SIEMENS

SINUMERIK 880 SW 6
SINUMERIK 880 GA2, SW 1
Interface Description
Part 1: Signals

Planning Guide 01.93 Edition

Manufacturer Documentation

SINUMERIK 880 SW 6
SINUMERIK 880 GA2, SW 1
Interface Description
Part 1: Signals

Planning Guide

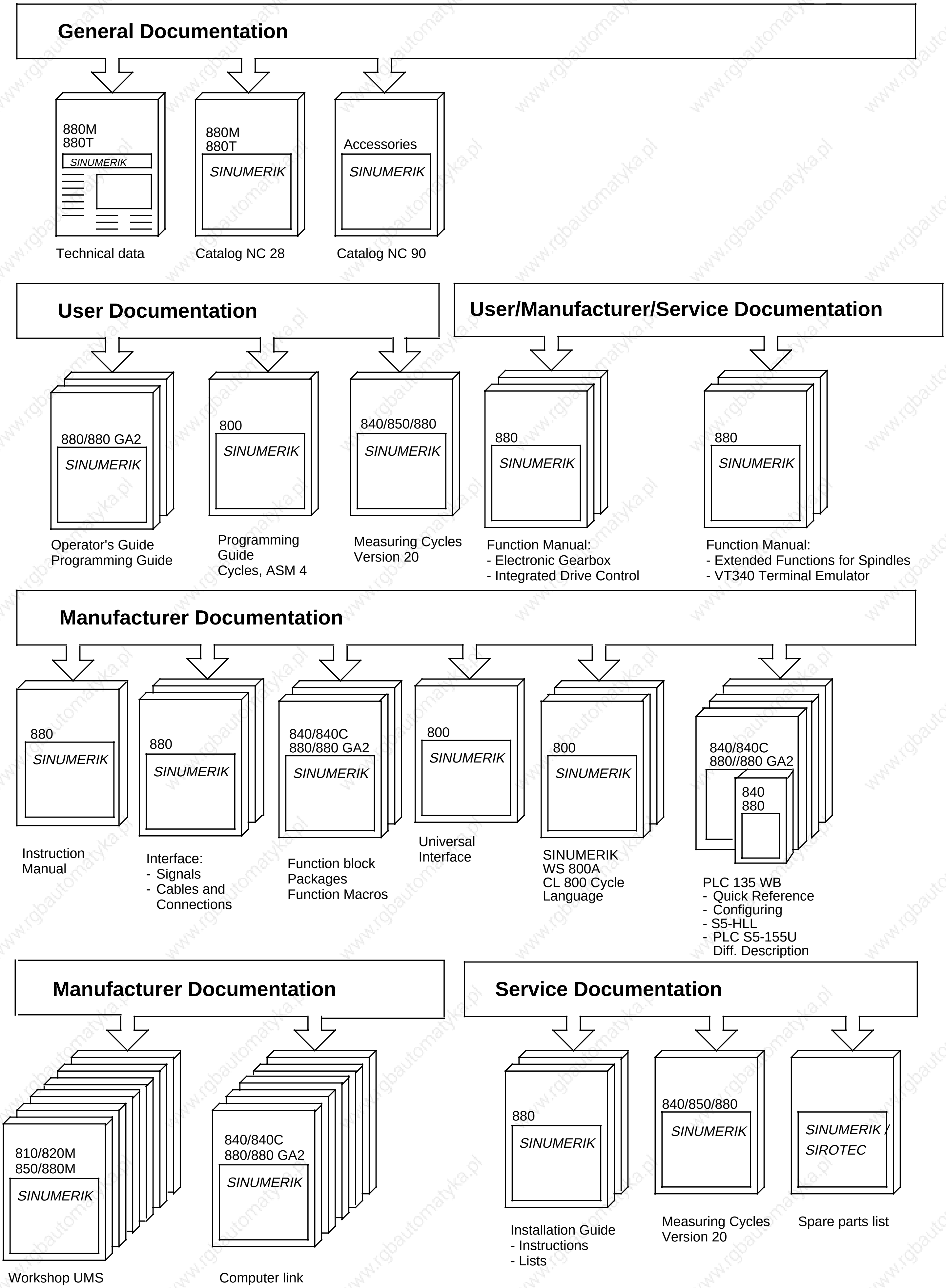
Manufacturer Documentation

Valid for:

Control	*Software version*
SINUMERIK 880 T/M	6
SINUMERIK 880 GA2 T/M	1

January 1993 Edition

SINUMERIK 880



SINUMERIK® documentation

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.
If actual changes have been made on the page since the last edition, this is indicated by a new edition coding in the header on that page.

Edition	Order No.	Remarks
05.91	6ZB5 410-0HE02-0AA0	**A**
01.93	6ZB5 410-0HE02-0AA1	**C**

Other functions not described in this documentation might be executable in the control. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

This publication was produced on the Siemens 5800 Office System.
Subject to change without prior notice.

Preliminary Remarks

Notes for the Reader

This manual is intended for users, manufacturers and servicers of machine tools with a SINUMERIK 880 control. It includes information on internal communication and data transfer between the NC and PLC as well as the interfaces of the PLC to the hardware signals of the machine and refers to the two software versions SW6 and GA2, SW1. The GA2 is a further development of the SW6. The GA2 is based on faster hardware with standard CPU modules for the COM and NC areas.

With every new software version certain functions, conditions, modules etc. are either removed or are added. Parts of this documentation affected by such changes are marked by the following footnotes:

c) up to and including software version 6
d) with GA2, software version 1 and higher

In other documentation you might also find the following footnotes:

a) up to and including software version 4
b) with software version 6 and higher

SINUMERIK documentation comprises four parts:

- General Documentation
- User Documentation
- Manufacturer Documentation and
- Service Documentation

The **Manufacturer Documentation** for the **SINUMERIK 880** control is divided into the following parts:

- Instruction Manual
- Interface Description
  Part 1: Signals
  Part 2: Connection Conditions
- Function Macros
- Function Blocks
  Package 0: Basic Functions
  Package 1/2: Tool Management
  Package 4/5: Computer Link
  Package 6: Loading and Unloading Tools with Code Carriers
  Package 7: Code Carriers
  Package 8: PLC-controlled Data Input/Output
- PLC 135WB Planning Guide
- S5-HLL Higher-Level Language Programming

Further SINUMERIK publications apply to all SINUMERIK controls (e.g. Universal Interface, Measuring Cycles, CL 800 Cycle Language).

Consult your local Siemens office for further details.

Notes on the signal descriptions

- In the signal descriptions, the interface signals are written in upper case characters (e. g. READ-IN DISABLE).
- In the signal charts, the interface signals are represented by thick lines. Thin lines represent signals symbolically or refer to internal messages.
- Signals with an asterisk (*) **in front of** the signal name are so-called inverse signals, i. e. a 0-signal has an effect rather than a 1-signal (e. g. *TEMPERATURE FAULT).

Technical comments

This Guide applies to software version 6

and GA2, software version 1!

Please refer to the following publications if using a SIMATIC S5-155U:

SIMATIC Manual for the S5-155U
Order No. 6ES5 998-0UM12 (Gerätewerk-Karlsruhe)

SIMATIC Manual for U I/Os
Order No. 6ES5 998-0PC11 (Gerätewerk-Karlsruhe)

SINUMERIK 880 with S5-155U, Difference Description to PLC 135WB
Order No. 6ZB5 410-0GC02-0BA0 (ZVW Fürth/Bislohe)

Contents

1 General Overview

1.1 Control

The following Subsections are intended as an introduction to the SINUMERIK 880 control. They describe

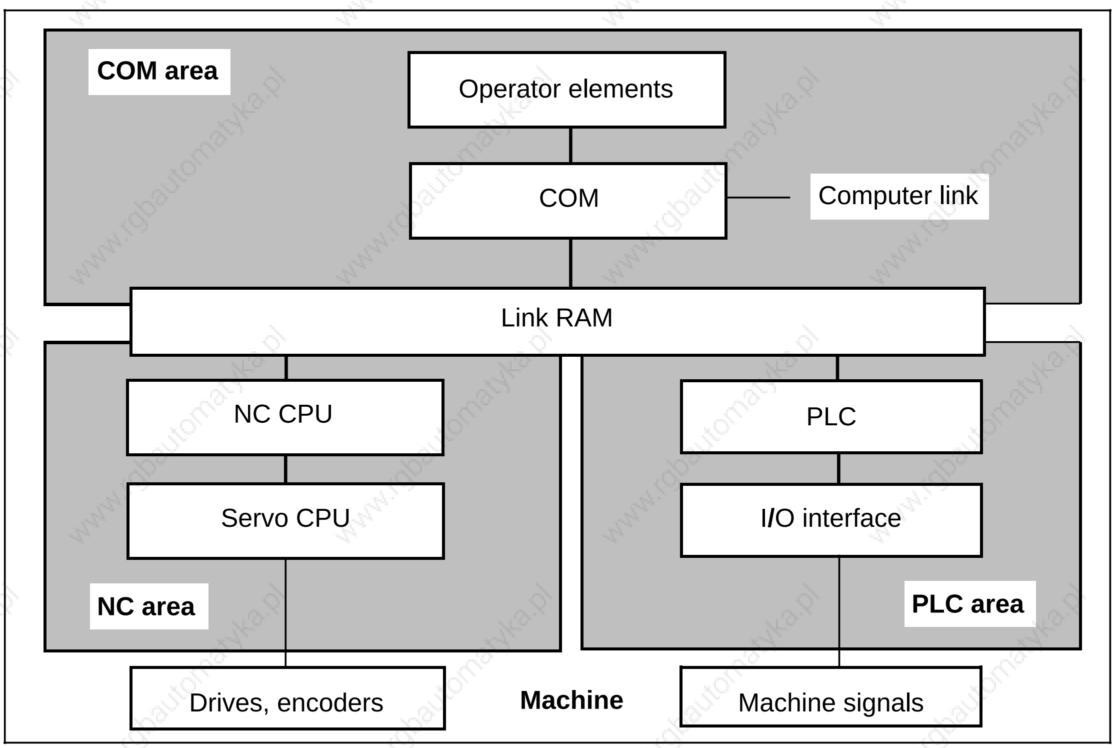
- The breakdown of the SINUMERIK 880 into areas
- The tasks of the individual areas and
- The basic mechanical structure of the control.

1.1.1 Control structure

The SINUMERIK 880 comprises three areas:

Area	**Task**
COM area (communication)	Operation, communication, computer link, management
NC area (numerical control)	Control of axes and spindles
PLC area (programmable logic control)	Adaptation to the machine

The three areas communicate by means of a link RAM. The NC, PLC and COM areas are described below.

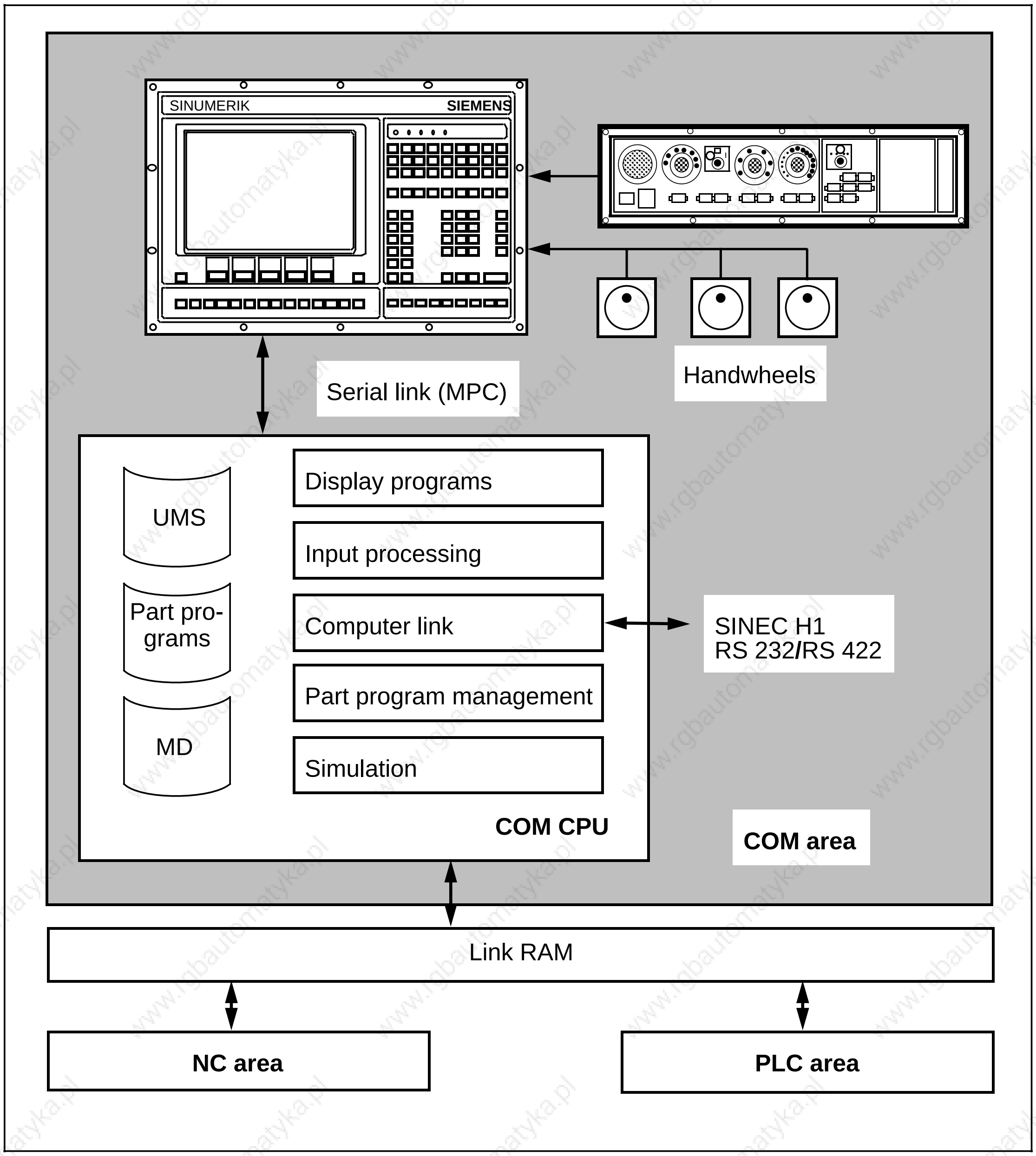


Schematic structure of the SINUMERIK 880

1.1.2 COM area

The COM area accommodates the following principal elements:

- Operator devices
- COM CPU
- Part program management
- Computer links and
- Parameters for the control (machine data (MD), user memory submodule (UMS)).



