. brake current and, after a time fixed via machine data has elapsed, the opening of the position control loop. Then only the actual position value is followed-up.
3) There is an axis stop for all axes moving with interpolation, if FOLLOW-UP OPERATION is set for **one axis**. The axis for which there is no follow-up operation can only be stopped by setting the command speed value ZERO. The following error of these axes is still eliminated.
4) If FOLLOW-UP OPERATION is specified for an axis moving with interpolation, an NC fault message is output. Further execution of the NC program is then no longer possible.
5) After cancellation of follow-up operation (0 signal), the axis need **not** be resynchronized (reference point approach).
6) In order to avoid wrong positioning, follow-up operation may be cancelled only when the program NC is the STOP state if AUT mode has been selected.

## FEED ENABLE

AUT/MDA mode

1 signal: Causes feed enabling of the respective axis.
0 signal: a) Causes feed stop of the respective axis.
b) Causes feed stop of **all axes moving with interpolation,** if the feed enabling signal is removed for **one axis.** In this case, all axes are stopped without deviation from the continuous path.
Position control is maintained, i.e. the following error is eliminated.

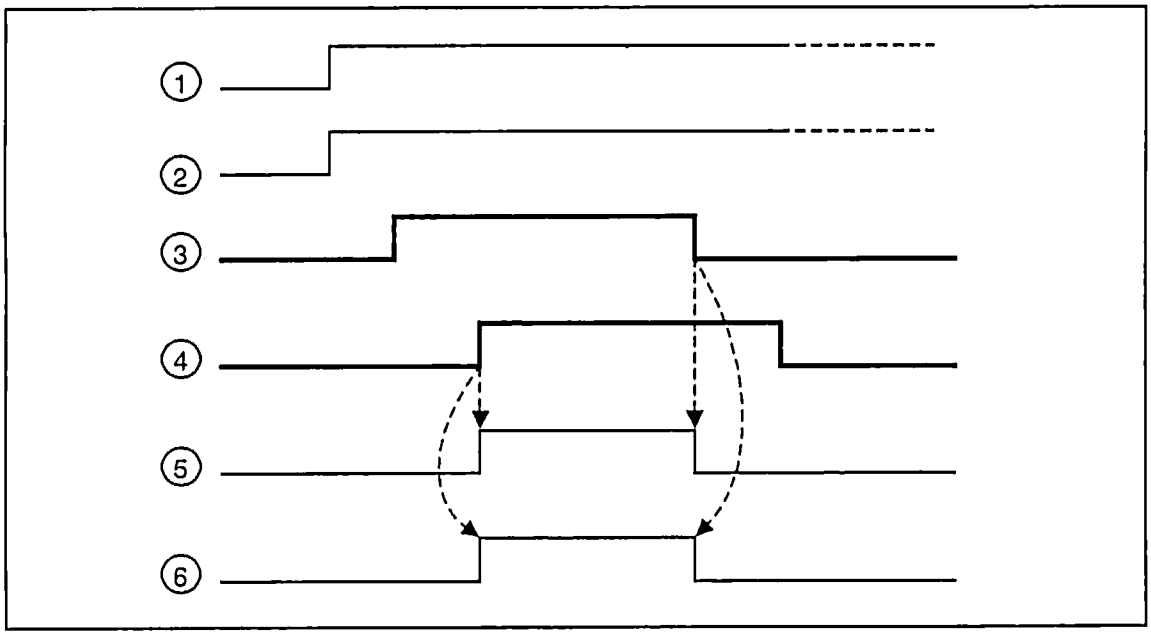



*Fig. 4.22*

1: Travel command (e.g. +X)
2: Travel command (e.g. +Z)
3: signal FEED ENABLE X
4: signal FEED ENABLE Z
5: X axis moving
6: Z axis moving

Set-up modes:

1 signal: Causes feed enabling of the respective axis.
0 signal: Causes feed stop of the repective axis.

***DECELERATION**

Only effective in APPROACH REFERENCE POINT mode:

1/0 changeover: Causes deceleration of the selected axis to an internally settable creep speed (machine data).
0/1changeover: Causes the zero point of the measuring system to be approached plus (2 mm distance ± reference point offset).

Reference point approach without automatic detection of direction, e.g. for 810 T:

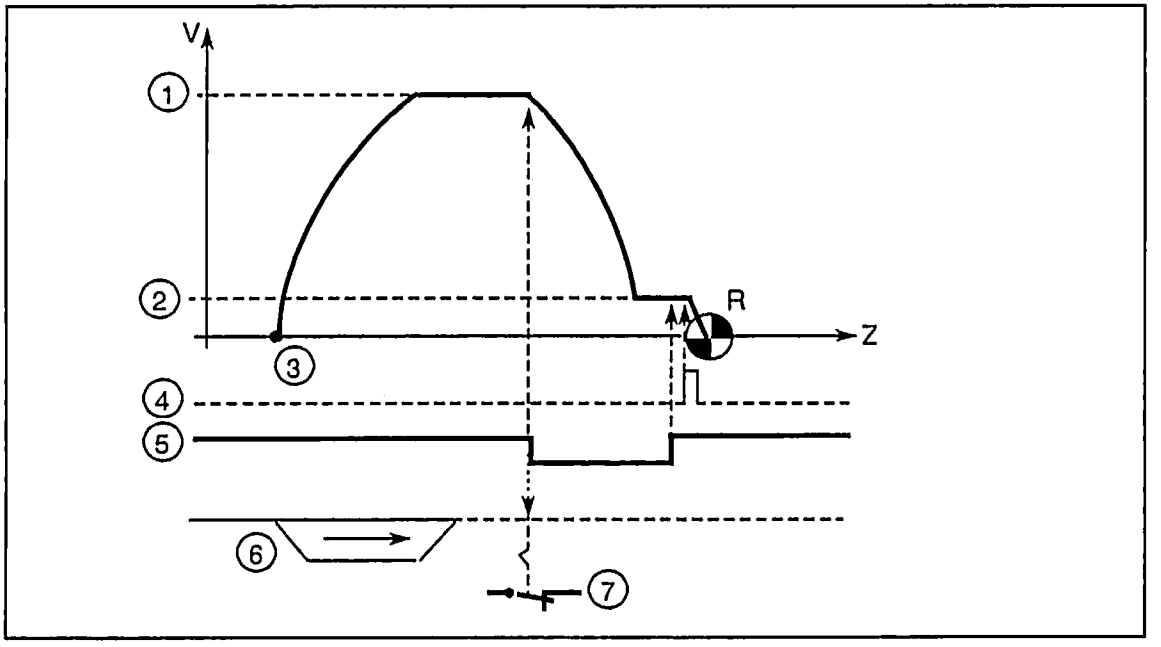



*Fig. 4.23*

1: Speed of reference point approach
2: Creep speed
3: Starting point for reference point approach
4: Signal for measuring system zero
5: *DECELERATION signal
6: Operating cam
7: Limit switch

Sequence:

The Z axis must be positioned at the starting point, e.g. in negative direction from the reference point. The operator presses direction key Z+ and the axis approaches the reference point. As soon as the operating cam passes the limit switch, the *DECELERATION signal changes from 1 to 0: The axis decelerates to creep speed. As soon as the operating cam clears the limit switch, approach to the next measuring system zero is initiated when the *DECELERATION signal changes from 0 to 1. As soon as the zero point signal appears, the axis homes in to the reference point.

Conditions:

The limit switch issuing the *DECELERATION signal should be a normally-closed switch. If the connection to the limit switch is interrupted, this is detected and the axis approach prevented.

Reference point approach with automatic detection of direction:

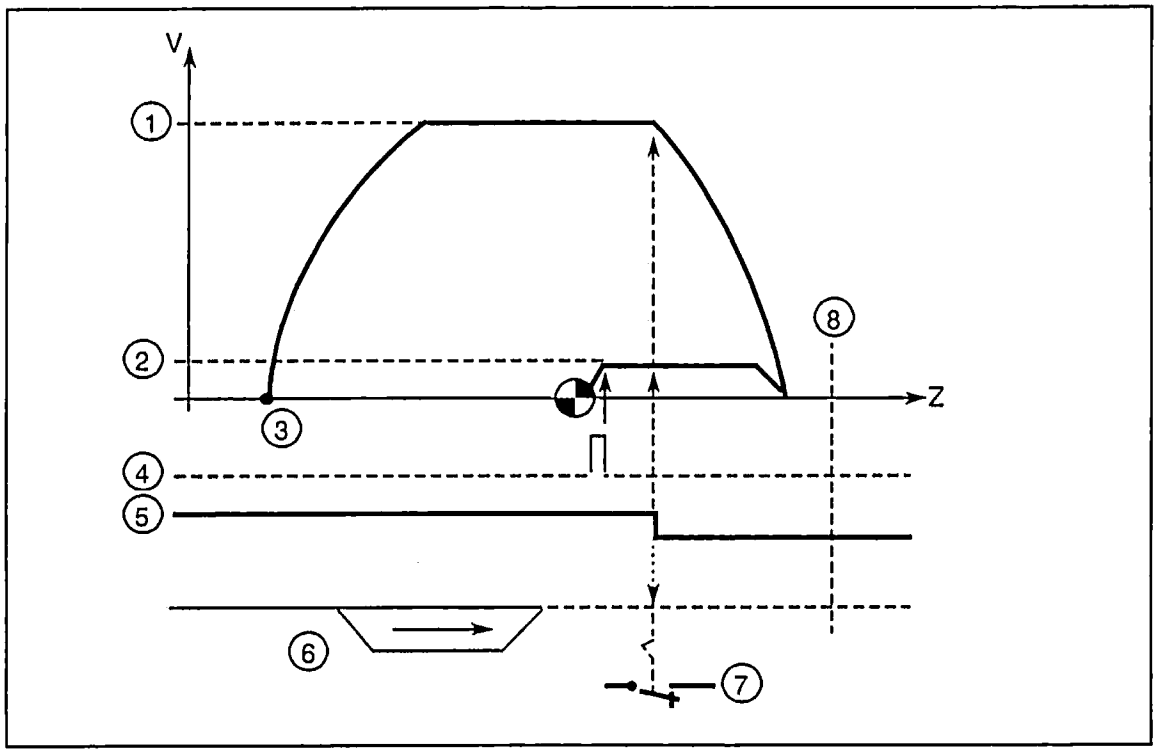



*Fig. 4.24*

1: Speed of reference point approach
2: Creep speed
3: Starting point for reference point approach
4: Signal for measuring system zero
5: signal *DECELERATION
6: Operating cam
7: Limit switch
8: Machine end, end of traverse path

Sequence 1:

The Z axis is situated at the starting point, e.g. in negative direction from the reference point. The operator presses direction key Z+ which has been defined by machine data as starting key for the approach to the reference point. The axis approaches the machine end at which the reference point is situated. The direction is detected (*DECELERATION signal = 1). As soon as the operating cam passes the limit switch, the *DECELERATION signal changes from 1 to 0: the axis decelerates to zero speed and accelerates to creep speed in the opposite direction. On clearing the limit switch, approach to the next measuring system zero is initiated when the *DECELERATION signal changes from 0 to 1. As son as the zero point signal appears, the axis homes in to the reference point.

Sequence 2:

If, at the start of the approach to the reference point, the axis is situated between machine end and reference point (*DECELERATION signal = 0) and if key Z+ is then pressed, the Z axis approaches the reference point at creep speed in the negative direction.

Conditions:

- Due to the special operating cam (length: from machine end to switching point), this procedure is only suitable for reference points situated near the machine end.
- The cam may not leave the limit switch from the switching point to the machine end (end of traverse path), i.e. the *DECELERATION signal remains "0".
- The limit switch issuing the *DECELERATION signal must be a normally-closed switch. If the connection to the limit switch is interrupted (*DECELERATION signal = 0), the axis can only accelerate to creep speed.

**PARKING AXES**

1 signal: Axis is in parking position.
0 signal: No effect.

Notes:

1) If an axis is declared as PARKING AXIS, the monitoring of the connection between measuring sensor and measuring circuit module is switched off.
   Accordingly there is no alarm if this connection is opened (e.g. to remove the axis, such as a rotary table, from the machine).
2) In addition, a PARKING AXIS must be switched to FOLLOW-UP OPERATION to prevent the monitoring functions of the position control (e.g. standstill monitoring) being triggered.
3) If the PARKING AXIS signal is removed, the axis must either be resynchronized or the actual value of the current position must be given by means of "Set actual value" (PRESET).

## CONTROLLER ENABLE

AUT/MDA mode:

1 signal: Causes closing of the position control loop of the respective axis.
0 signal: a) Causes opening of the position control loop if the axis is stationary.
b) Causes rapid deceleration if the axis is moving.
The drive is stopped with max. brake current and the position control loop is opened after a time set by machine data has elapsed.
c) All axes travelling in interpolation are stopped, if the controller enable is cancelled for **one axis.** The axes for which CONTROLLER ENABLES are still valid can be stopped only by setting the set speed value ZERO. The following error of these axes is eliminated. Further execution of the NC program is then no longer possible since the axes cannot reach their programmed set position (NC block is not executed).

Set-up modes:

1 signal: Enables the control loop for the respective axis.
0 signal: a) Opens the position control loop if the axis is stationary.
b) Causes rapid deceleration if the axis is travelling.

Notes:

1) A following error remaining after rapid deceleration remains stored and is only compensated after renewed controller enable.
2) If the controller enable is cancelled while the axes are travelling, an alarm NC is output.
3) During normal operation, the controller enable signals must be available for all axes to be moved with interpolation.

CONTROLLER ENABLE

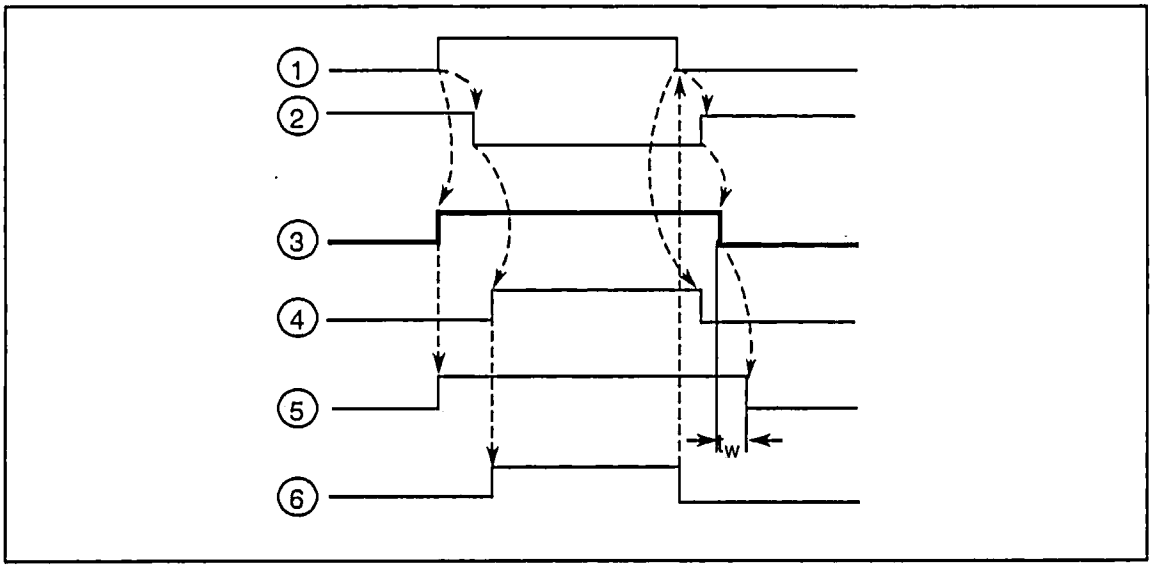



*Fig. 4.25*

1: TRAVEL COMMAND signal (e.g. +X)
2: X axis clamp
3: CONTROLLER ENABLE X signal
4: FEED ENABLE X signal
5: *Controller disable X
6: X axis travelling ($t_w$ = deceleration time)

Sequence:

1) The travel command of the axis (e.g. X-) unclamps the axis and enables the controller.
2) Controller enable ends controller disable.
3) As soon as the clamp is released, the feed enable signal is output and the axis travels.
4) On cancellation of the travel command, the axis stops and is again clamped. The feed enable signal is cancelled.
5) After clamping, the controller enable signal is cancelled; after a deceleration time $t_w$ (machine data), the signal for controller disable is again set.

**2ND SOFTWARE LIMIT SWITCH +/- EFFECTIVE**

1 signal: Second software limit switch is effective for the +/- direction.
0 signal: First software limit switch effective.

Application example:

Reduction of the permissible traversing range with the tailstock swung in.

### JOG +/-

1 signal: In the set-up modes, the axis is moved in the preset direction.
0 signal: No effect.

Notes:

1) The axis traversing speed is determined by machine data in accordance with the operating mode.
2) If the "+" and "-"-keys of an axis are pressed simultaneously, no traverse command is activated.
3) Up to two axes can be traversed simultaneously; if the direction keys for more than 2 axes are pressed at the same time, the order of pressing decides which keys are effective.

### RAPID TRAVERSE OVERRIDE

1 signal: When traversing in the JOG, REPOS set-up modes via JOG +/-, the simultaneous setting of the RAPID TRAVERSE OVERRIDE signal causes rapid traverse.
0 signal: Jogging at the speed set by machine data.

### AXIS DISABLE

1 signal: No position setpoint value is output to the respective machine axis (axis disabled). The position control loop remains closed.
0 signal: Normal state.

Note:

In order to avoid erroneous positioning, AXIS DISABLE may be cancelled only after program end or abortion.

Application example:

Initialization of a new NC program without the axes traversing.

**HANDWHEEL 1, 2 or 3 ACTIVE**

With handwheel selection, handwheels are assigned to the axes.

1 signal: The handwheel corresponding to the bit causes traversing of the axis.
0 signal: The handwheel corresponding to the bit does not act on the axis.

Notes:

1) Each handwheel can be assigned to any axis.
2) Each handwheel may be assigned to only one axis at a time.
3) Per axis, the following signal combinations are allowed:

| Handwheel | | |
|---|---|---|
| 3 active | 2 active | 1 active |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 0 | 0 | 1 |

Only the above bit combinations may be set.

## 4.2.5 Spindle modification (PLC→NC)

**SPINDLE ENABLE**

1 signal: Causes enabling of the spindle drive so that the spindle is accelerated in accordance with the ramp characteristic.
0 signal: Causes stopping of the spindle and reduction of the spindle speed in accordance with the ramp characteristic.

Notes:

1) If spindle enable is cancelled, the default set speed is ZERO.
2) If the spindle is again enabled, the previous set speed is activated.

**CONTROLLER ENABLE**

1 signal: Enables the spindle controller, the position control loop is closed.
0 signal: a) Opens the position control loop if the spindle is at rest.
b) With the spindle running, this signal causes rapid deceleration. The spindle is stopped with maximum brake current and the interface for the drive is separated after a certain time fixed by machine data has elapsed.

Note:

Cancellation of the controller enabling signal with the spindle running causes a alarm NC to be output.

### PRESET ZERO SETPOINT

1 signal: The current speed setpoint is overwritten with ZERO and thus causes deceleration of the spindle in accordance with the ramp characteristic.
0 signal: No effect.

Note:

Normally, the ZERO speed setpoint is automatically set at program end or on program abort. If it is suppressed by machine data, then this must be done via the ZERO SETPOINT INPUT signal in accordance with criteria which must be given in the PLC program.

### SPINDLE OVERRIDE EFFECTIVE

1 signal: The spindle override set on the machine control panel is effective.
0 signal: The spindle override values set on the machine control panel are not effective; the offset value is fixed at 100%.

Application example:

With the SPINDLE OVERRIDE EFFECTIVE signal, the spindle override switches can be enabled during installation of a new NC program , for instance by means of the key-operated switch.

### SPINDLE OVERRIDE

The spindle override can be set by means of selector switches on the external machine control panel, on an external customer operator panel or the integrated machine control panel as follows:

| Position | Code D | C | B | A | Override value in % |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | 50 |
| 2 | 0 | 0 | 1 | 1 | 55 |
| 3 | 0 | 0 | 1 | 0 | 60 |
| 4 | 0 | 1 | 1 | 0 | 65 |
| 5 | 0 | 1 | 1 | 1 | 70 |
| 6 | 0 | 1 | 0 | 1 | 75 |
| 7 | 0 | 1 | 0 | 0 | 80 |
| 8 | 1 | 1 | 0 | 0 | 85 |
| 9 | 1 | 1 | 0 | 1 | 90 |
| 10 | 1 | 1 | 1 | 1 | 95 |
| 11 | 1 | 1 | 1 | 0 | 100 |
| 12 | 1 | 0 | 1 | 0 | 105 |
| 13 | 1 | 0 | 1 | 1 | 110 |
| 14 | 1 | 0 | 0 | 1 | 115 |
| 15 | 1 | 0 | 0 | 0 | 120 |
| 16 | 1 | 0 | 0 | 0 | 125 |

Note:

The percentage values given in the table are standard values stored as machine data. If necessary, they can be changed.

**REVERSE M03/M04**

1 signal: The setpoint voltage defined for M03/M04 is reversed.
0 signal: No reversal.

Application example:

In the case of mechanical transmissions (e.g. drilling heads) the direction of rotation is reversed mechanically. The correct rotation can be obtained with REVERSE M03/M04.

**AUTOMATIC SELECTION OF GEAR SPEED**

1 signal: This signal must always be set to "1" statically if "Automatic selection of gear speed" is required for the NC program.
0 signal: The set gear speed is not selected automatically.

Note:

If there is a 1 signal , the gear speed is selected automatically by the NC according to the programmed S value provided that constant cutting speed (G96) does not apply. The limit speeds of the individual gear speeds are preset via machine data and may overlap each other within the change limits. The aim is to avoid frequent gear changes. This means that the spindle is kept in the same gear speed until the upper or the lower speed limit is reached; only at the limits of the current set gear speed does the NC change gear. Normally, the limits of gear changing will more or less overlap so that a wide range of spindle speeds is available in any one gear.
(See Section 4.1.4 CHANGE GEAR signal.)