Structure of COM area

Operator devices

These comprise operator panels, machine control panels and handwheels. The machine control panels and handwheels are connected to the operator panel. A serial link exists between the operator panel and COM CPU. The COM CPU transfers the data and signals from the operator panel to the PLC by means of the link RAM.

Illustrations of the operator panel and machine control panels are contained in the "SINUMERIK 880 units" Section.

Part program management

The part programs for workpiece machining are stored and managed in the COM area. They can be edited at the operator panel or read in via the universal interfaces.

When machining a workpiece, the COM CPU transfers the running part program in blocks to the NC area via the link RAM.

Computer link and interfaces

A SINEC H1 industrial bus interface is provided for integrating the control in automated manufacturing systems. The COM area also offers RS 232 C or RS 422 interfaces for connecting data terminals (e.g. tape reader, programmer).

Machine data (MD)

All the data specified by the machine manufacturer for matching the control to the machine tool in question are stored in the machine data. These include, for example, the position of the machine zero and reference point, traversing range limits, acceleration and deceleration characteristics, spindle speeds, feedrates etc..

The machine data are stored and managed in the COM area. They are entered at the operator panel or read in via the universal interfaces. When the control starts up the machine data are made accessible to the other areas by means of the link RAM. The machine data are protected by a settable codeword.

Configuring (UMS)

Configuring describes the procedure used to match the control's functionality to the machine concerned and to the operator's requirements. Machine-specific functions (e.g. cycles) or operator interfaces (images, menus, messages) can be compiled on a WS 800A NC workstation. The configured functions, texts and images are stored in the user memory submodule (UMS). The UMS is located in the COM area.

Maximum complement

Up to 3 operator panels, up to 3 machine control panels and up to 3 handwheels can be connected.

1.1.3 NC area

The NC area comprises:

- Block preparation for the part program blocks (NC-CPU),
- Interpolators for setpoint assignment for axes and spindles and (NC-CPU)
- Position controllers for the axes and spindles. (SERVO-CPU).

The NC area is subdivided into channels, each of which behaves like an independent numerical control. Each NC channel has its own block preparation function and interpolator. The NC CPU does the block preparation and interpolation.

The NC channels are grouped together to form mode groups. The axes and spindles of the machine are assigned to the mode groups by machine data. Each NC channel in a mode group can control the axes and spindles that belong to its group, but an axis or spindle can be controlled by only **one** NC channel at any time. (Mode groups are explained in greater detail in a later Section.)

Each drive (axis or spindle) has a position controller that implements the setpoint assignments of the interpolator. As far as the PLC is concerned, a drive's position controller is the same as the drive itself; at the interfaces of the PLC, therefore, reference is made to axes and spindles. The SERVO CPU does the position control.

The NC channels (block preparation, interpolators), axes and spindles communicate with the PLC by means of the link RAM. The PLC can influence the NC channels, axes and spindles and react to their conditions (see "Tasks of the PLC program" Section).

The SINUMERIK 880 can be equipped with up to four NC CPUs [c)] or two NC CPUs [d)] and up to four SERVO CPUs. This permits the implementation of 30 measuring circuits (24 axes and six spindles). The axes and spindles can be controlled by 16 NC channels [c)] or by eight NC channels [d)] that can be distributed over eight mode groups.

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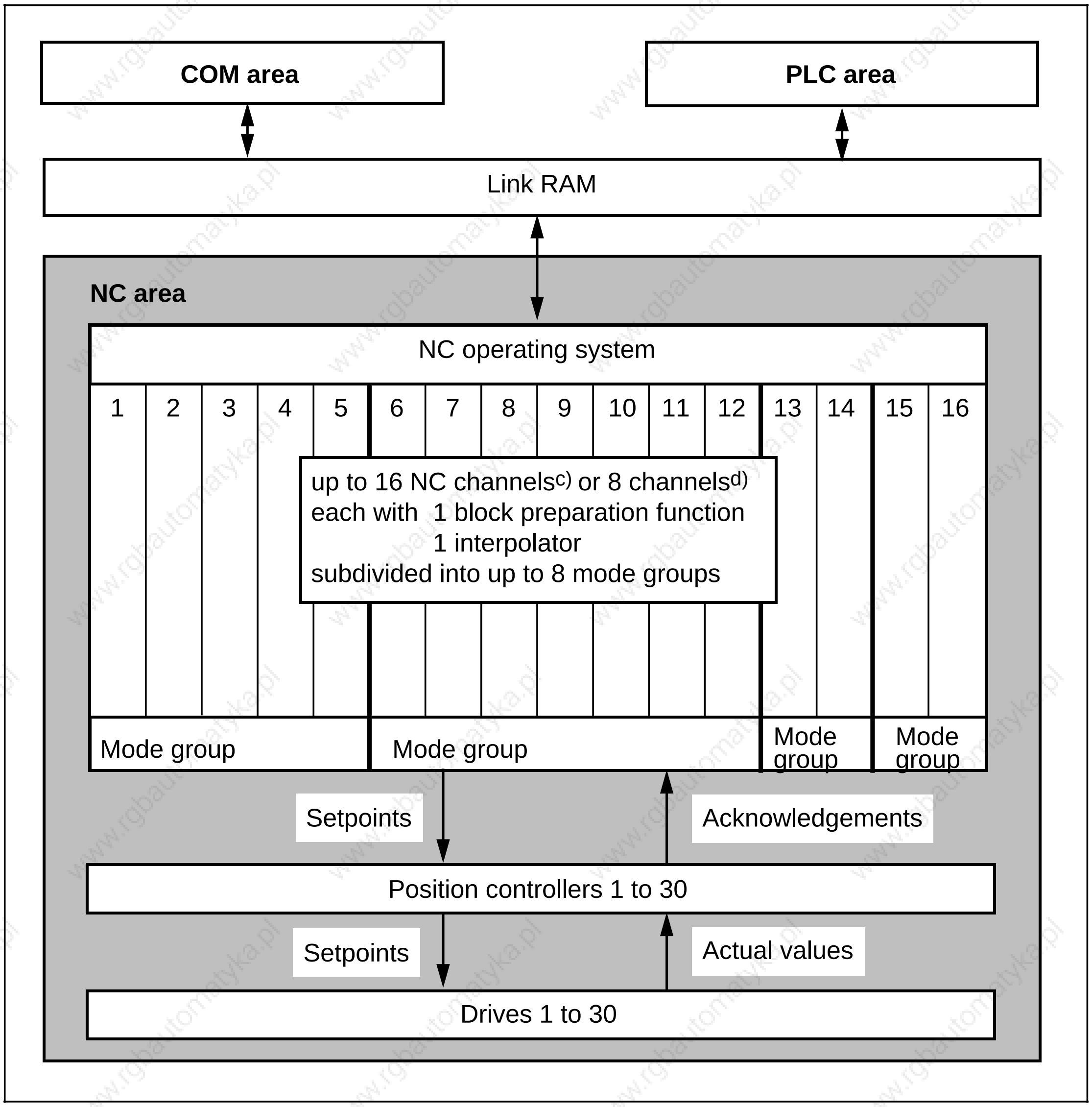
c) up to and including software version 6

d) with GA2, software version 1 and higher



Structure of NC area, example with 4 mode groups

c) *up to and including software version 6*

d) *with GA2, software version 1 and higher*

1.1.4 PLC area

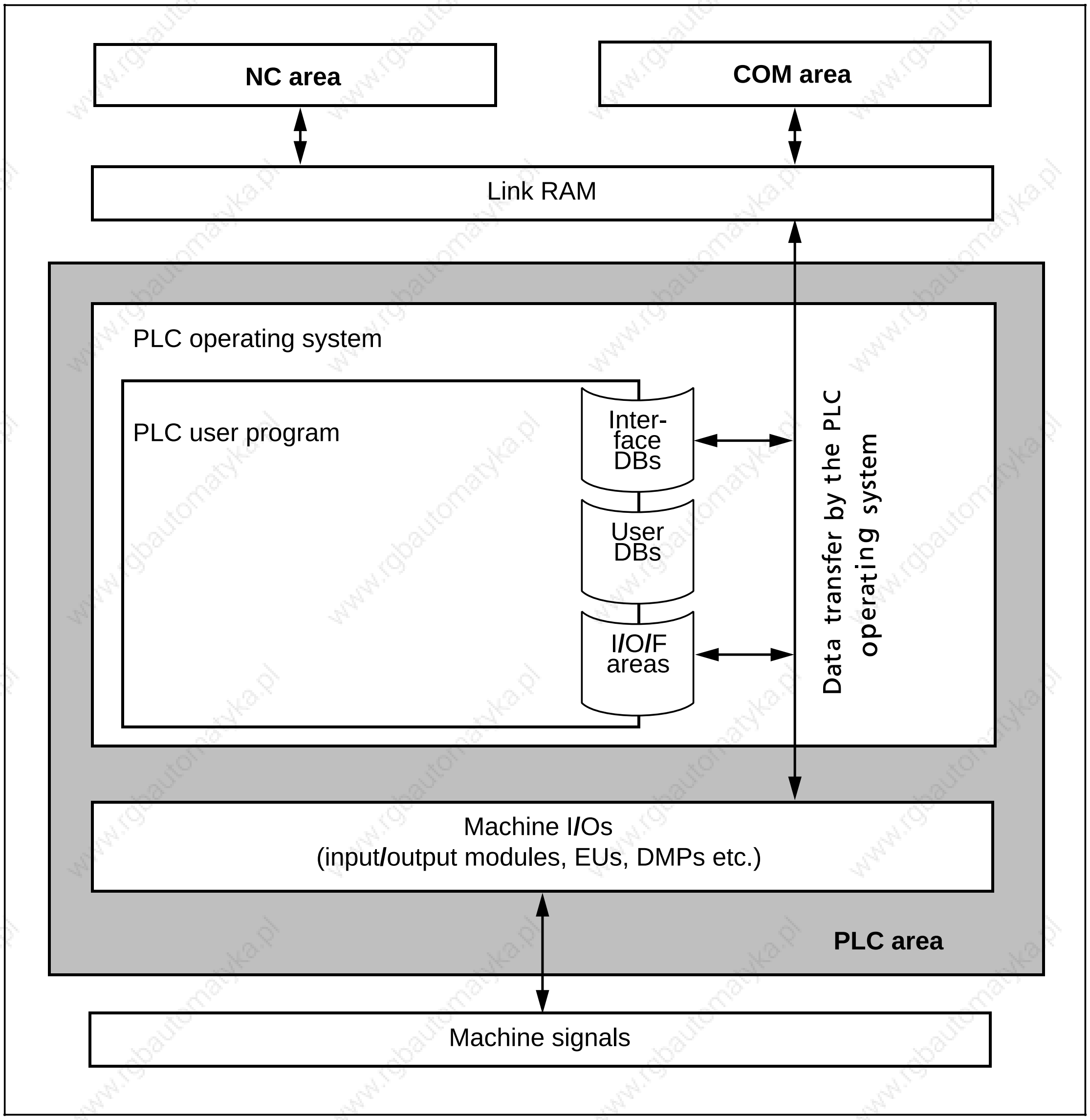
The PLC area accommodates the interface control. This is where the machine-specific signals (machine I/Os) are evaluated and switched.
The interface control

- Adapts the control to the machine
- Implements functions supported by the machine but not by the NC area and
- Coordinates the machine-specific functions with the tasks of the NC.

The interface control is implemented by the PLC user program. The PLC user program is compiled by the machine manufacturer. If required, the tasks of the interface control can be divided between two PLC CPUs.

Notes:

- This publication describes the (maximum) signal complement that can be processed by the PLC user program.
- The tasks of the PLC user program are explained in greater detail in a later Section.

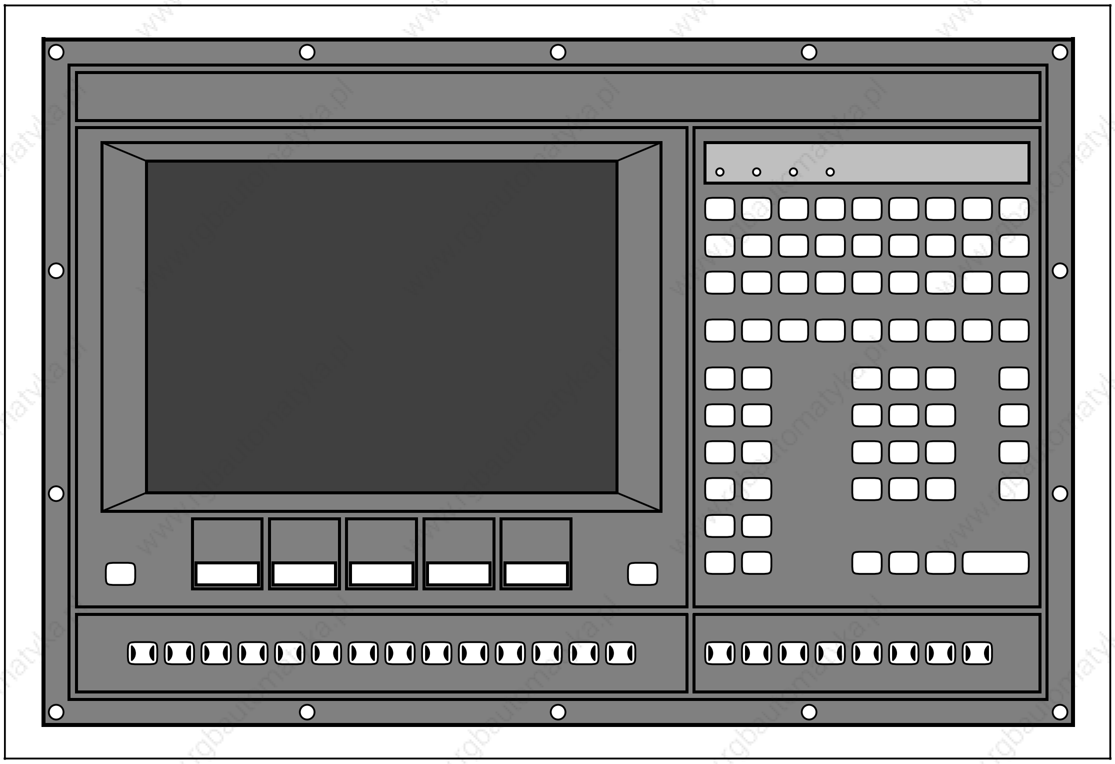


Structure of PLC area

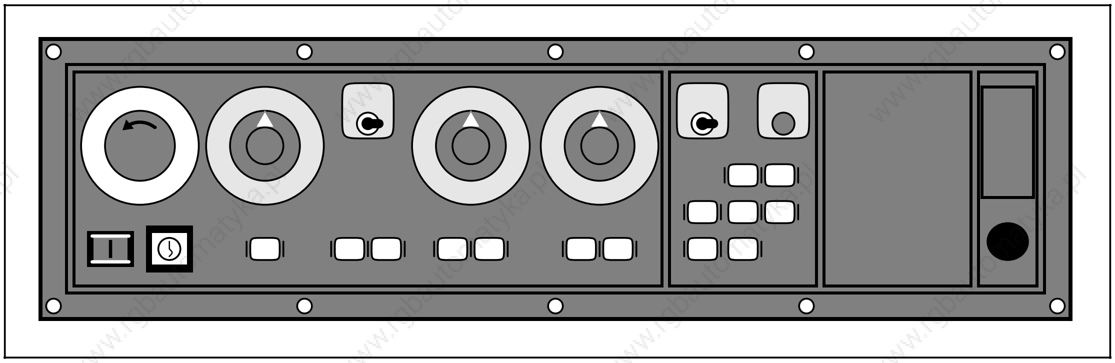
1.1.5 SINUMERIK 880 units

An exact schedule of the units belonging to the SINUMERIK 880 and their characteristics is contained in the Catalog for the SINUMERIK 880 and in Interface Description, Part 2, Connection Conditions.

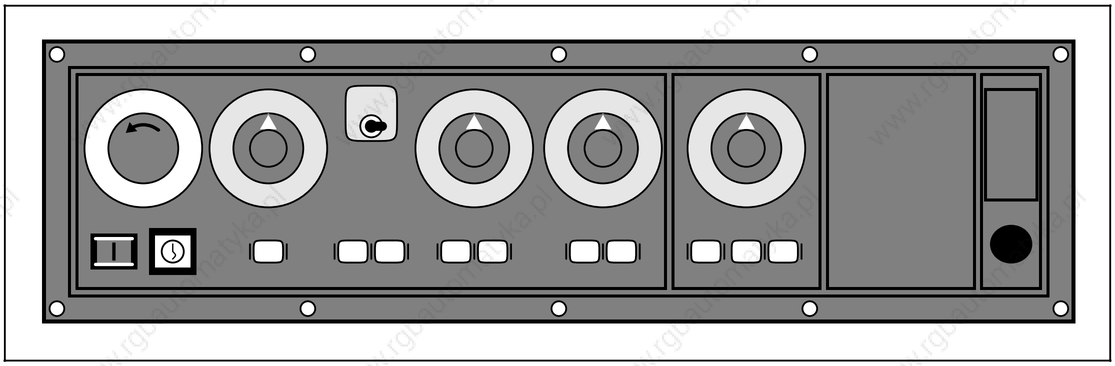
The most prominent unit of the SINUMERIK 880 from the operator's point of view is the operator panel, in some cases installed in conjunction with a machine control panel. The operator panel is accommodated separately, away from the central controller, to which it has a serial link.



SINUMERIK 880 operator panel



SINUMERIK 880T machine control panel



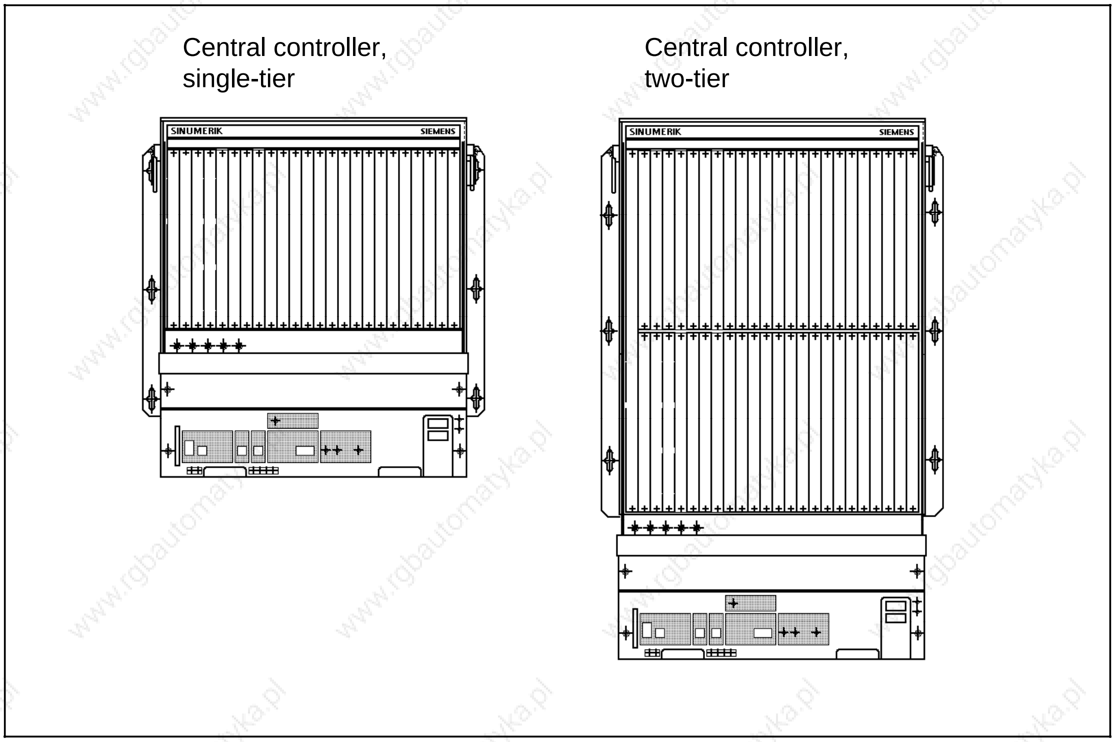
SINUMERIK 880M machine control panel

The central controller comprises a single or two-tier subrack which accommodates the printed circuit boards of the control.

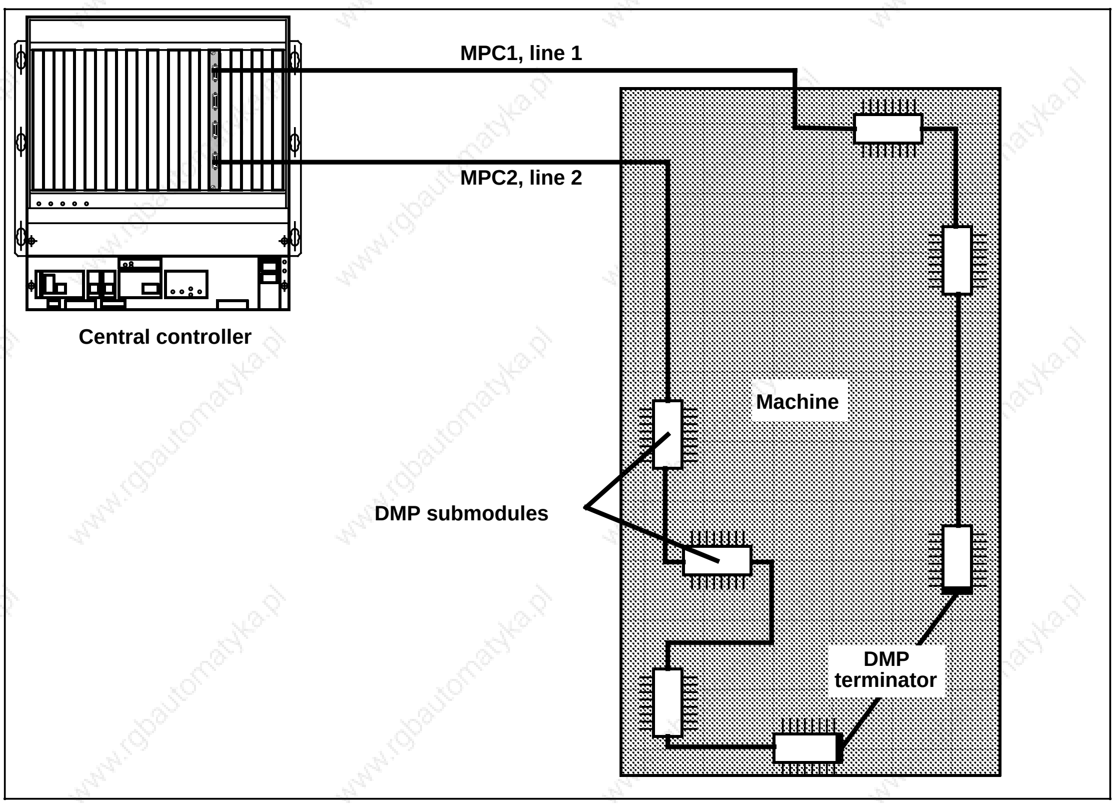
The central controller is supplemented by expansion units (EUs) and submodules for recording machine signals (DMPs).

SINUMERIK expansion units can be equipped with SINUMERIK or SIMATIC I/O modules; mixed complements are also permitted. SINUMERIK EUs and DMPs have serial links to the central controller.

SIMATIC expansion units can also be used for connecting machine signals. SIMATIC EUs can be equipped only with SIMATIC modules. SIMATIC EUs have a parallel link to the SINUMERIK central controller.



Subrack sizes for the central controller

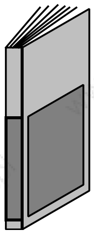


Linking distributed machine peripherals, represented here by DMP submodules

1.2 PLC program

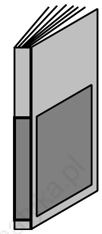
The following Subsection outlines the following:

- The structure of the PLC program
- The tasks of the PLC program
- The distribution of tasks between the PLC operating system and PLC user program and
- The basic mechanisms of signal and data transfer.



The "PLC 135 WB Planning Guide" for the SINUMERIK 880

contains a detailed introduction to programming the PLC.