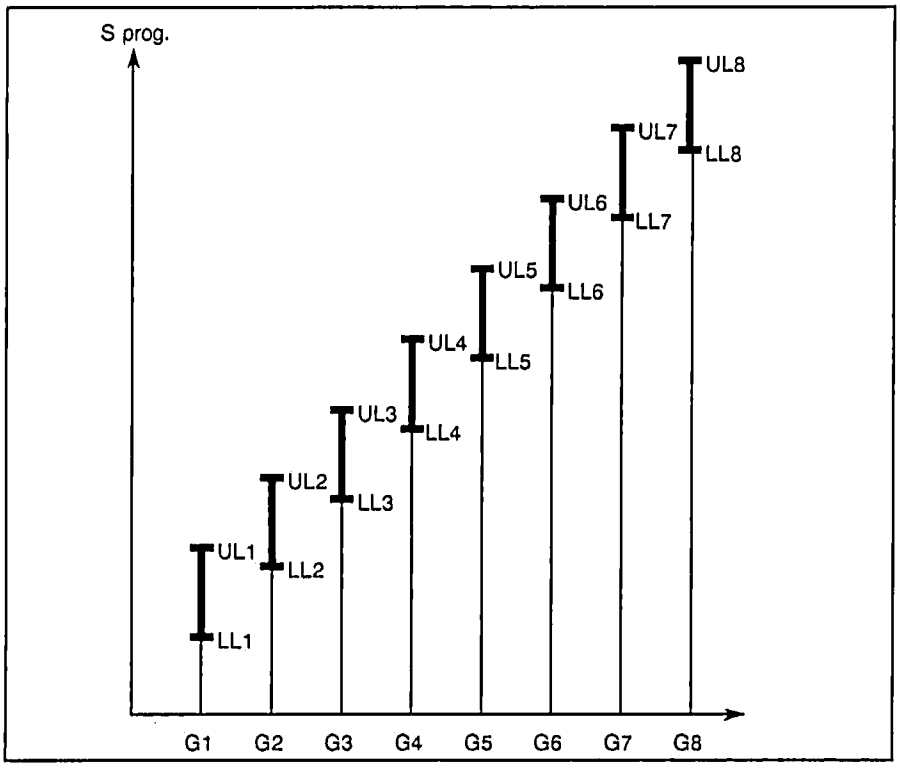



*Fig. 4.26*

| | | |
|---|---|---|
| UL | : | Upper speed limit of the gear |
| LL | : | Lower speed limit of the gear |
| G1-G8 | : | Gear speeds 1 to 8 |
| S prog | : | Programmed S value |

## ACTUAL GEAR SPEED

A wide speed range of the main spindle is obtained by a change-speed gear in the power train of the DC spindle motor. The set speed preset via the NC program with the S value is always the speed of the main spindle and not the speed of the DC motor. Accordingly, the current gear speed must be taken into account when calculating the set speed to be output via an S analog word.
The actual gear speed must therefore be output to the NC in the following code:

| Gear speed | Code C | B | A |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 1 |
| 3 | 0 | 1 | 0 |
| 4 | 0 | 1 | 1 |
| 5 | 1 | 0 | 0 |
| 6 | 1 | 0 | 1 |
| 7 | 1 | 1 | 0 |
| 8 | 1 | 1 | 1 |

Notes:

1) The lowest spindle speed range is assigned to gear speed 1.
2) If there are less than 8 speeds, the codings for the gear speed not available must not be transferred to the NC.
3) The signals for the actual gear speed are transferred to the NC at the end of a PLC cycle and cause an immediate change of the spindle speed.

## SET ROTATION CLOCKWISE

1 signal: PLUS setpoint voltage is output (rotation clockwise).
0 signal: MINUS setpoint voltage is output (rotation counterclockwise).

Notes:

1) The SET ROTATION CLOCKWISE signal is effective only in conjunction with the OSCILLATION SPEED or ADJUSTING SPEED signals.
2) When the spindle is controlled through the NC, i.e. when the spindle speed is given by the NC program or the NC operator panel, the SET ROTATION CLOCKWISE signal is ineffective.

## OSCILLATION SPEED

1 signal: A fixed oscillation speed (spindle-specific machine data) is specified for the spindle motor.
0 signal: No effect.

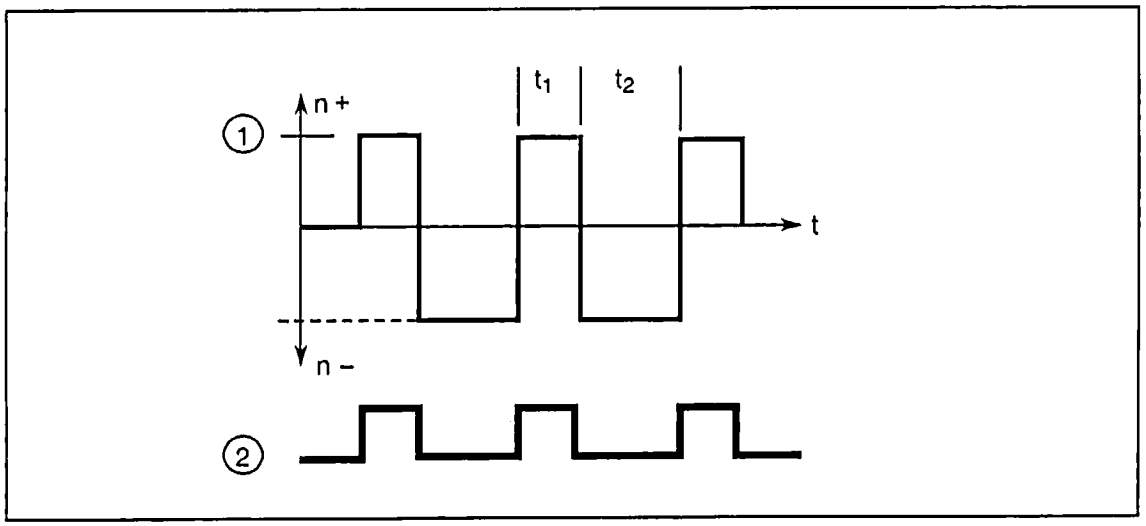



*Fig. 4.27*

1: Oscillation speed of motor
2: SPINDLE SET ROTATION CLOCKWISE signal ($t_1$ not equal to $t_2$)

Notes:

1) The oscillation speed is set via machine data; the SPINDLE OFFSET is **not** effective.
2) The **motor speed**, not the spindle speed, is preset with the oscillation speed.
3) The period $t_1$ and $t_2$ of the respective direction of rotation is given with the SET ROTATION CLOCKWISE by the user program in the PLC. On changing the direction of rotation, the ramp characteristic is ignored.
4) If no oscillation is required, the direction of rotation must be preset.

Application example:

Gear changing with oscillation of the drive motor in order to facilitate engagement of the gears (see Section 4.1.4, description of CHANGE GEAR signal).

### ADJUSTING SPEED

The ADJUSTING SPEED signal is effective in all modes.

1 signal: A fixed adjusting speed for the spindle is given.
0 signal: No effect.

Notes:

1) The adjusting speed, a very low fixed set speed, is preset via machine data; SPINDLE OFFSET is effective.

2) With the adjusting speed, the **spindle speed** is specified, i.e. the current gear speed is taken into account when calculating the speed setpoint for the spindle motor.

Application example:

Rotate spindle at very low speed for measuring processes.

### SPINDLE POSITIONING

1 signal: Positioning of the spindle is started (e.g. for a tool change).
0 signal: No effect.

Notes:

1) The set spindle position is determined via machine data (4520).
2) With the spindle running, positioning is carried out without changing the direction of rotation.
3) With the spindle not running, positioning is carried out with the least possible rotation.
4) The spindle rotates the creep speed specified in the machine data (also applies to M19 = option).

Application example:

Positioning of the spindle to the tool or tool change position.

### RESYNCHRONIZE SPINDLE

1 signal: The spindle is resynchronized to the encoder.
0 signal: No effect.

Notes:

RESYNCHRONIZE SPINDLE is effective only in conjunction with PLC SPINDLE CONTROL.

Application example:

Resynchronization of encoder and spindle control, for example when the encoder is changed **with** the drilling head.

### ACKNOWLEDGE M19

1 signal: Position control for the spindle is cancelled. The signal is effective only if "M19 active" (I 114.1) has previously been transferred from NC to PLC.
0 signal: No effect.

Note:

If the "M19 active" (I 114.1) function has been selected, "ACKNOWLEDGE M19" cancels the spindle position control. The signal must be generated in the PLC program as follows:
AI114.1 (M19 active)
AI114.1 (Spindle position reached)
A "User signal"
AQ103.2 (ACKNOWLEDGE M19)

Application example:

Positioning of the spindle to the tool change position; tool change can only be programmed with M06 without M19 if the PLC has been activated as a result of M06 POSITION SPINDLE.

### SPINDLE DISABLE

1 signal: Causes the spindle to stop, the spindle speed being reduced by means of the acceleration time constants (at least one signal = 1).
"Position spindle" by M19 or POSITION SPINDLE is cancelled by SPINDLE DISABLE.
0 signal: Causes enabling of the spindle drive, the spindle being accelerated by means of the acceleration time check.

Notes:

1) If spindle disable is given, the default setpoint speed is ZERO.
2) If the spindle is again enabled, the previous setpoint is effective.
3) Spindle disable is activated if at least one bit has a 1 signal.
4) A message can be assigned to each bit (fault or status message).
5) The acceleration time constants are stored in NC-MD419*.

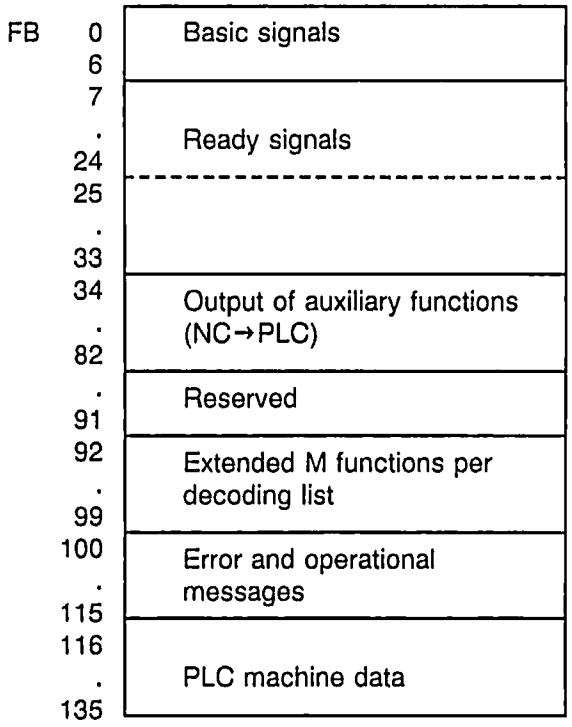
### PLC SPINDLE CONTROL

1 signal: Enabling of PLC interface signals (SET ROTATION CLOCKWISE, OSCILLATION SPEED, ADJUSTING SPEED, POSITION SPINDLE, RESYNCHRONIZE SPINDLE).
0 signal: Spindle control by the NC.