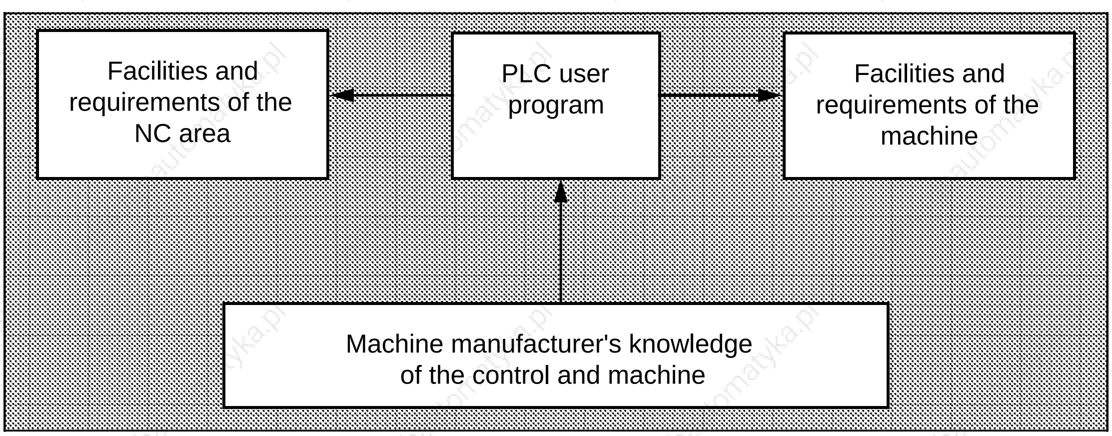
1.2.1 Tasks of the PLC program

The SINUMERIK 880 can be used for a variety of tasks. The "classic" task of the NC, executed here by the NC area (NC CPU and SERVO CPU), is to control the drives. The NC obtains the necessary enables from the NC/PLC interface.

The machine signals required to control the drives are supplemented by various other signals which differ from machine to machine and cannot be processed by the customary NC functionality. The control is matched to the signal scope of the machine by accordingly equipping the PLC area with I/O submodules to register and switch the machine-specific signals.

The PLC user program must provide the link between the machine-specific signals and the NC functions. This requires the PLC user program to create the signals needed by the NC from the machine-specific signals and, conversely, to generate the signals needed by the machine from the control signals.

The PLC user program is also responsible for utilizing machines' special facilities that are not covered by the usual NC functions. It must therefore implement these potential machine functions and actuate and monitor them as necessary.



PLC program as a mediator between the machine and NC

Typical tasks of the PLC user program:

- Implementation of monitoring devices
- Machine-specific reactions to malfunctions
- Actuation of auxiliary axes
- Management of a tool magazine
- Management of communication with a host computer
- Gear shifts at request of NC
- Coordination of machine and NC functions by means of disables and enables
- Menu selection for operation configured for specific manufacturers

1.2.2 PLC program structure

The PLC program comprises the PLC operating system and the PLC user program. The PLC user program is compiled by the machine manufacturer.

By way of support, we offer program packages (function blocks) for recurring complex functions.

1.2.2.1 PLC operating system

The three principal tasks of the PLC operating system are:

- Organization of system start
- Calling of the PLC user program
- Signal and data transfer via the system's internal interfaces

These main tasks of the PLC operating system are described in greater detail below.

System start-up

The PLC operating system can be adapted to the user-specific channel, spindle and axis structure of the control by means of the PLC machine data (see "Installation Guide, Instructions"). When the system starts up, the PLC operating system analyzes the machine data and configures itself accordingly.

Examples:

- When the system is started a distinction is made between cold restart, warm restart and start-up mode.
- The number of interfaces to the NC that have to be processed is determined.
- A check is made to establish which OBs have to be called.
- It is determined which inputs and outputs have to be processed, where they are depicted in the process image and whether the relevant I/O modules are ready.

In the event of contradictory or defective machine data, the PLC operating system branches to stop status.

OB 20 of the PLC user program is called (if available) from the system start-up routine. This gives the user the opportunity to insert his own functions in the system start-up.

The system start-up is concluded with the first call of OB 1. Once OB 1 has been fully processed, the PLC operates cyclically. Refer to the description of the initial setting signals for further information on system start-up.

Calling the user program [1)]

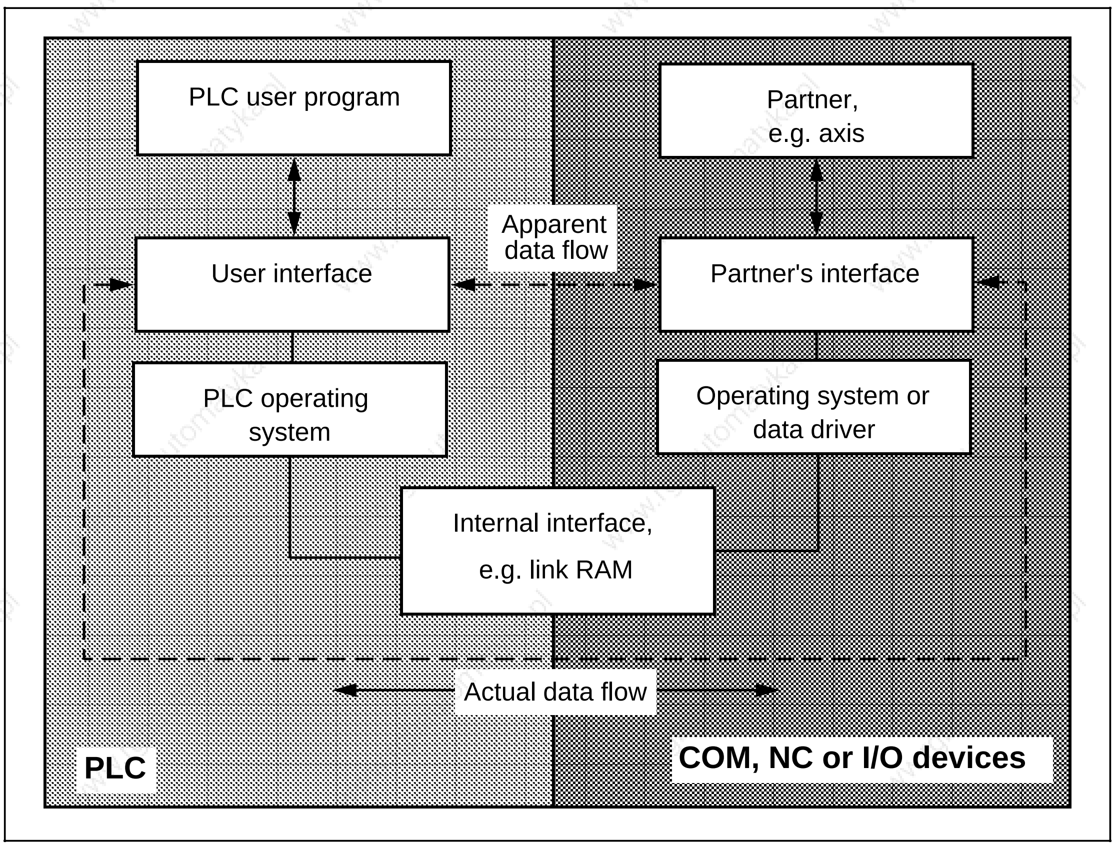
The PLC operating system calls organization blocks. These represent the highest level of the PLC user program. Primarily, these are the organization blocks for:

- Cyclic processing (OB 1)
- Interrupt-controlled processing (OB 2)
- Alarm-controlled processing (OB 3
- Aperiodic processing (OB 4) and for
- Time-controlled periodic processing (OB 5 - OB 7).

The machine manufacturer can structure his PLC user program according to these criteria by having program blocks called by the relevant organization blocks.

Signal and data transfer via internal interfaces

The PLC user program has interfaces available for communicating with the other areas of the control. These interfaces are not the same as the system's internal interfaces. The PLC operating system evaluates the user interfaces and transfers the data via the internal interfaces.



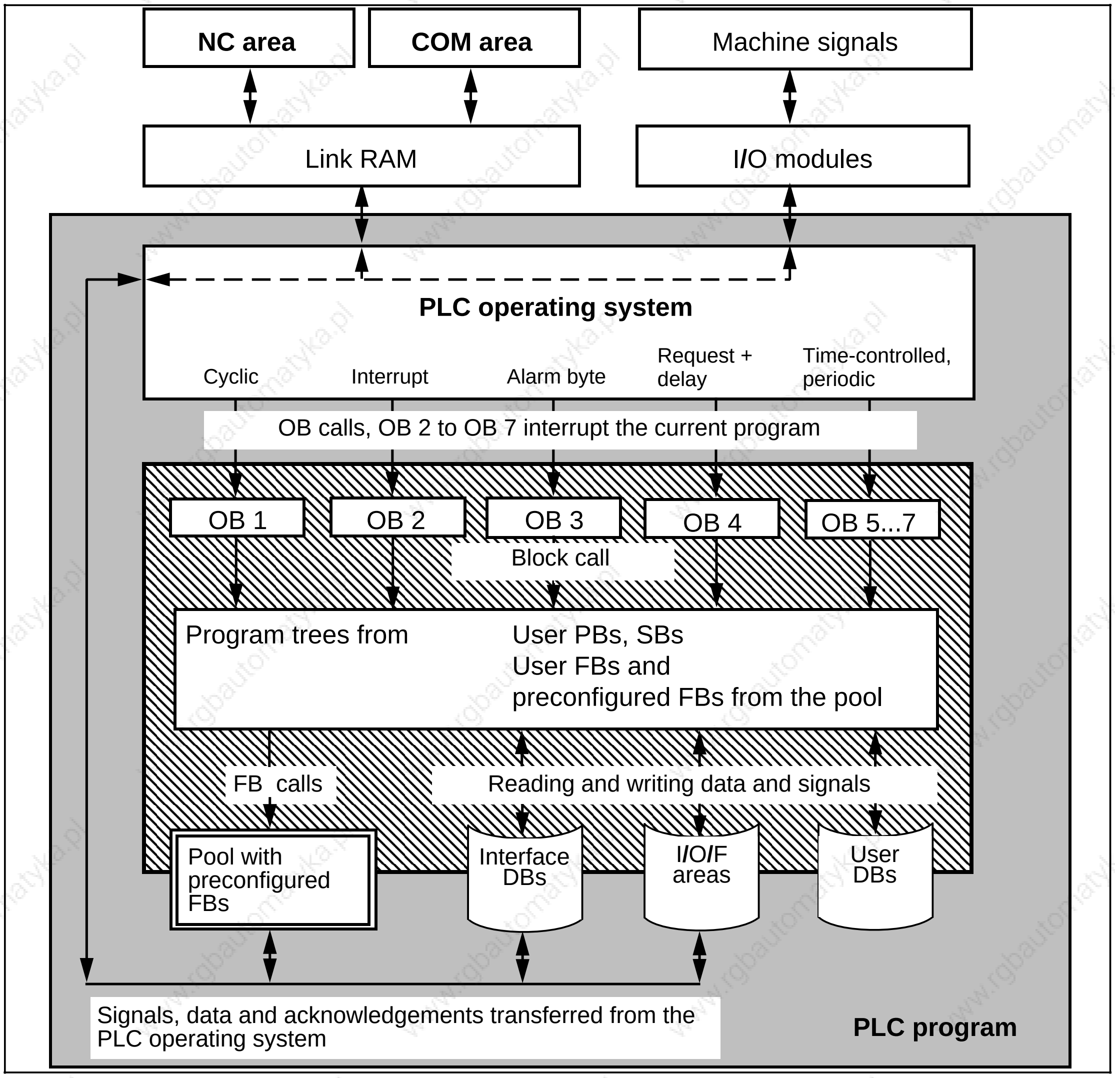
Data transfer principle

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context*

1.2.2.2 PLC user program [1)]

The PLC user program is assembled from organization blocks (OBs), program blocks (PBs), sequence blocks (SBs) and function blocks (FBs). Sequence blocks are special forms of program blocks used in particular to program sequential controllers. The organization and program blocks are compiled by the machine manufacturer. FBs are available in the form of preconfigured blocks. Some FBs are contained in the PLC operating program; refer to the "Function Macros" publication for the SINUMERIK 880. Others can be downloaded from FB packages. Machine manufacturers can also program FBs.

As the organization blocks are activated by the PLC operating system (ibid.) according to specified criteria, the fundamental (cyclic) structure of the PLC user program is predetermined. The organization blocks represent the highest level of the PLC user program.



PLC program structure

Note:

The hatched area of the figure represents the PLC user program.

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1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context*

Each OB and the programs called in it represent a processing level. The processing level can change during an operating routine; OB 2 breaks off the cyclic programs of the operating level of OB 1 in the event of an interrupt. The PLC operating system coordinates this processing level change. In particular, the flags FY 224 to FY 255 or FY 200 to FY 255[d)] (if bit MD 6026.3 is set) are saved and restored before resuming processing of the interrupted level.
The PLC user program is offered the following types of interface:

- Communication via data blocks (DBs)
- Communication via the data areas of the input, output and flag bytes (IB, QB, FY)
- Reaction to interrupt and alarm signals.

The type and scope of an interface often depends on machine data (MD) and Options; the interface can therefore be parameterized by means of machine data.

1.2.2.3 Communication via data blocks

Each data block has a fixed structure. The structure of the data blocks depends on the interface. One or several data blocks exist for each interface (exception: IB, QB, FY). Some DBs contain fields that can be utilized freely by the user. The PLC user program can read and write the signals in the DBs.

The data blocks represent images of the relevant signals of the communication partner. The image is not necessarily a 1:1 representation; the program parts (PLC operating system, FBs, data driver of the partner) that implement the data transfer via the link RAM ensure the correct assignment of the data by the communication partner as appropriate.

Depending on when an interface DB is processed by the PLC operating system, a distinction is made between cyclic, time-controlled and request-controlled signal transfer.

Cyclic transfer

At the beginning of the following PLC cycle, the input signals of the cyclically processed DBs are updated by the PLC operating system reading the relevant signals from the internal interface of the communication partner and transferring them to the DBs.

At the end of the PLC cycle, the PLC operating system reads the output signals of the interface DBs and transfers them to the communication partner.

At the start of a PLC cycle, therefore, the signals in the DBs are always up to date.

Cyclically transferred input signals thus have the characteristic of being constant for the duration of a PLC cycle, whereas cyclically transferred output signals are not effective until the end of the PLC cycle (possibly following an additional delay by the recipient).

Examples of the cyclic transfer of DBs are provided by DB 10 ... DB 25, the interfaces to the NC channels.

d) with GA2, software version 1 and higher

Time-controlled transfer

The time-controlled transfer of interface signals corresponds to cyclic transfer except that the signals are processed periodically, that is to say after determined time intervals, independent of the PLC cycle. As a result, input signals transferred with time control can change their condition during a PLC cycle. Similarly, output signals transferred with time control can take effect more quickly in certain circumstances.

Request-controlled signal transfer

In the case of request-controlled signal transfer, the data and signals are transferred only when requested by the PLC user program. Examples of request-controlled DB processing are provided:

- In the command channel (request by special bits)
- In the PLC/NC interface (request by calling FB 63 or FB 64, not with S5-155U) and
- In the NC/PLC data channel (FB 61, FB 62).

Common memory area

In one special instance (PLC/PLC, DB 59) the user is able to implement communication via a **jointly** used memory area. The PLC operating system is not activated in this case. The PLC provides semaphores for the required handshake mechanism. The user can decide on the use of semaphores.

1.2.2.4 Communication via data areas

The DBs are supplemented by the data areas of the input bytes (IB), output bytes (QB) and flag bytes (FY).

Process image in I/O area

The IBs and QBs contain the image of the machine signals, that is the process image. The incoming machine signals are transferred by the PLC operating system to the IBs (process input image, PII) at the beginning of the PLC cycle (as with the cyclic processing of DBs described above). The PLC operating system reads the output bytes (process output image, PIQ) at the end of the cycle and switches the relevant machine signals.

The PII remains constant during a PLC cycle (provided that the user program does not implement any changes). Changes in the PIQ take effect at the end of the PLC cycle.

When the power is switched off the PII and the PIQ of the PLC 135 WB remain stored. When the PLC 135 WB is then restarted it resumes the PLC user program from where it was interrupted. However, the PIQ is not output to the inputs/outputs at the end of the cycle. Output is only resumed after the first complete cycle has be executed. On the S5 155U the PIQ is deleted on restart.

On a cold and warm restart, the PIQ is deleted and the PII updated according to the machine signals (PLC 135 WB and S5 155U).

The assignment of the machine signals to the I/O signals (bits) in the I/O area is determined by machine data. Bits in the I/O area not assigned by signals can be used as flags by the PLC user program. To prevent these flags from being deleted with the process images when the PLC is restarted, a delete limit for the IBs and QBs can be specified in the machine data.

Basic signals in the flag area

Certain flag bytes (FYs) contain the basic signals for the PLC program. These comprise, for example, ready signals, initial setting signals, interrupt signals and alarm signals. The PLC operating system informs the PLC user program of the system condition by means of the basic signals.

The flag area encompasses the flag bytes FY 0 to FY 255. The basic signals are contained in FY 0 to FY 24. The area FY 25 to FY 255 can be utilized by the user program. Certain peripheral conditions that are explained with the description of the flag area must, however, be taken into account here (see Section "Provision of Basic Signals").

1.2.2.5 Difference between dynamic/static signals

Signals are either dynamic or static.

Static signals are set or reset only by communication partners (PLC user program and, e.g., the NC). Static signals retain their value for several PLC cycles provided that it is not changed by one of the communication partners.

Dynamic signals, on the other hand, are reset by the PLC operating system after one PLC cycle. Dynamic signals are passed only **to** the PLC, that is to say from the NC, operator panel, COM and the peer PLC.

Most dynamic signals are also available in the form of static signals.

1.2.3 Reaction to interrupt and alarm signals [1)]

A differentiation is made between interrupts triggered by machine signals (hardware interrupts) and program interrupts triggered by the PLC operating system owing to alarm signal edge changes (also see "Interrupt-generating I/O devices" Section).

Hardware interrupts

Hardware interrupts can be processed only in a special PLC mode, referred to as the special mode. The PLC operating system depicts the interrupt-generating signals (see Section 1.4.3) in the flag area so that the image showing the interrupt-generating signals reveals which signal triggered the interrupt. Then the organisation block for interrupt processing OB 2 is called as the user interface.

The signals that generate hardware interrupts can be masked. The edge of the interrupt-generating signal that triggers the interrupt is determined by machine data.

Program interruption by alarm signal edge changes

The user can define certain input bytes as alarm bytes by means of machine data. The signals depicted there trigger program interrupts.

Unlike the hardware interrupts, program interrupts are not triggered directly by the signals in this case. The PLC operating system periodically updates the image of the incoming alarm signals in the alarm bytes (about every 10 ms). OB 3 is activated if an edge change is detected in an alarm byte.

1) If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context

In the flag area the PLC user program is informed of the alarm signals that have been affected by edge changes and of the current edge status, either rising or falling. Branching can be effected in OB 3 with reference to this information.

1.3 PLC interfaces

The individual interfaces of the PLC are briefly outlined and their delimitations are explained in the following Subsections. The interface signals are described in Section 3.

1.3.1 Interfaces, definition and overview

"PLC interface" is used here to refer to an interface between the PLC user program and a communication partner. The abbreviation "PLC" is therefore often used to denote the PLC user program when describing the interfaces.

The following interfaces are available to the PLC user program:

Interlocutor	INTERNAL INTERFACE	Interfaces for the PLC user program
Machine control panel		IB m...IB m+7 (m is variable, specified in MD)
Machine I/Os Inputs (PII) Outputs (PIQ) Interrupt signals 1) Alarm bytes (edge recognition) 1)		 IB 0...IB 127 (IB 128...159 without PII) QB 0...QB 127 (FY 128...159 without PIQ) FY 8...FY 11 FY 12...FY 19
PLC basic, ready signals (own PLC) NC basic, ready signals		FY 0...FY 7 FY 20...FY 24
Diagnostics		DB 1
NC channel ELG-specific signals Spindles Axes Tool management (only 880N, up to SW 4) NC data NC functions (command channel)		DB 10...DB 25 DB 29 DB 31 DB 32 DB 33 DB 36 DB 41
Signals decoded according to list		DB 30
Serial interface		DB 37
Operator panel		DB 40
COM		DB 48
Peer PLC (in the case of two PLCs) 2) from peer PLC to peer PLC Central user DBs		PLC I (PLC II) DB 52 (DB 50) DB 53 (DB 51) DB 59 (DB 59)
PLC machine data words for operating system for function blocks for user PLC machine data bits for operating system for function blocks for user		 DB 60 DB 61 DB 62 DB 63 DB 64 DB 65
Setup user DBs, words Setup user DBs, bits		DB 68 DB 71
Decoding lists for M signals		DB 80...DB 95
Computer link		DB 101, DB 102

Overview of PLC interfaces

1) If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context

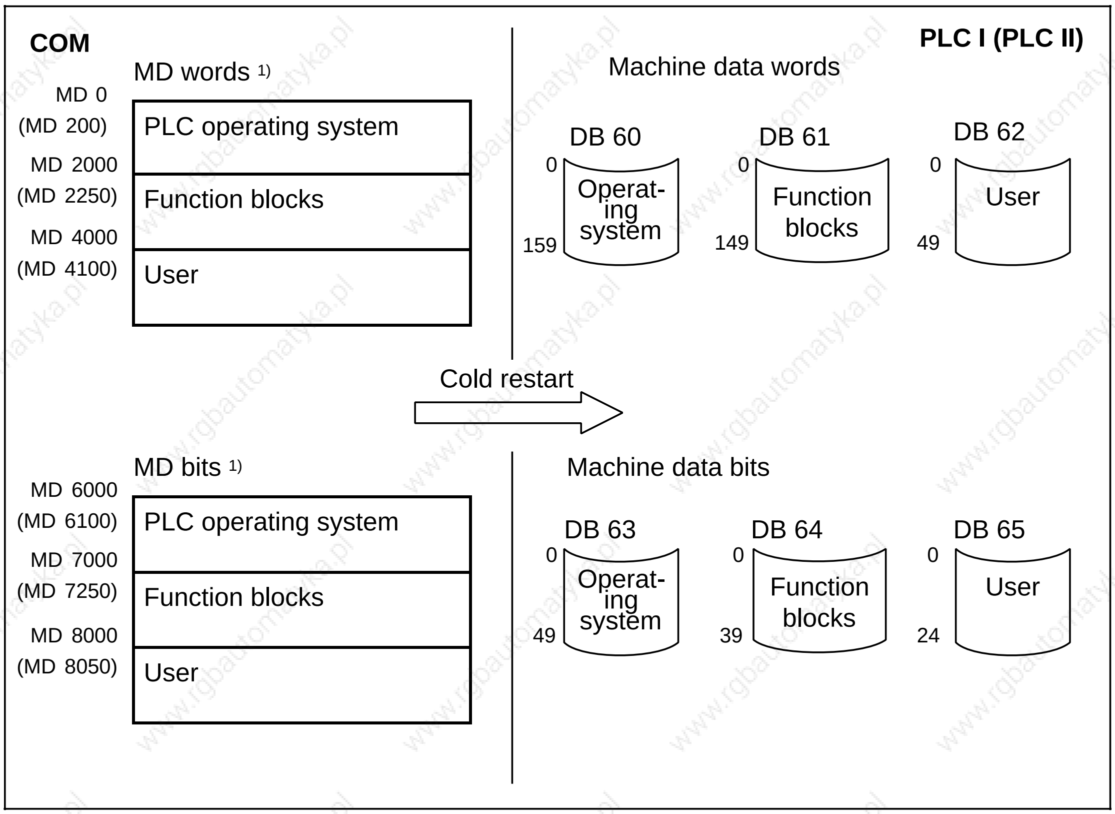
2) Not with SIMATIC S5-155U

1.3.2 Loading PLC machine data

As far as the machine data are concerned, a distinction is made between MD words and MD bits. The PLC machine data are also broken down according to target groups; PLC machine data words and bits exist, for example, for the PLC operating system, function blocks and the PLC user program.

The PLC machine data are stored together with the NC machine data in the machine data submodule (COM area). Each PLC has its own machine data. The machine data can be entered at the operator panel or read in via the universal interfaces.

When a PLC cold restart is performed, the PLC machine data are transferred to the relevant data blocks of the PLC and thus made available to the user program.



Loading PLC machine data on cold restart

1) *The machine data contain the MDs for both PLCs; they are transferred to the relevant PLC when a cold restart is performed.*

1.3.3 Provision of I/O signals, process image [1)]

Acquisition of signals, I/O area 0 - 159 [c)] or 255 [d)]

I/O signals (input/output signals) are acquired and switched by I/O modules. The I/O modules can be located in the central controller, in expansion units or at the operator panel (I/O submodule). There are also DMP submodules for connecting machine signals.

All machine signals that can be processed by the PLC are located in the I/O area 0 .. 159 [c)] or 255 [d)]. A maximum of 160 [c)] or 256 [d)] x 8 = 1280 [c)] or 2048 [d)] inputs and 1280 [c)] or 2048 [d)] outputs can be processed by one PLC.

When an I/O address is read, the signals that are evaluated are different from those that are switched when the same address is written.

Direct access to I/O addresses has certain disadvantages, however, if individual signals are to be processed; bit-oriented operations cannot be executed in the I/O area. The I/O area is divided into two parts.

I/O devices with process image

The I/O area 0 - 127 is provided for digital individual signals or signal groups for bit-by-bit processing. These I/O devices are depicted in the I/O area (process image). The image of the signals in the I/O area can (and should) be processed with bit orientation.

Example:

```
A  I  10.0
S  Q  53.6
```

I/O devices without process image

The I/O area 128 - 159 [c)] or 255 [d)] is provided for byte or word-oriented I/O devices. There is no process image for these I/Os. The signals are read and switched through directly in bytes or words.