Notes:

If only PLC SPINDLE CONTROL is set, the set rotation is counterclockwise! If a new S word is transferred from the NC program during PLC SPINDLE CONTROL, it is effective only after PLC SPINDLE CONTROL has been removed.

## 4.3 Output of auxiliary functions (NC→PLC)




The M, S, T, H auxiliary functions are output to the interface together with the respective modification signals. The modification signals indicate that the value in the auxiliary function word is valid. The modification signals apply for one PLC scan. If several auxiliary functions are programmed in an NC block, up to three functions are output to the interface at the same time within one PLC cycle. This also applies if 3M functions are programmed in one block. If more than 3 items of information are programmed in one NC block, the output is divided up over up to 3 PLC scans. When all information has been output, the "Last information" signal is also output.
The auxiliary functions M, S, T and H can be written with extended address. If an auxiliary function has been programmed with extended address, this is also output. The output sequence is: M word 1, M word 2, M word 3, S, T, H.

Example for the output of several items of information programmed in one NC block:

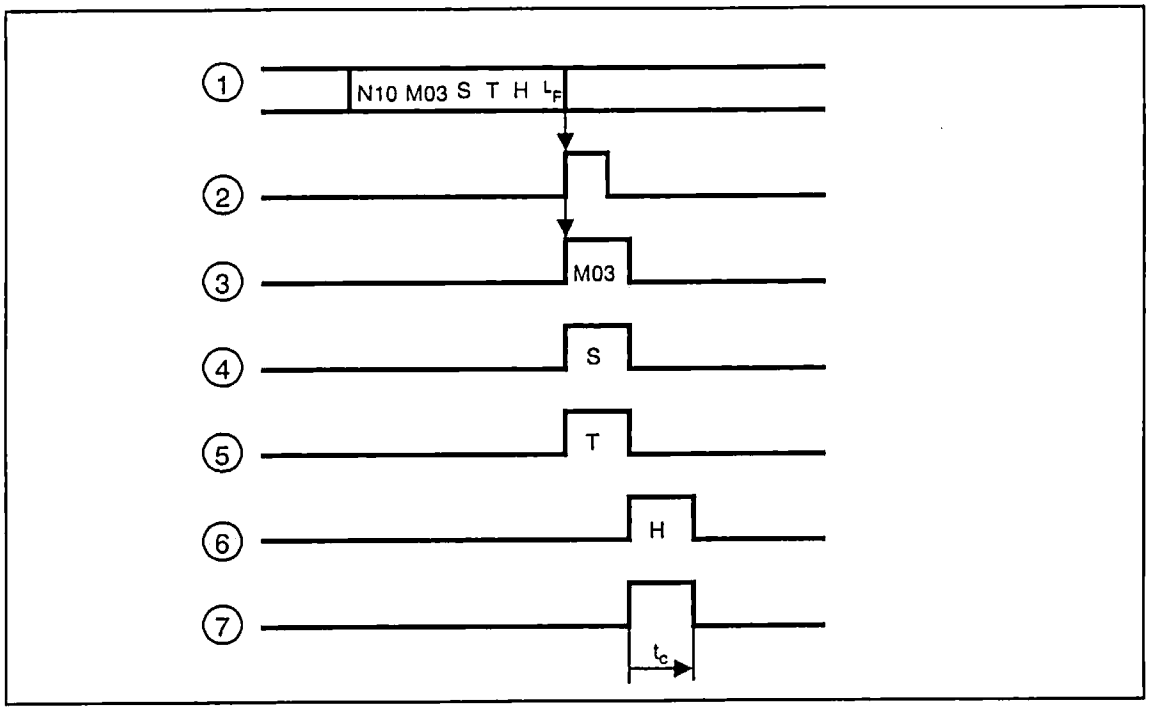



*Fig. 4.28*

1: NC block with information in the buffer
2: Data transfer into the main memory
3: M modification signal
4: S modification signal
5: T modification signal
6: H modification signal
7: LAST INFORMATION signal

The following can be determined by means of machine data:

a) Output of information before or at the beginning fo the NC axis movement (NC-MD 5003.2).
b) Which information is output at block search (NC-MD 546-).
c) Binary or BCD output of information (PLC-MD 2001).

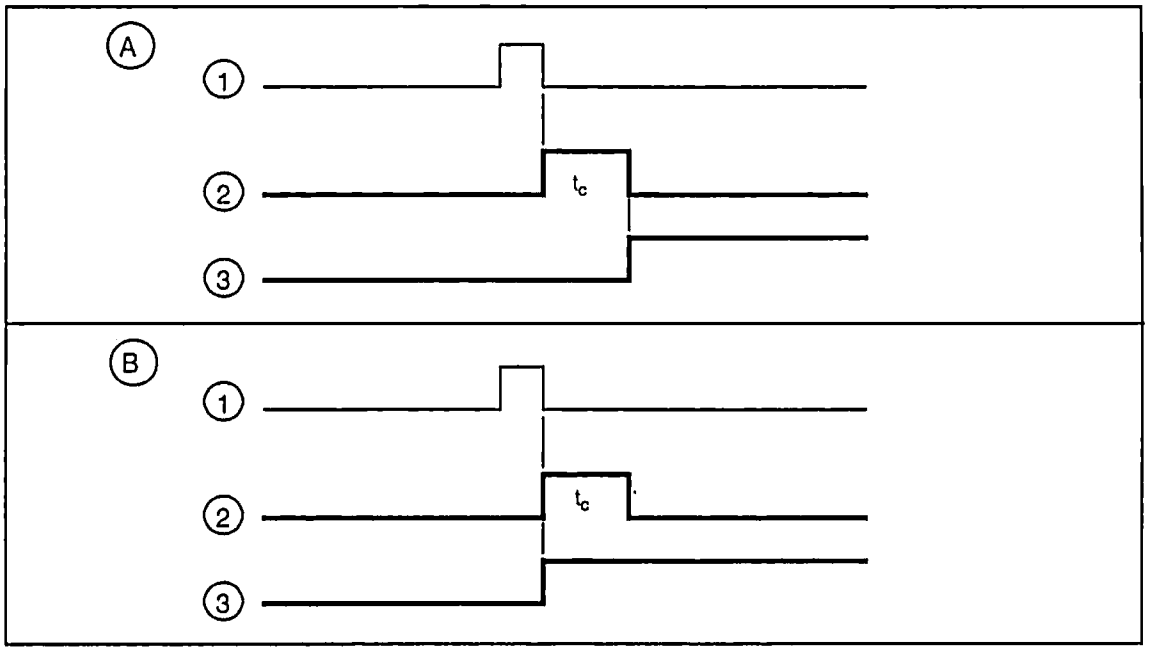



*Fig. 4.29*

A: Output of information before axis movement
B: Output of information with axis movement
1: Reading-in of NC block into main memory
2: Information at the interface (word and modification signal, $t_c$ = PLC scan time)
3: TRAVEL COMMAND signal

In the case of M functions, decoded signals are output in addition to the words, both in **static and dynamic form.**
Static signals are set once by the basic program after decoding. The following M functions are decoded:

Without extended address: M00 - M99
With extended address: 32 M functions in accordance with decoding list (DB 80)

If an M function does not come from the range M00 - M99 and is not contained in the decoding list, then the M word and "M NOT DECODED" are output.

If an S, T or H function appears in the NC program running on channel 2, the PLC operating system considers this to be an error and outputs an appropriate message (alarm number starting from 6032).
With M functions, a dynamic bit and a static bit are output in addition to the word.
A static M function is retained by the PLC user until deleted; a dynamic M function is deleted again automatically by the PLC operating system after one PLC cycle.

## 4.3.1 Behaviour in different modes

### 4.3.1.1 BLOCK SEARCH mode

Three types of auxiliary functions can be selected via NC machine data:

a) during block search, auxiliary functions are neither stored nor output;
b) during block search, the programmed auxiliary functions are output immediately with modification signal;
c) during block search, the NC stores each time the last auxiliary function of an address; after the NC start, these stored auxiliary functions are output together with the related modification signals (see figure: output of M functions).
Up to three M functions are stored and output, provided that they were programmed in one block (!) and provided that there is no M function following this block up to the search block.

After reaching the block selected, auxiliary functions can be stored manually.

### 4.3.1.2 AUTOMATIC mode

After the decoding of the auxiliary functions in the NC, they are output - together with the related modification signal - to the interface. The modification signal only lasts for one PLC cycle. The auxiliary function words are retained until a new block programmed with M, S, T, H, functions is decoded by the NC.

### 4.3.1.3 JOG, INC, MDA, AUT mode interrupted

M, S, T and H functions can be stored manually. The INPUT key serves to input the new value of the operating mode. Erroneous values keyed in are deleted by means of the CLEAR key. The auxiliary function is output to the interface with the corresponding modification signal only when NC START is issued (duration: one PLC cycle).

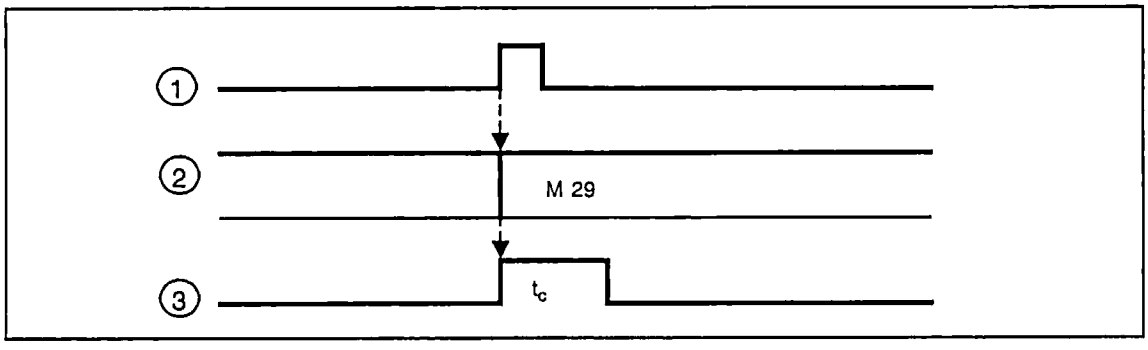



*Fig. 4.30*

1: NC START
2: Auxiliary function, e.g. M29
3: M modification signal ($t_c$ = PLC cycle time)

## 4.3.2 Description of auxillary function signals

### LAST AUXILIARY FUNCTION, CHANNEL 1

1 signal: The last auxiliary function programmed in the NC block (M, S, T or H function) is at the interface as a valid word with the modification signal.
0 signal: The last auxiliary function of the NC block is not yet available or no auxiliary function is output (none programmed).

Note:

This signal only exists for one PLC scan (together with the output modification signal).

### M WORD 1, M WORD 2, M WORD 3, M, S, T, H MODIFICATION

1 signal: The M, S, T, or H function is output to the interface with a new value.
0 signal: The value of the respective auxiliary function is not valid.