Example:

```
L PY 128   Read input signals 128.0 to 128.7
T PY 128   Switch output signals 128.0 to 128.7
```

---

1) If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context

c) up to and including software version 6

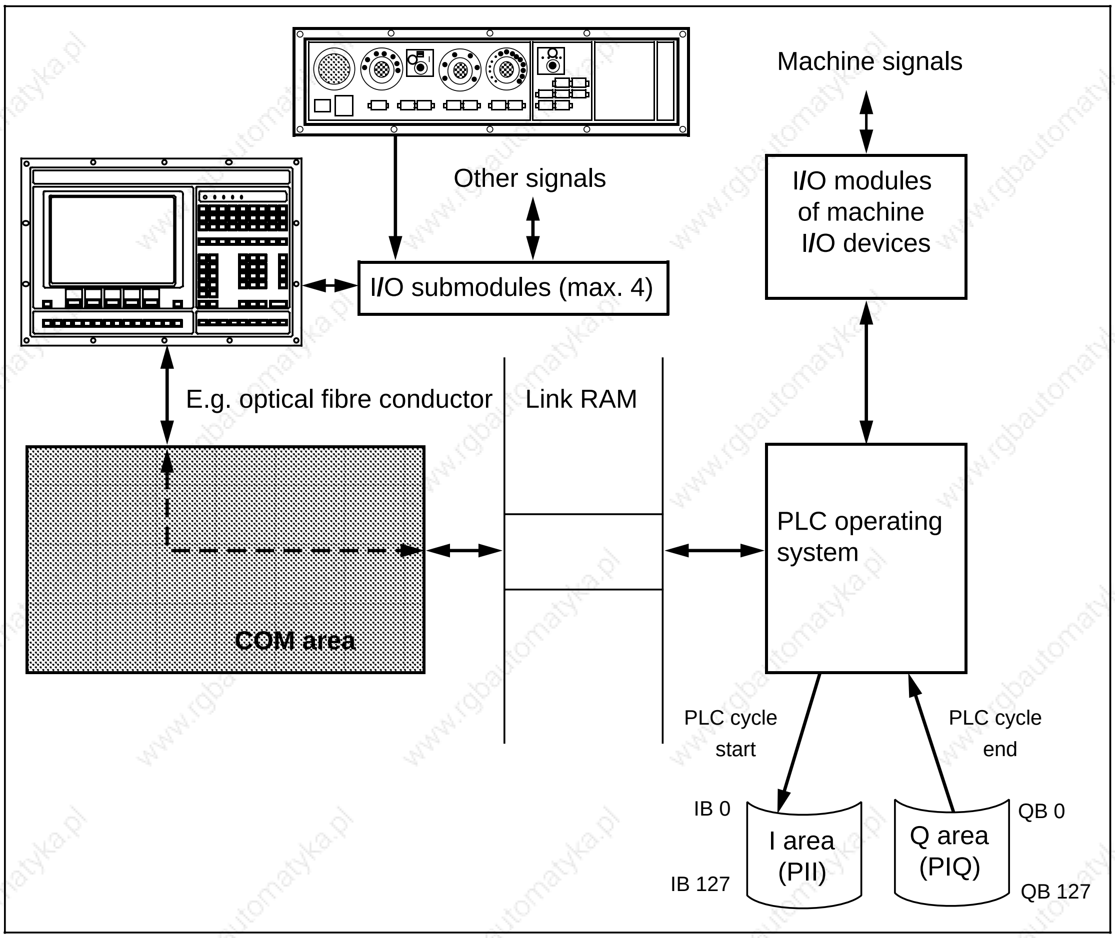
d) with GA2, software version 1 and higher

Process image PII, PIQ

The image of the inputs in the I area is called the process input image (PII) and the image of the outputs in the Q area is called the process output image (PIQ).

At the start of a PLC cycle (before OB 1 is activated), the PLC operating system reads the inputs of the digital I/O devices and updates the PII. The PII then remains stable for the duration of one PLC cycle (provided that the PLC user program does not change it). The change of an input signal appears in the PII after one PLC cycle at the latest.

At the end of a PLC cycle (after OB 1 has been processed), the PLC operating system reads the PIQ and switches the output signals accordingly. If the PLC user program changes a signal in the PIQ, the relevant output signal thus follows after one PLC cycle at the latest.



Provision of I/O signals

Breakdown of the I/O area

The input and output signals are mapped 1:1 into the process image. In other words, the inputs in peripheral byte PB x are mapped in IB x and the outputs in PB y are switched by QB y. The I/O address under which an input or output can be accessed depends on the machine data and/or settings on the I/O modules.

The signals of the I/O submodules at the operator panel are depicted in the I/O area like the other I/O signals. The initial addresses for the signal images of these I/O submodules are specified by machine data:

	PLC I	**PLC II**	**Value range**
Inputs:	MD 0006	MD 0206	64...96
Outputs:	MD 0007	MD 0207	64...112

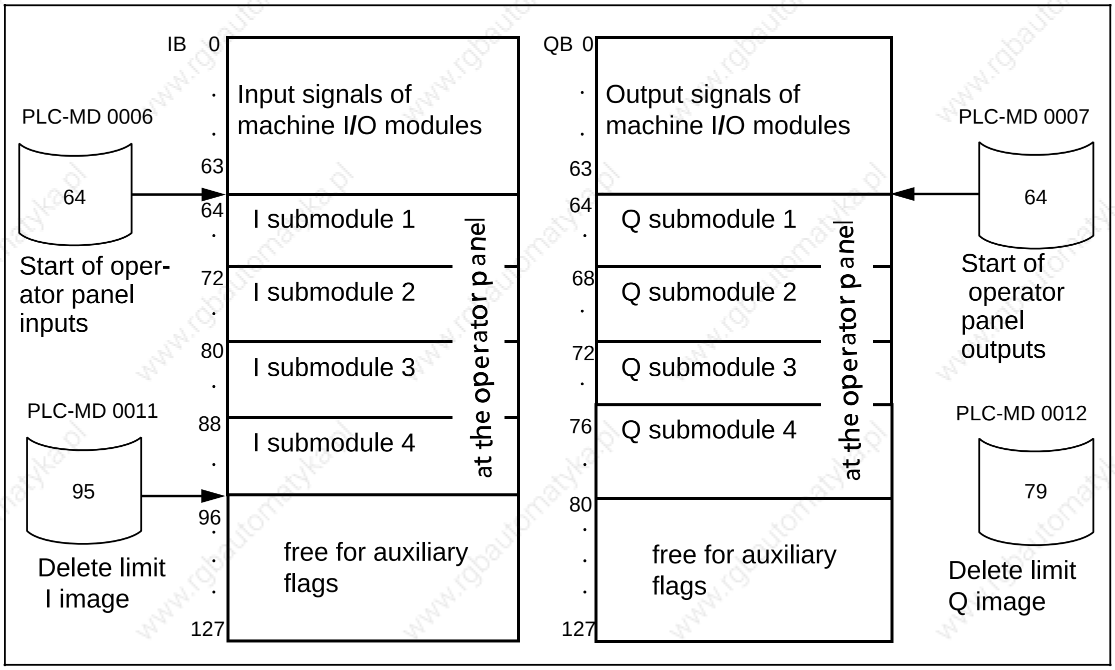
The inputs of the I/O submodules at the operator panel can be read by both PLCs; the outputs can be switched submodule by submodule by one of the PLCs. PLC machine data bits determine whether and how an I/O submodule is processed by the relevant PLC:

	PLC I	**PLC II**	**Value range**
Inputs:	MD 6027	MD 6127	see machine data description
Outputs:	MD 6028	MD 6128	for exact assignment
			(also see MD 6400 and thereafter)

If fewer than 128 bytes are required for inputs or outputs, appropriate assignment of the I/O address space can minimize the size of the process image. Input and output bytes above IB 64 and QB 64 that are not assigned by I/O signals can be used by the PLC user program as auxiliary flags. The PLC operating system must be informed that it is not to change the area used for auxiliary flags when transferring signals between the process image and I/O devices. The following machine data are available in this context:

	PLC I	**PLC II**	**Value range**
Delete limit I image:	MD 0011	MD 0211	63...127
Delete limit Q image:	MD 0012	MD 0212	63...127

c) up to and including software version 6



Typical assignment of I/O area for PLC I

Note:

When using a SINUMERIK EU in conjunction with the EU/MPC interface, Q 127.7 is assigned by an internal signal.

I/O device acquisition on warm restart 1)

As when performing a cold restart, the PLC records the I/O devices when a warm restart is executed. The following rules apply:

- If the I/O device complement has been changed in a way that would prevent start-up with a cold restart (e.g. an EU was switched off during Power Off and not switched back on after control Power On), a warm restart cannot be executed. The detailed error identifiers are set according to the cold restart detailed error identifiers.
- If an I/O device that was present at the time of the cold restart is found to be missing on a warm restart, the PLC behaves as though the I/O device in question failed during cyclic operation; in other words the response is determined by the machine data responsible for stipulating the reactions to I/O device malfunctions. The detailed error identifiers correspond to those during cyclic operation.
- If a change in the address location of a peripheral byte is detected, the PLC branches to stop status with detailed error identifier F5 (impermissible restart) and the expanded error identifier 3C (changed address location of I/O device). A change in the address location indicates, for example that an I/O device which was located centrally at the time of Power Off is inserted at a distributed location when Power On is performed. You will find the errror lists in the manual "PLC 135 135 WB, Planning Guide".
- Additional I/O devices that were not detected in the I/O device complement at the time of the cold restart are not processed.

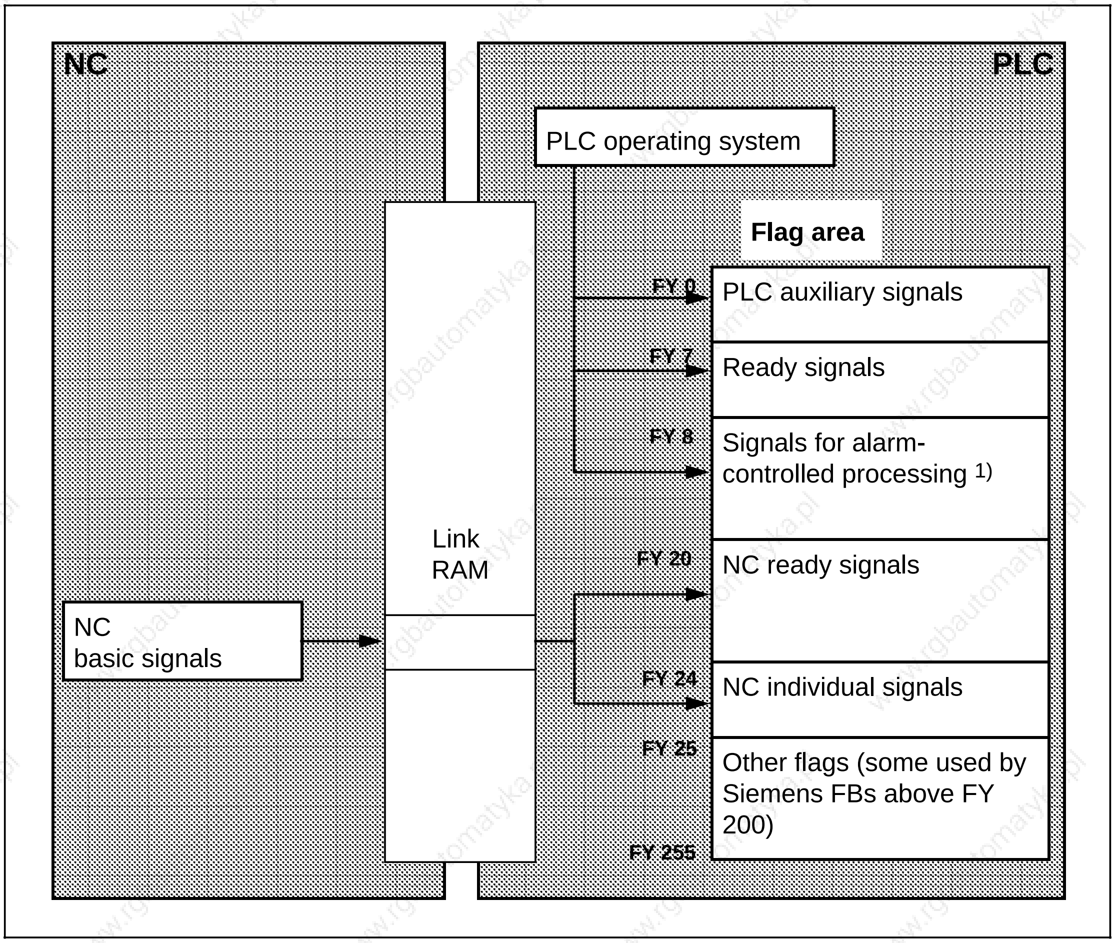
---

1) If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context

c) up to and including software version 6

1.3.4 Provision of basic signals

The basic signals are stored by the PLC operating system in the flag area. With reference to the basic signals the PLC user program is able to obtain information on the system status (ready signals, processing level etc.).