Note:

The modification signals exist for one PLC scan at a time.

### M WORD 1, M WORD 2, M WORD 3 NOT DECODED

This signal exists together with the associated M modification signal for one PLC scan.

1 signal: M word greater than 99 (ext. addr. = 0) and not contained in decoding list.
0 signal: M word less than 99 (ext. addr. = 0) and/or contained in decoding list.

### M WORD 1, M WORD 2, M WORD 3

Up to three functions programmed in one NC block are available here as soon as the M modification signals exist.

Format: Fixed-point number or BCD number (value range 0-9999)
Ext. address: Fixed-point number or BCD number (value range 0-99)

Note:

With the functions M3, M4, M5 and M19, the spindle referred to by the M function is addressed by means of the extended address. It is generally advisable to relate the M function to a specific channel by means of the extended address.

Application example:

Decoding or evaluation of M functions which are not decoded as standard or decoded via list.

## STATIC M SIGNALS, CHANNELS 1 AND 2

The static M signal flags are merely set via M functions decoded by the NC. They remain at "1" until they are reset by a command in the PLC user program.
Up to three M signals are set per PLC cycle.

## DYNAMIC M SIGNALS, CHANNELS 1 AND 2

The dynamic M signal flags are set by means of decoded M functions in the same way as the static M signal flags, but they remain at "1" for only one PLC scan before being reset by the PLC operating system. Up to three M signals are output per PLC cycle.

Application example:

Switching-on of the coolant by static polling of a static M signal.
Switching-off of the coolant by resetting the static M signal with a dynamic M signal.

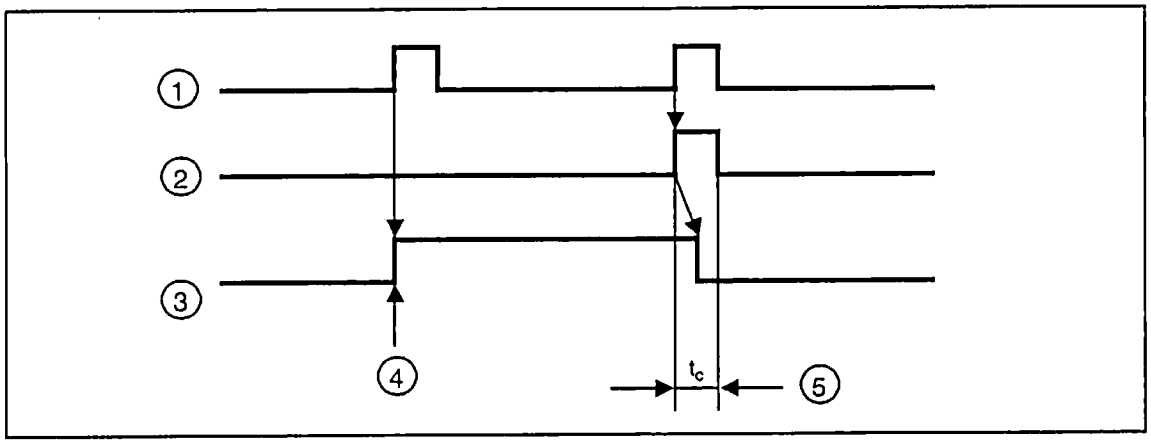



*Fig. 4.31*

1: M modification signal
2: Dynamic M signal
3: Static M signal (coolant ON)
4: Static M signal is set
5: Static M signal is reset per user program within one PLC scan via the dynamic M signal ($t_c$ = PLC scan time)

### S WORD, CHANNEL 1

As soon as an S modification signal appears, the S value programmed in the NC is made available.

Format: Fixed-point number or BCD number (value range 0-12000; BCD: 0-9999)
Ext. address: Fixed-point number or BCD number (value range 0-9)

Note:

If an S value exceeding the selected value range (BCD or fixed-point) is programmed, only the related maximum value is output. This also applies to the output of an analog value.

Application example:

Gear speed selection from the PLC.

### T WORD, CHANNEL 1

The tool number programmed in the NC (T no.) is made available as soon as a T modification signal appears.

Format: Fixed-point number or BCD number (value range 0-9999)

Application example:

Control of automatic tool selection.

### H WORD, CHANNEL 1

The auxiliary function programmed in the NC is prepared as soon as an H modification signal appears.

Format: Fixed-point number or BCD number (value range 0-9999)

Application example:

Switching functions on the machine.

## 4.3.3 Structure of M decoding list

A data block DB80 must be preset as decoding list for decoding the M functions with extended address. Up to 32 M values can be decoded using the list. Also, the function must be selected via PLC machine data.

| | Ext. M addr. | M address | PLC bit address (DB 30) | |
|---|---|---|---|---|
| | 0-99 (KF) | 0-9999 (KF) | FY No. 93-99 (KY) | Bit No. 0-7 (KY) (stat. bit) |
| 1st value | DW 0 | DW 1 | DL 2 | DR 2 |
| 2nd value | DW 3 | DW 4 | DL 5 | DR 5 |
| | | | | |
| 32nd value | DW 93 | DW 94 | DL 95 | DR 95 |

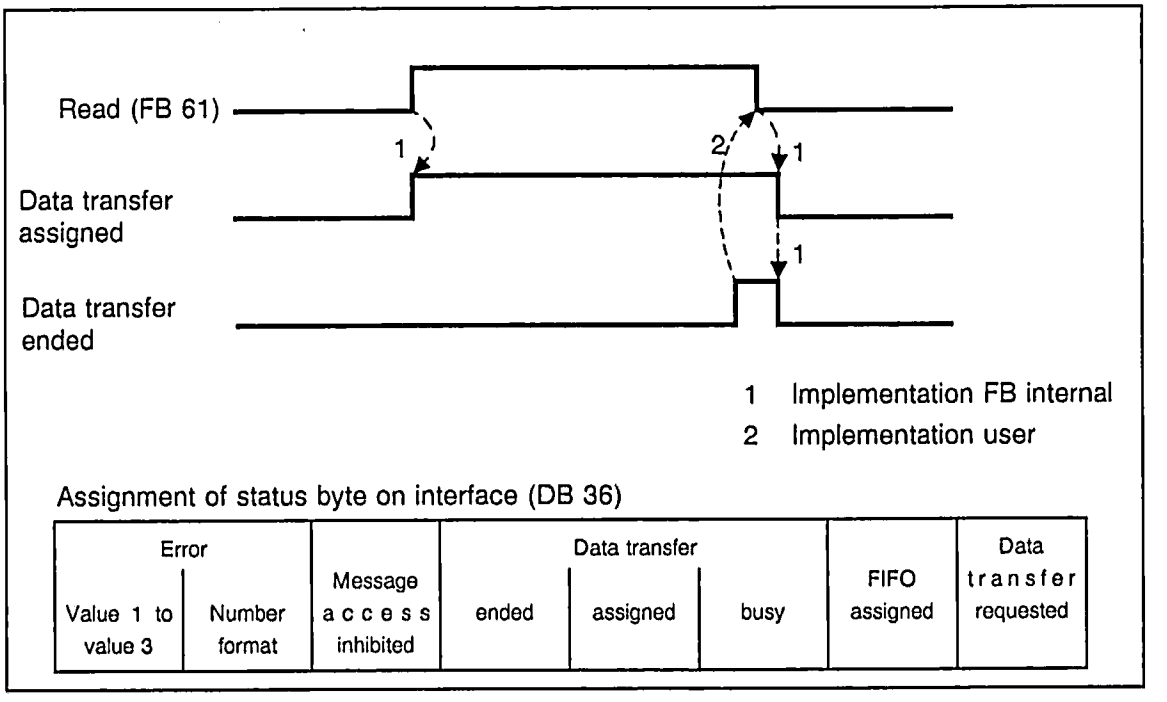
Note:
The data block must be set up in modulo 3 steps (e.g. DW 0-2 or DW 0-5, DW 0-8, ...).

## 4.4 Data transfer PLC initiative

***For further information on the parameterization of function blocks 61 and 62, please refer to the PLC Programming Guide***

### 4.4.1 Structure with example

Data can be exchanged between PLC and NC via data channels. Function blocks are available in basic program 2 for activating data transfer:
Read NC data (FB 61) and write NC data (FB 62).
The function blocks enter the parameters for data transfer (data type, data source, data target) into an internal interface. The interface is a first-in/first-out (FIFO) register and can hold up to 8 jobs. This ensures that, even when there are several jobs, they are executed in the correct sequence.
A job must still be assigned an interface byte showing the status of data transfer (DB36, DW0 - DL32 corresponds to 65 interface bytes). Data transfer can be checked and branches performed in the user program according to these acknowledgements.
Fig. 4.32 shows the main signal diagrams.




Assignment of status byte on interface (DB 36)

| Error | | Message | Data transfer | | | FIFO | Data |
|---|---|---|---|---|---|---|---|
| Value 1 to value 3 | Number format | access inhibited | ended | assigned | busy | assigned | transfer requested |

*Fig. 4.32 Main signal diagrams, data transfer NC/PLC*

If data transfer is initiated on FB61 at the READ input, for example, the "DATA TRANSFER ASSIGNED" signal is immediately output on the interface. Because this signal exists until the end of data transfer, it can be used among other things for the purposes of read-in disable. When data transfer has ended, the "DATA TRANSFER ENDED" signal is output. This signal is not reset until the user cancels the READ signal on the FB.
In order to reduce the load on the PLC program when calling the FB61/62 function blocks more than one, FB61/FB62 can be called either unconditionally or conditionally.
The advantage of an unconditional block call is that the FB can be initialized simply.

Fig. 4.33 shows the signal diagrams of all signals when a block is called unconditionally.

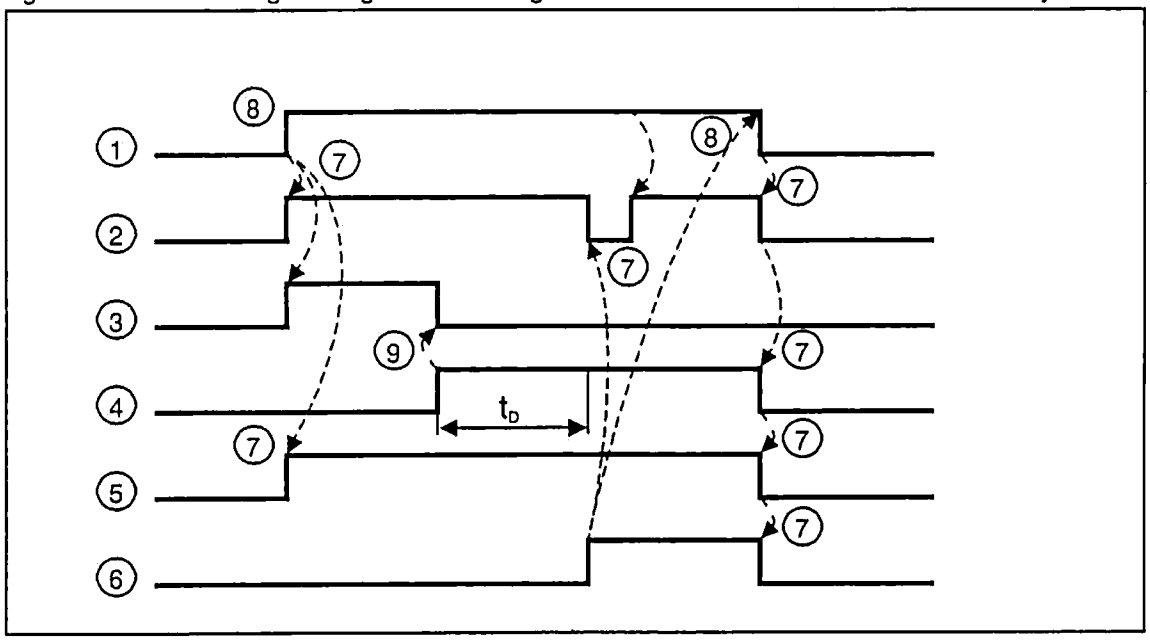



*Fig. 4.33 Signal diagrams for unconditional block call*

1: READ/WRITE
2: DATA TRANSFER REQUESTED
3: FIFO ASSIGNED
4: DATA TRANSFER BUSY
5: DATA TRANSFER ASSIGNED
6: DATA TRANSFER ENDED and fault (if any)
7: Signal change by FB
8: Signal change by user
9: Signal change by FB; omitted if FIFO not yet full
$t_D$: Assignment of internal interface by data transfer

The FBs can, optionally, also be called conditionally, i.e. processing of the FBs must take place only until the job has been transferred to the job buffer (FIFO). This is notified by DATA TRANSFER BUSY.
Fig. 4.34 shows the related signal diagrams.

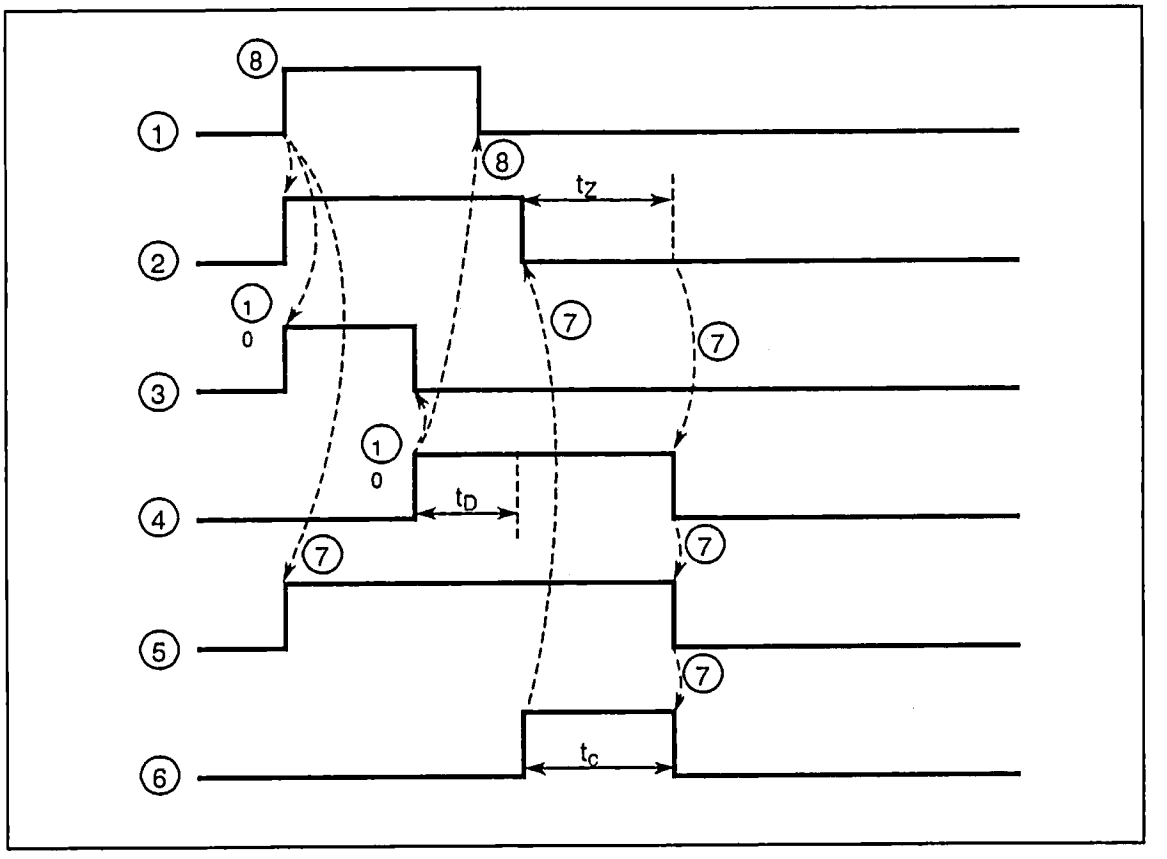



*Fig. 4.34 Signal diagrams for conditional block call*

1: READ/WRITE
2: DATA TRANSFER REQUESTED
3: FIFO ASSIGNED
4: DATA TRANSFER BUSY
5: DATA TRANSFER ASSIGNED
6: DATA TRANSFER ENDED and fault (if any)
7: Signal change by FB
8: Signal change by user
9: User no longer calling block
10: Signal change by FB; omitted if FIFO not yet full
$t_c$: PLC cycle time
$t_D$: Assignment of internal interface by data transfer

If the function blocks are incorrectly parameterized (e.g. data source unknown in the PLC), the PLC branches into the stop loop. The number of the interface byte and an error ID are stored in accu 2 of the interrupt stack.
Fig. 4.35 shows as an example the parameterization of FB61 for reading the "Machine-specific actual value of axis" for the 3rd axis. (Data type, AXPM). The actual value should be stored in DB150 in data words 10, 11 and 12.

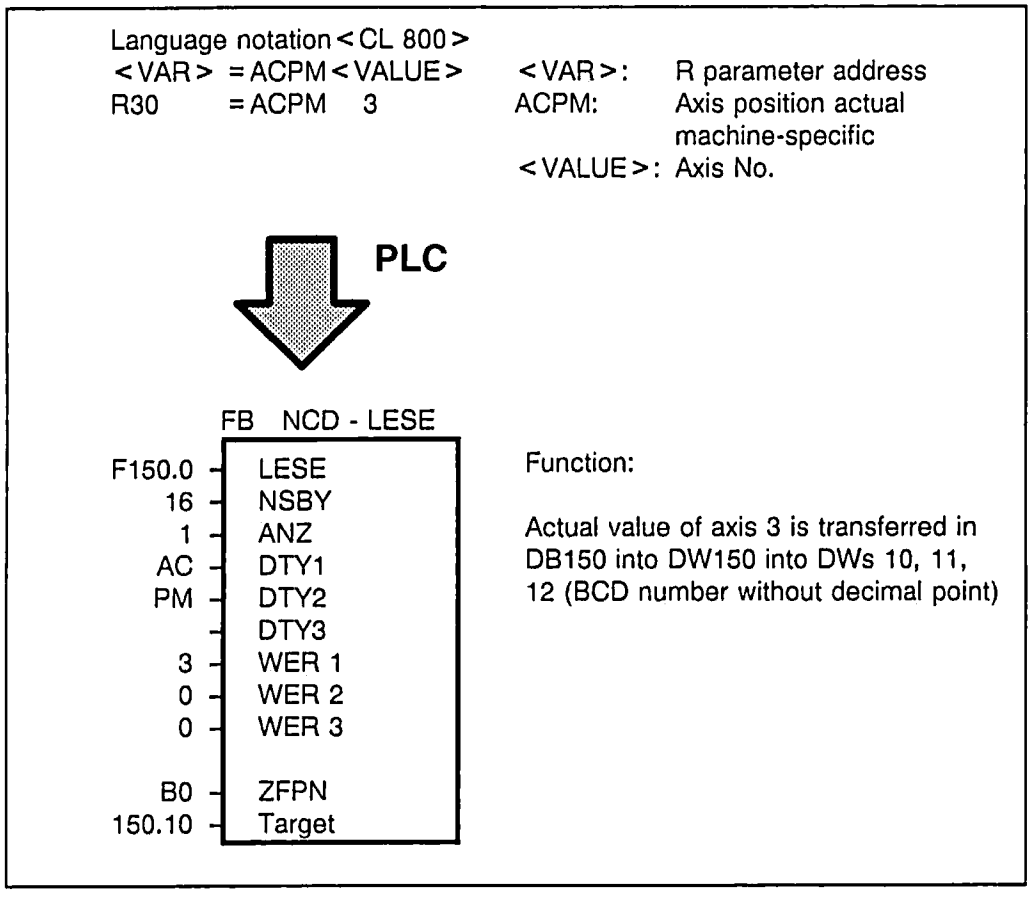



*Fig. 4.35 Read actual axis value*

When transferring data via the PLC, the number format is converted depending on parameter ZFPN of FBs 61 and 62. The following number formats are possible:

| Parameter ZFPN | Format | Target/source in PLC DBs |
|---|---|---|
| BI<br>F.<br>B. | Bit pattern<br>Fixed-point number 32 bit<br>BCD number with sign and comma | DR n<br>DW n, DW n+1<br>DW n, DW n+1, DW n+2 |

Fig. 4.36 shows an example for format conversion with fixed-point representation in the PLC.

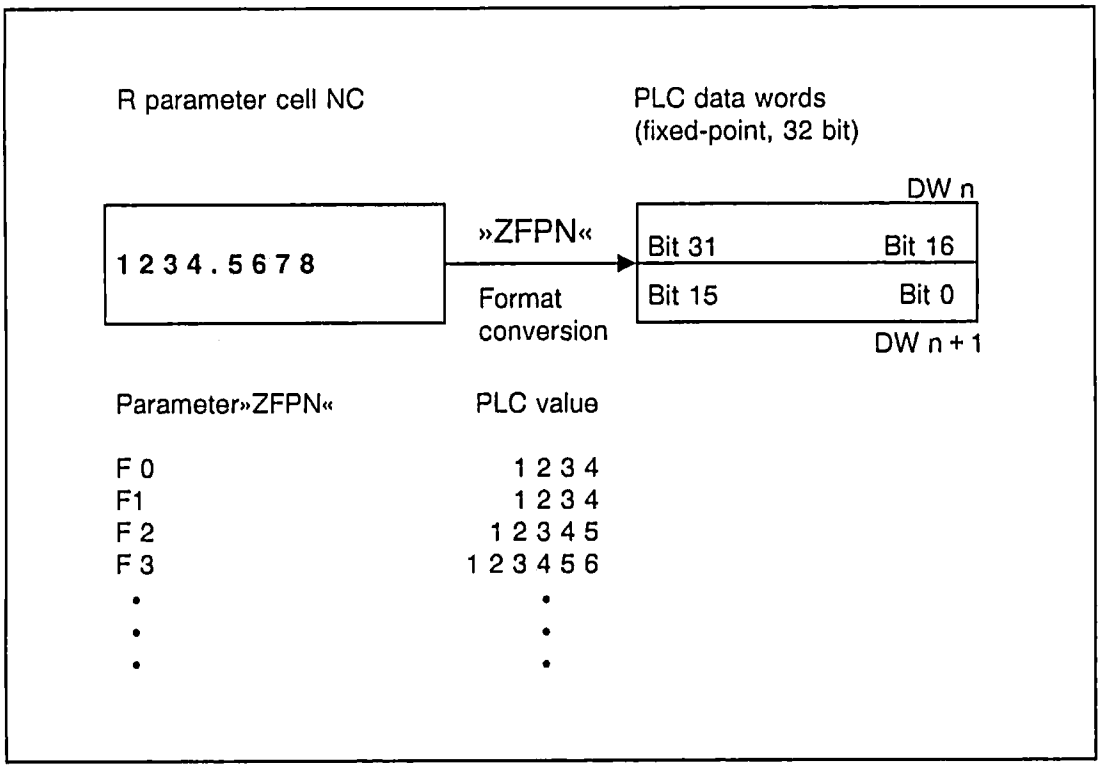



*Fig. 4.36 Data transfer NC/PLC, format conversion*

## 4.4.2 Description of job-specific interface signals

Note: Signal diagrams are given in Section 4.4.1, Figs. 4.33 and 4.34.