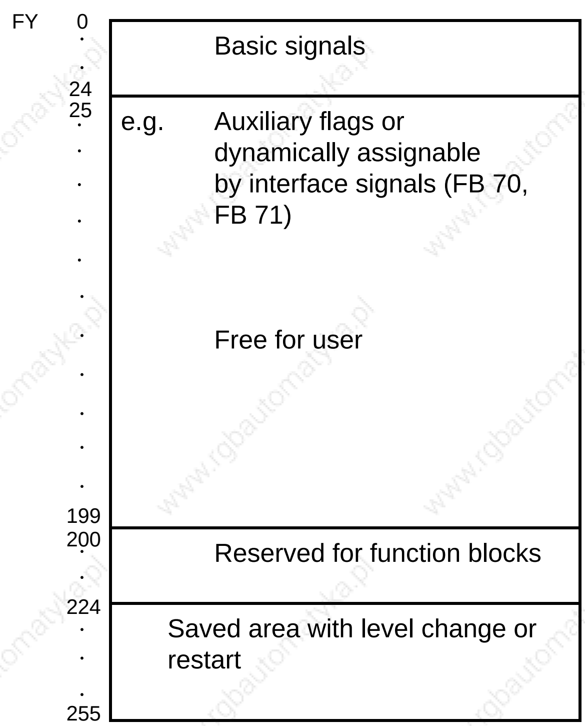


Provision of basic signals in flag area

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context*

The figure below illustrates the structure of the flag area. The flag area FY 25 - FY 255 is available to the user.
The following points must be observed here:

- Interface signals for bit-by-bit processing can be copied between the flag area FY 25 - FY 223 and data blocks with the function macros FB 70 and FB 71. (Function macros are FBs that are integrated in the operating system.) The user must split up this area himself, that is to say he must specify the area between FY 25 and FY 223 that is to be or can be used for dynamic auxiliary flags. Some restrictions apply when using certain FBs (see below).
- The flag area FY 224 to FY 225 or FY 200 to FY 255[d)] (if MD 6026.3 is set) is saved by the operating system when the processing level changes. This flag area is also restored after a restart.
- The flag area FY 200 to FY 255 is used to some extent by function blocks (see FB descriptions, also SIMATIC FBs where applicable). The following exceptions apply here: no assignment of dummy parameters. The conditions of the flags may have to be saved by the user when leaving the block. If these function blocks are not utilized by the PLC user program, these flags are at the free disposal of the user.



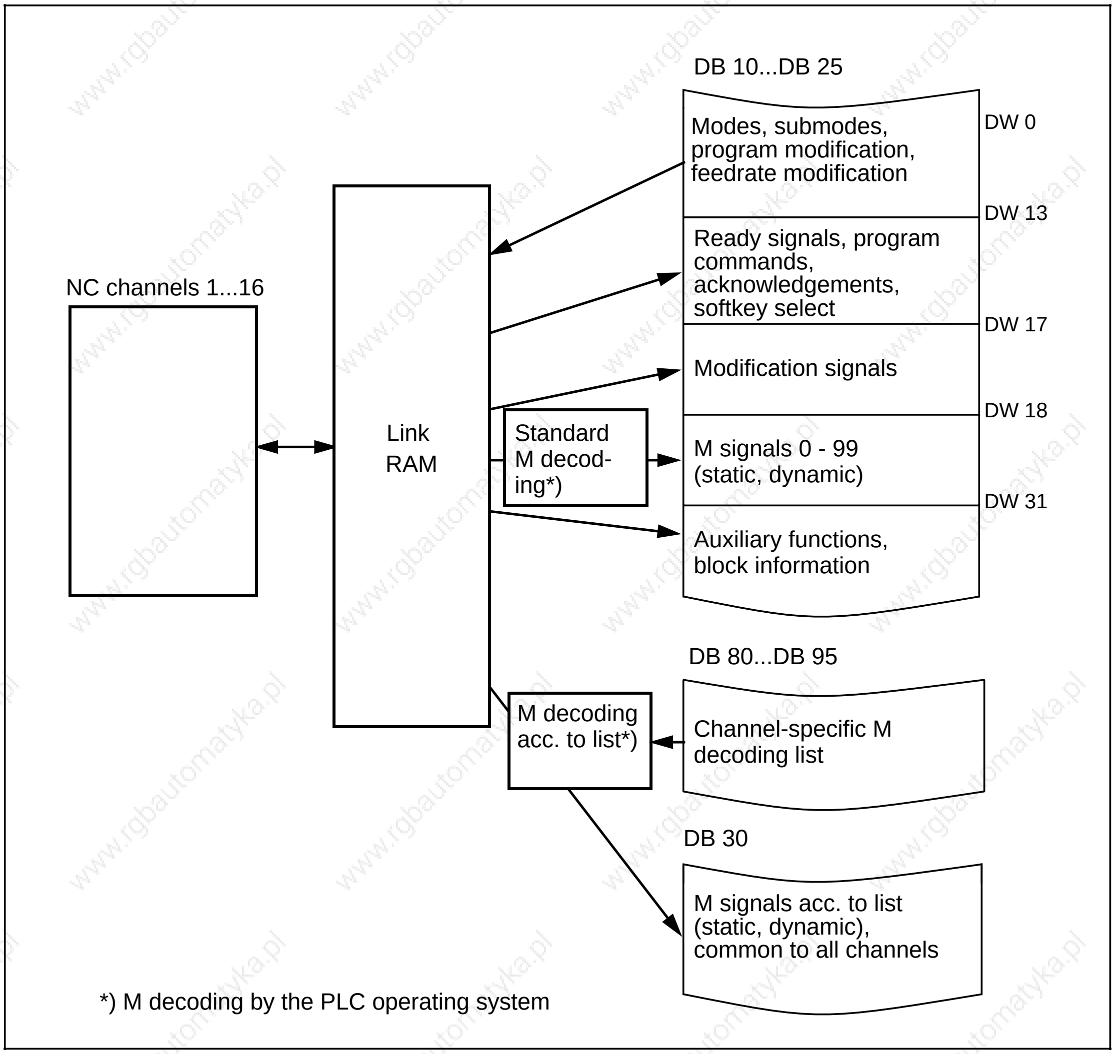
Structure of flag area

d) with GA2, software version 1 and higher

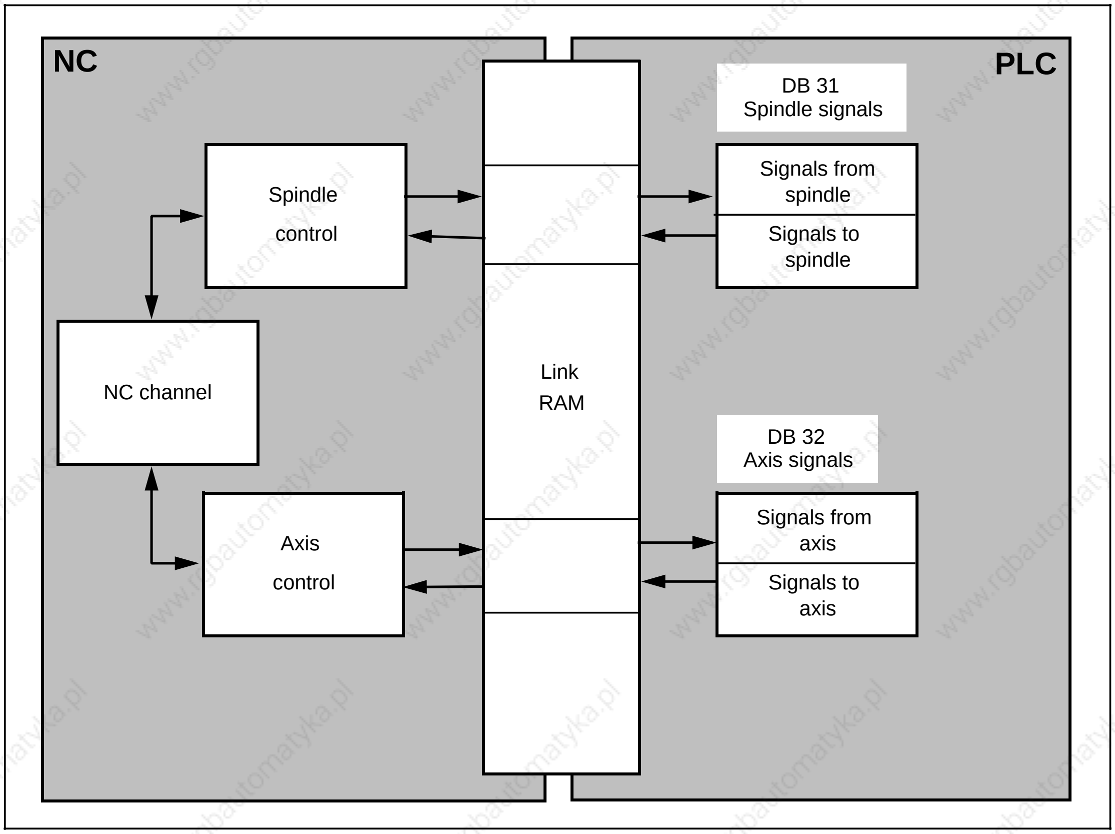
1.3.5 Signal transfer via NC/PLC interface

Using the example of the interfaces to the NC, the method of transferring signals via the system's internal interfaces is illustrated below.

The figure shows how the PLC operating system stores the channel-specific signals in the data blocks of the PLC/NC channel interface in groups; this also embraces decoding of the extended M functions (M decoding according to list).



Transfer of channel-specific signals



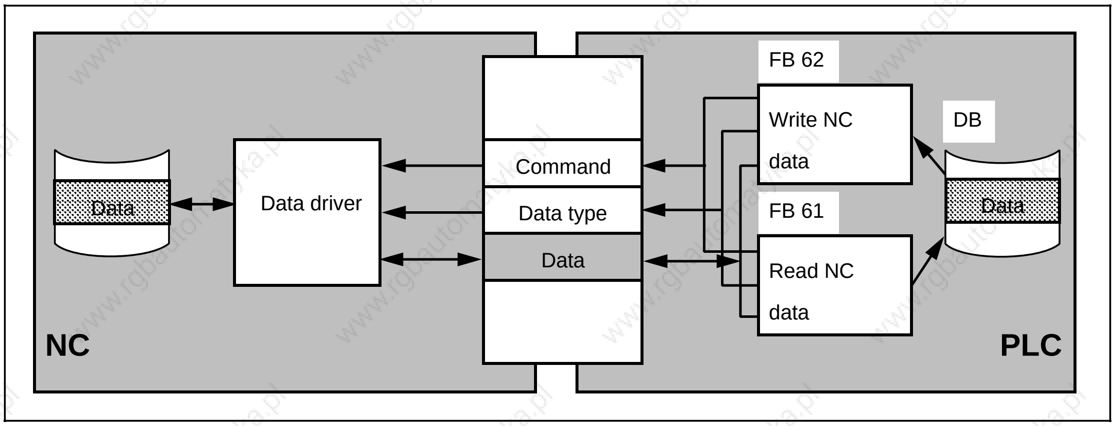
Transfer of axis-specific and spindle-specific signals

1.3.6 Data transfer between NC and PLC

Data not transferred via the standard interfaces can also be exchanged between the NC and PLC areas. The data transfer can be triggered on the initiative of the NC or PLC.

Data transfer with PLC initiative

The PLC user program parameterizes and calls the function macros FB 61 (read NC data) and FB 62 (write NC data).

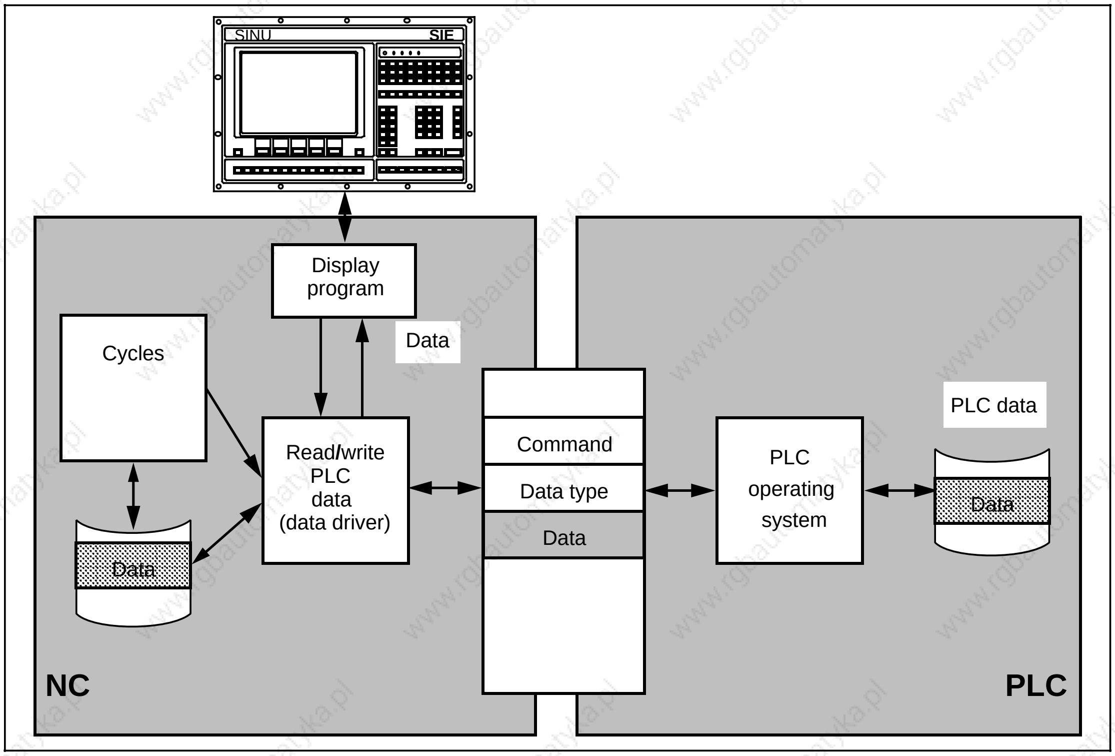


Data transfer on PLC initiative

Data transfer with NC initiative

In the case of data transfer on the initiative of the NC, the PLC user program is generally not affected[1)]; the data transfer routine on the PLC side is performed by the PLC operating system.