### DATA TRANSFER REQUESTED

1 signal: 'READ' and 'WRITE' signals of the FBs are '1'.
0 signal: a) When 0 → 1, signal edge of 'Data transfer ended' and 'Error during data transfer'.
b) 'READ' and 'WRITE' signals are '0' (see also pulse diagram, Section 4.4.1).

### FIFO ASSIGNED

1 signal: Job cannot be entered in FIFO at present time. When 'READ' or 'WRITE' = 1, the attempt is repeated until entry is possible.
0 signal: Otherwise

### DATA TRANSFER BUSY

1 signal: Job has been entered in buffer or job being processed.
0 signal: After 1 signal, when DATA TRANSFER ENDED is '1'.

### DATA TRANSFER ASSIGNED

1 signal: 'FIFO ASSIGNED' and 'DATA TRANSFER BUSY' signals are '1'.
0 signal: Otherwise

Application note:

Application of READ-IN INHIBIT during data transfer.

### DATA TRANSFER ENDED

1 signal: Job has been processed without or with NC error message.
0 signal: After 1 signal, when READ or WRITE are '0' on FB61/62.

### ACCESS INHIBITED MESSAGE

Available soon

### NUMBER FORMAT ERROR

1 signal: Job processed with NC error message. The FB number format parameter is inadmissable (e.g. an axis actual value has been read as bit pattern).
0 signal: After 1 signal only if 'READ/WRITE' signal is again '0'.

### VALUE 1 - VALUE 3 ERROR

1 signal: Job processed with NC error message. The FB VALUE1 to VALUE3 parameters cannot be interpreted by the NC (e.g. a non-existent machine data is addressed).
0 signal: After 1 signal only if 'READ/WRITE' signal is again '0'.

# 4.5 Serial Interface (DB 37)

## 4.5.1 General information

**One** serial interface can be activated by the PLC.
The PLC is assigned an interface with PLC machine data MD 8.

The signals in QB 78 and FY 23 are valid for the other RS232 (V.24) interface.

## 4.5.2 Description of interface signals

### RS232 (V24) BUSY

1 signal: Data input/output via interface busy.
0 signal: Otherwise

**Note:**
The RS232 (V.24) BUSY signal is 1 if data is input or output via the RS232 (V.24) interface selected with MD 8 regardless of whether or not it has been initiated by the PLC or NC (operator).

### DATA START INPUT

1 signal: Start of data input via RS232 (V.24)
0 signal: Start by user if
a) TRANSFER END
b) ERROR DURING DATA INPUT/OUTPUT

### DATA START OUTPUT

1 signal: Start of data input via RS232 (V.24)
0 signal: Start by user if
a) TRANSFER END
b) ERROR DURING DATA INPUT/OUTPUT

**Note:**
The parameters DATA TYPE, START NUMBER and END NUMBER must be initialized before data output is activated.

### V24 ABORT

1 signal: Start of data input via RS232 (V.24)
0 signal: Start by user if
a) Otherwise
b) TRANSFER ENDED

### DATA TRANSFER ENDED

1 signal: Start of data input via RS232 (V.24)
0 signal: Start by user if
a) Otherwise
b) After 1 signal, if signals
- DATA START INPUT
- DATA START OUTPUT
- ABORT
-"0"

### ERROR DURING DATA TRANSFER

1 signal: After incorrect activation of RS232 (V.24)
0 signal: After 1 signal if signals
- DATA START INPUT
- DATA START OUTPUT
- ABORT

are "0"

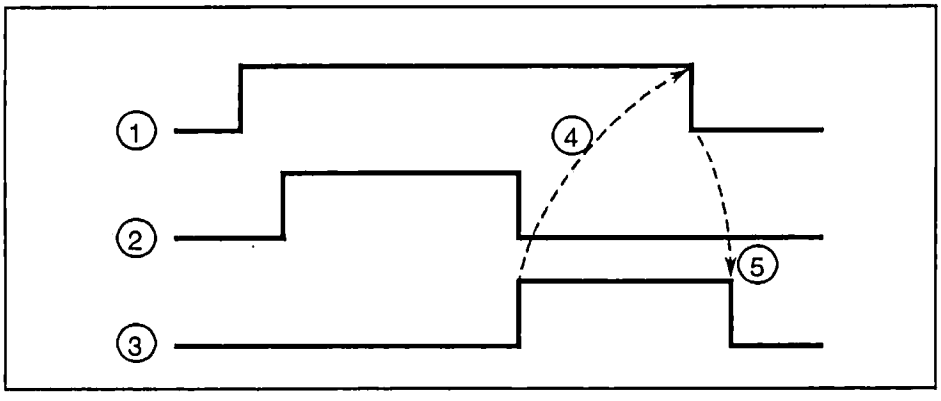
**Note:**

Error message can be triggered by:

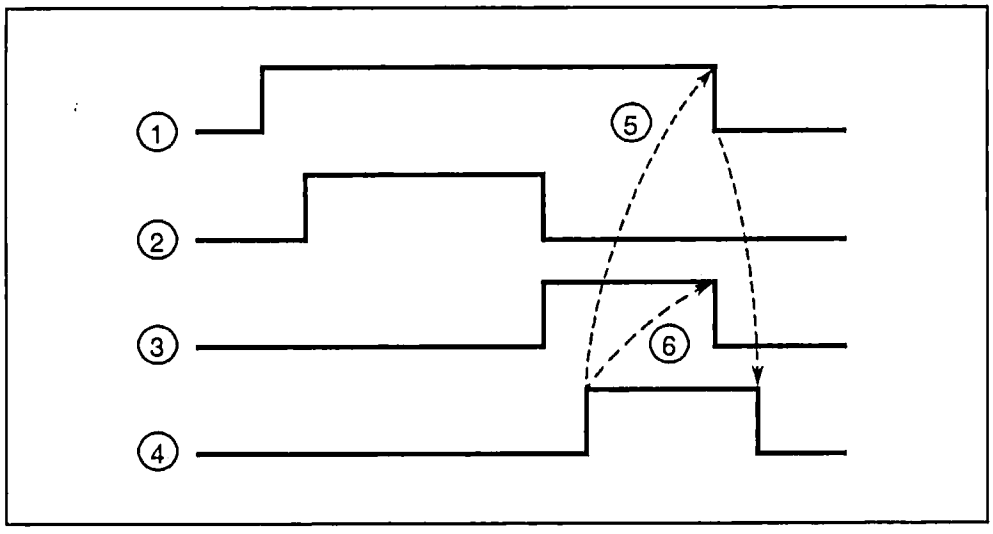
a) missing or incorrect data during data input

b) wrong data type on data output

**Signal diagram:**




Data input/output without abort
1. Data start output or input
2. RS232 (V.24) busy
3. TRANSFER ENDED or ERROR DURING DATA TRANSFER.
4. User cancels signal 1
5. System program cancels signal 3




Data input/output with abort

1. DATA start output or input
2. RS 232 (V.24) busy
3. ABORT
4. TRANSFER ENDED
5. User cancels signals 1 and 3
6. System program cancels signal 4

**DATA TYPE FOR DATA OUTPUT**

**START NUMBER**

**END NUMBER**

**CHANNEL NUMBER**

Parameterization is according to the following table:

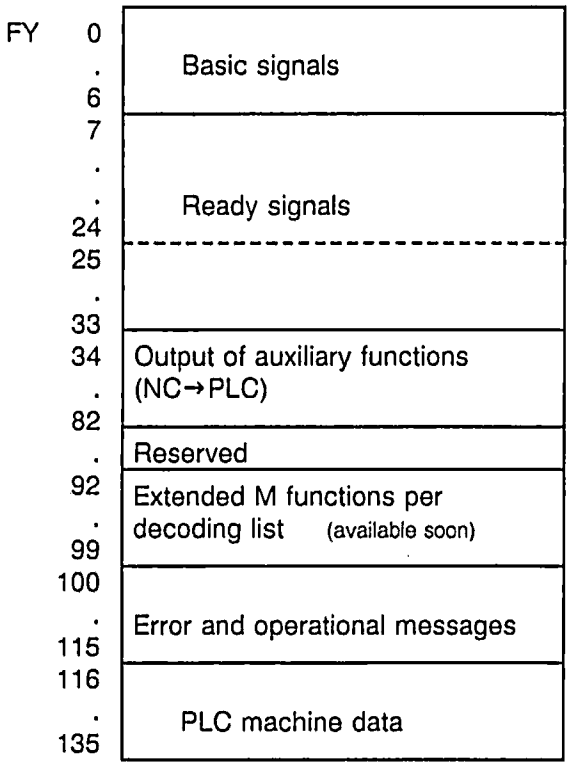
| DATA TYPE FOR DATA OUTPUT (DB37;DW2,3) (KC) | MEANING | START NO. (DB37;DW4) (BCD) | END NO. (DB37;DW5) (BCD) | CHANNEL NO. (DB37;DL6) (BCD) |
|---|---|---|---|---|
| MPF | Part program | 0 - 9999 | 0 - 9999 | - |
| SPF | Subroutine | 1 - 999 | 1 - 999 | - |
| TOA | Tool offset | 1 - 99 | 1 - 99 | - |
| RPA | R parameters<br>- channel-specific<br>- central | <br>0 - 499<br>900 - 999 | <br>0 - 499<br>900 - 999 | <br>1 - 2<br>0 |
| TEA1 | NC machine data | - | - | - |
| TEA2 | PLC machine data | - | - | - |
| ZOA | Zero offsets<br>(G54 - G57)<br>Angular offset | -<br>-<br>- | -<br>-<br>- | -<br><br>1 - 2 |
| SEA | NC setting data | - | - | |

**Note:**
The ASCII characters DATA TYPE FOR DATA OUTPUT must be entered left justified.

**Example:**
Output of the part program 10 to 20

```
C  DB37
L  KSMP
T  DW2
L  KSF
T  DW3
L  KH 10
T  DW4
L  KH 20
T  DW5
SU D 1.8
```

# 5 Error and Operational messages




## 5.1 Handling

The flag fields of the error and operational messages can be used to produce displays on the screen in the NC/PLC message line.
In the message line, only **one** error or operational message can be displayed at any one time. Error messages have priority. As long as an unacknowledged error message exists in the message line, no operational message can be displayed.
If there are several message, the error message appearing first or the operational message with the lowest number is displayed in the message line. It is possible to store up to 12 error messages in order of occurrence and to display 10 of these messages in a special message display. If there are additional error messages, they are displayed in ascending numerical order when the next screen page is displayed.
Texts can be displayed with the error numbers.

Example:

"No oil pressure".
This text must be stored in program %PCA and can be up to 36 characters long.
Example %PCA

```
N6001 = No oil pressure LF
N6002 = Text max. 36 char.
:
:
M02
```

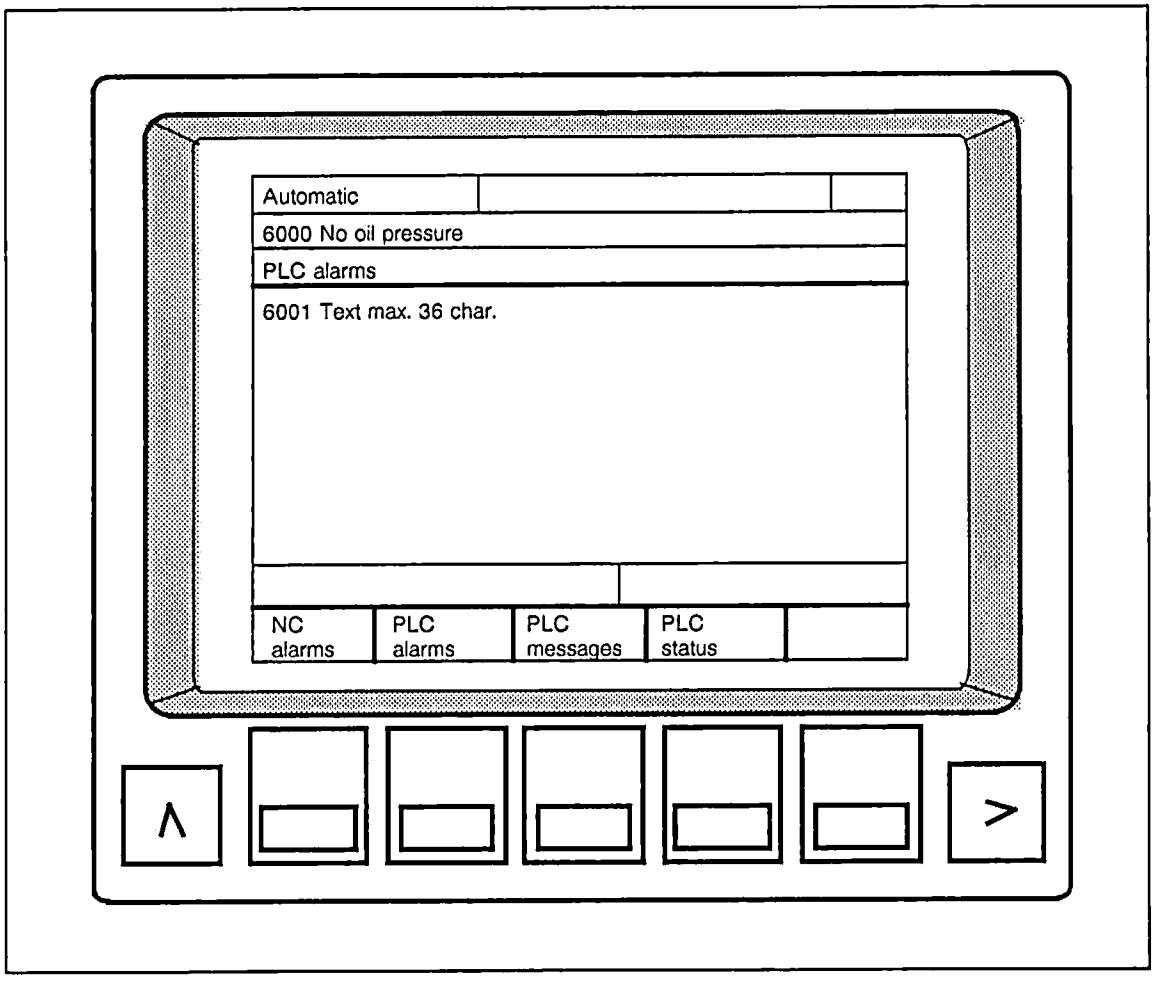



*Fig. 5.1 Error and operational messages*

## 5.2 Error messages

Flags: 1 signal: An error has occurred (1 signal appears for at least one PLC scan)
0 signal: There is no error or the error has disappeared.

Acknowledgement: After correction of the condition (related message flag reset to 0), the error message must be acknowledged by pressing the ALARM ACKNOWLEDGEMENT key (see Section 3.2.1). Only then will the NC clear the message line and display the next error message, if any exists.

Display: As error numbers starting from 6000, statically in the message line.

## 5.3 Operational messages

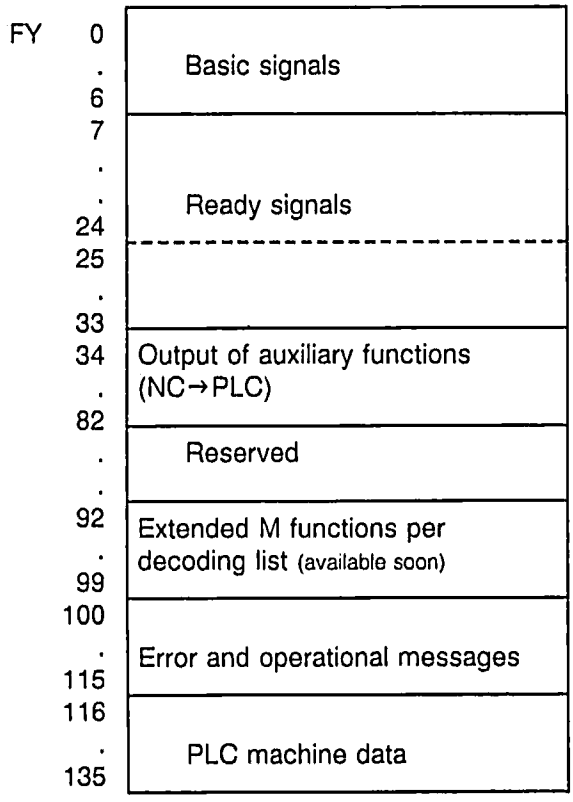
Flags: 1 signal: An operational message is to be displayed ("1" signal appears for at least one PLC scan).
0 signal: The corresponding operational message is not displayed.

Acknowledgement: Not required.

Display: As operational message number starting from 7000, statically in the message line.

# 6 Handling the PLC User Machine Data




The PLC user machine data represent a flag area into which a list of machine data stored in the NC memory is copied when there is a PLC cold restart. This list resides in the same area as the NC machine data and can also be changed via the operator panel.
The user can preset individual bits and words which he scans in his PLC program. It is thus possible for him to execute, for example, certain program sections in accordance with the flag state and to preset certain values for execution via machine data words, e.g. lubrication periods. Similarly as with the NC machine data, it is possible for him to adapt his PLC program optimally to the machine tool.

The PLC user machine data can be input byte-by-byte (individual bits):

FB 116
:  z.B.: 1 0 0 1 0 0 1 1
FB 119

or word-by-word (machine data words) as fixed-point number without sign **(no negative values)**:

FB 120
:  e.g.: 65535  (max. value, if all 16 bits = 1)
FB 135

# 7 Alphabetic List of Signal Names

| Name | Interface | |
|---|---|---|
| | Signal | Descr. |
| **A** | | |
| | | |
| Actual direction of spindle rotation CW | 1.5.1 | 4.1.4 |
| Actual gear speed | 1.5.2 | 4.2.5 |
| Adjusting speed | 1.5.2 | 4.2.5 |
| Axis disable | 1.5.2 | 4.2.4 |
| | | |
| **B** | | |
| | | |
| B0...B31 (PLC machine data bits) | | |
| Battery fault | 1.5.3 | 4.1.1 |
| Block search active | 1.5.1 | 4.1.2 |
| | | |
| **C** | | |
| | | |
| Change gear | 1.5.1 | 4.1.4 |
| Controller enable: - axis | 1.5.2 | 4.2.5 |
| - spindle | 1.5.2 | 4.2.4 |
| Cycle disable | 1.5.2 | 9.2.1 |
| | | |
| **D** | | |
| | | |
| DRF effective | 1.5.2 | 4.2.1 |
| DRF selected | 1.5.1 | 4.1.2 |
| Data start | 1.5.2 | 4.2.1 |
| Data transfer | 1.8 | 4.4.2 |
| Deceleration | 1.5.2 | 4.2.4 |
| Delete distance-to-go | 1.5.2 | 4.2.2 |
| Delete no. of subroutine passes | 1.5.2 | 4.2.2 |
| Dry run feed | 1.5.1 | 4.2.2 |
| | | |
| **E** | | |
| | | |
| Emergency Stop | 1.5.2 | 4.2.1 |
| Error messages | 1.6 | 5.2 |
| | | |
| **F** | | |
| | | |
| Feed override | 1.5.2 | 4.2.3 |
| Feed override effective | 1.5.2 | 4.2.3 |
| Flashing frequency 1 Hz | 1.5.3 | 2 |
| Follow-up mode | 1.5.2 | 4.2.4 |

| Name | Interface | |
|---|---|---|
| | Signal | Descr. |
| **G** | | |
| | | |
| G00 | 1.5.1 | 4.1.2 |
| G33/G63 | 1.5.1 | 4.1.2 |
| G96 | 1.5.1 | 4.1.2 |
| Gear speed selection automatic | 1.5.2 | 4.2.5 |
| | | |
| **H** | | |
| | | |
| H modification, channel 1 | 1.5.4 | |
| H word, channel 1 | 1.5.4 | 4.3.2 |
| Handwheel active | 1.5.2 | 4.2.4 |
| | | |
| **J** | | |
| | | |
| JOG | 1.5.2 | 4.2.4 |
| | | |
| **K** | | |
| | | |
| Key-operated switch | 1.3 | 4.2.1 |
| | | |
| **L** | | |
| | | |
| Last auxiliary function, channel 1 | 1.5.4 | 4.3.2 |
| | | |
| **M** | | |
| | | |
| M modification, channel 1, 2 | 1.5.4 | |
| M signals: static | 1.5.4 | 4.3.2 |
| dynamic | 1.5.4 | 4.3.2 |
| M word, channel 1, 2 | 1.5.3 | 4.3.2 |
| M00/M01 | 1.5.1 | 4.1.2 |
| M01 effective | 1.5.2 | 4.2.2 |
| M02/M30 | 1.5.1 | 4.1.2 |
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| Name | Interface | |
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| Name | Interface | |
|---|---|---|
| | Signal | Descr. |
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