1) *In the event of indirect addressing via the NC/PLC data channel (NC initiative), the PLC user program must make data addresses available (this can occur, for example, with specially programmed functions in the UMS).*



Data transfer on NC initiative

1.3.7 Command channel

The PLC user program can trigger functions in the NC by means of the command channel, whereby the user data for the functions are also transferred via this channel. A subsequent Section describes the functions that can be initiated by means of the command channel.

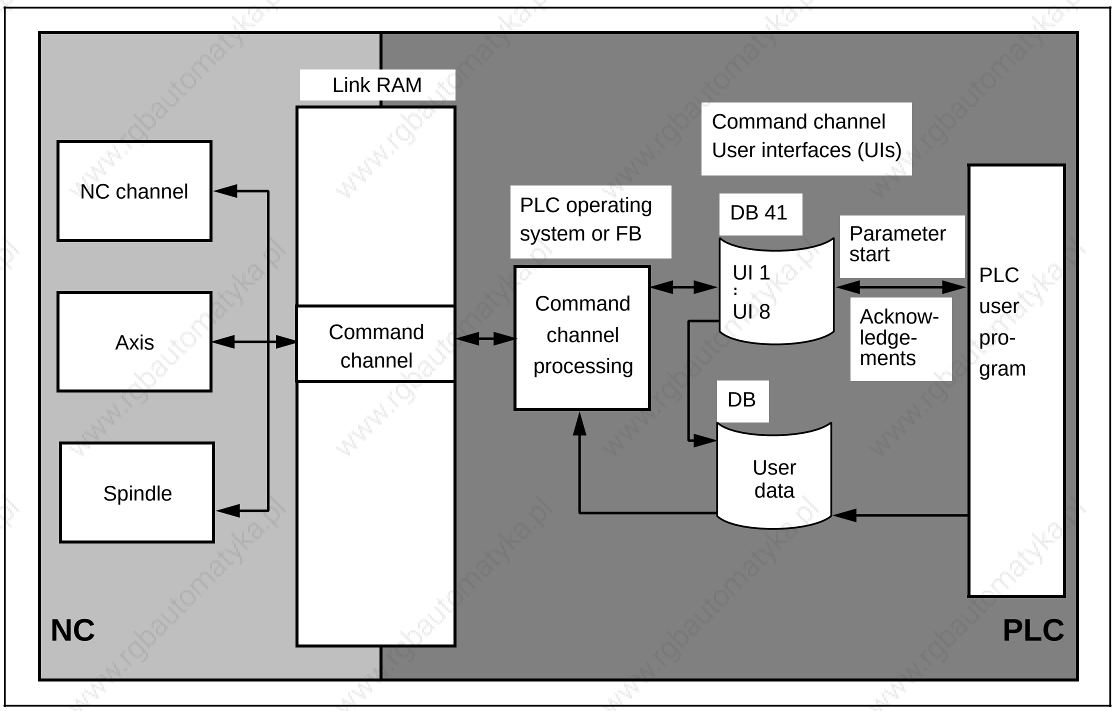
The command channel is a high-speed data channel. The interface to the command channel for the PLC user program is DB 41. The command channel is parameterized here and the location of the user data is also specified (DB number, offset, length).

The command channel can process several jobs at the same time and is subdivided into user interfaces (UIs) for this purpose. The system supports up to eight user interfaces, each of them operating like an independent command channel. All the user interfaces are contained in DB 41.

The PLC user program parameterizes the command channel and initiates processing by setting a request bit. The PLC operating system then transfers the job contained in DB 41 to the NC and subsequently stores the acknowledgement signals from the NC for the PLC user program in DB 41.

The scope of the command channel can be specified by machine data:

Activate command channel:	MD 6026.1	
Number of user interfaces:	MD 0033	Value range 0 to 8



Command channel

1.3.8 Display of messages

The PLC user program can issue messages at the operator panel. In order to output messages, message numbers are transferred to the COM area. These message numbers are independently generated by function blocks (FB 54 - FB 56) that are called by the PLC user program as required.

The FB called by the user program scans all the memory locations defined as message bytes and generates message numbers for all the set bits. These message numbers are stored in message buffers. A distinction is made here between error messages and operational messages. Many of the bits used to generate messages can trigger a function on the NC, e.g. spindle disable.

The following message types exist:

- Channel-specific messages (bit fields in DB 10 - DB 25)
- Spindle-specific messages (bit field in DB 31)
- Axis-specific messages (bit field in DB 32) and
- PLC-specific messages (bit field in DB 58).

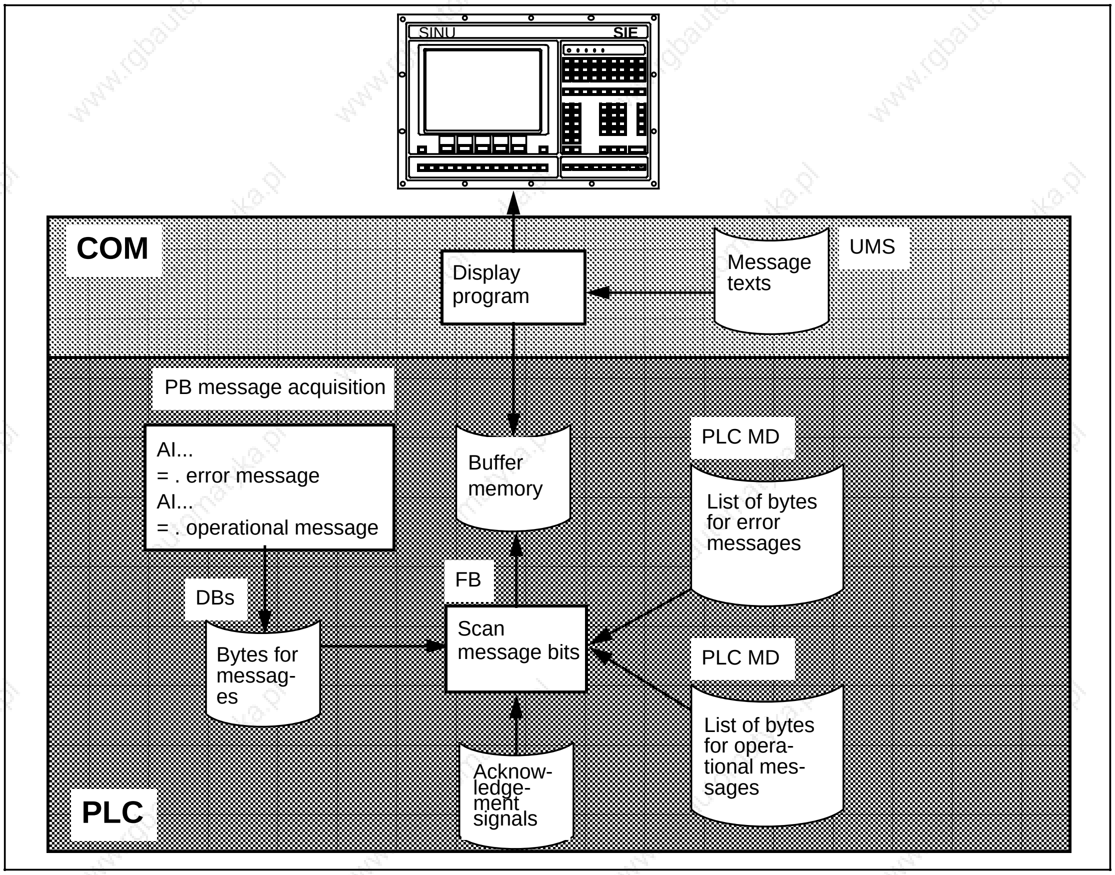
The display programs in the COM area search for the texts or images that belong to the message numbers they received from the PLC in the user memory submodule (UMS) and display them.

A set bit generates a message if:

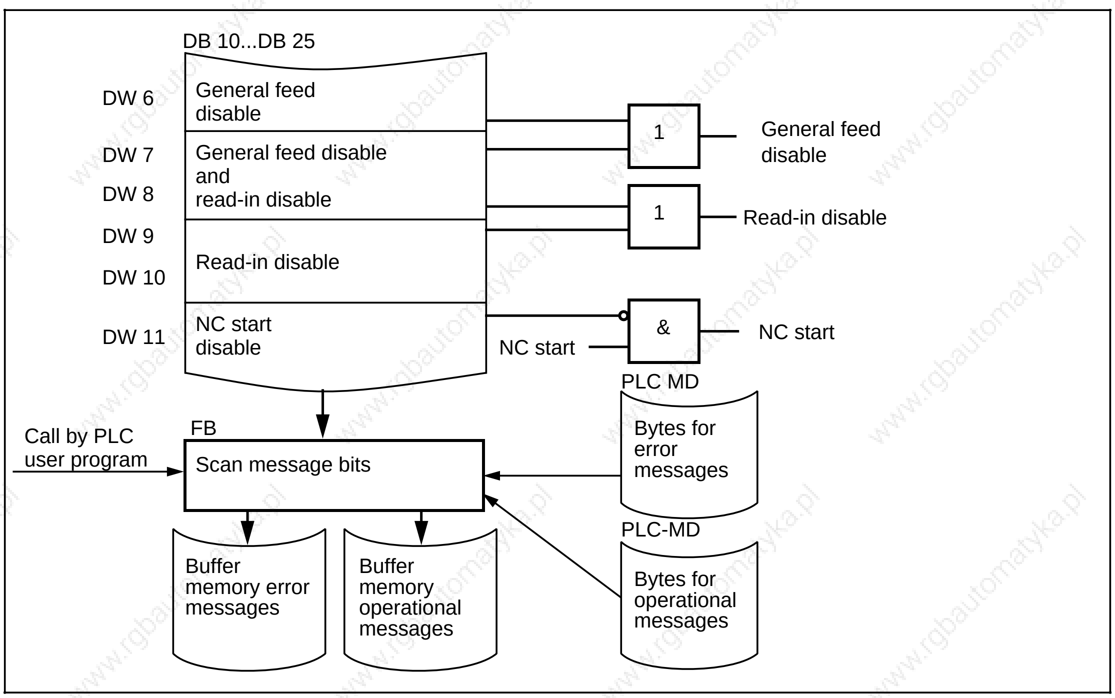
- The byte containing the bit is defined as a message byte (by MD)
- The FB package for messages is loaded in the PLC (FB package 0)
- The relevant FB is called in the PLC user program and if
- A message text for the bit is stored in the UMS.

The display in the message line depends on DB 58, DW 0. The images (overview alarms PLC) do not have to be specially programmed; only the texts for the messages have to be specified in the UMS.

As well as the error and operational messages (parameterized by machine data), messages for message groups that can be displayed in standard images are also available.



PLC message display principle



Dual function of message bits shown with channel-specific messages

1.4 I/O devices (machine signals)

Machine signals can be connected to the SINUMERIK 880 in the following ways:

- Connection to I/O modules in the central controller
- Connection to I/O submodules in the operator panel
- Connection of distributed I/O modules such as I/O modules in an expansion unit or DMP[1)] submodules.

It is important to note that input signals of very short duration are either not detected by the PLC or not passed on by the input modules to the PLC. There are two reasons for this:

- The PLC is a cyclic program. It therefore scans the inputs in cycles of a certain duration. If an input signal is set and reset again between two scans, the signal change is not detected by the PLC.
- Transfer from the distributed inputs/outputs is also cyclic because the stations exchange signals with the PLC one after the other. If a signal is set and reset entirely within a cycle, the signal change is not detected.

1.4.1 Central I/O devices

The I/O modules are inserted in the central controller. The signals are transferred to the I/O area (PII, PIQ) according to the principles described in the "Provision of I/O signals, process image" Section. The slightly different procedure when working with two PLCs is described in the "Operation with two PLCs" Section (not with S5-155U).

1.4.2 Distributed I/O devices

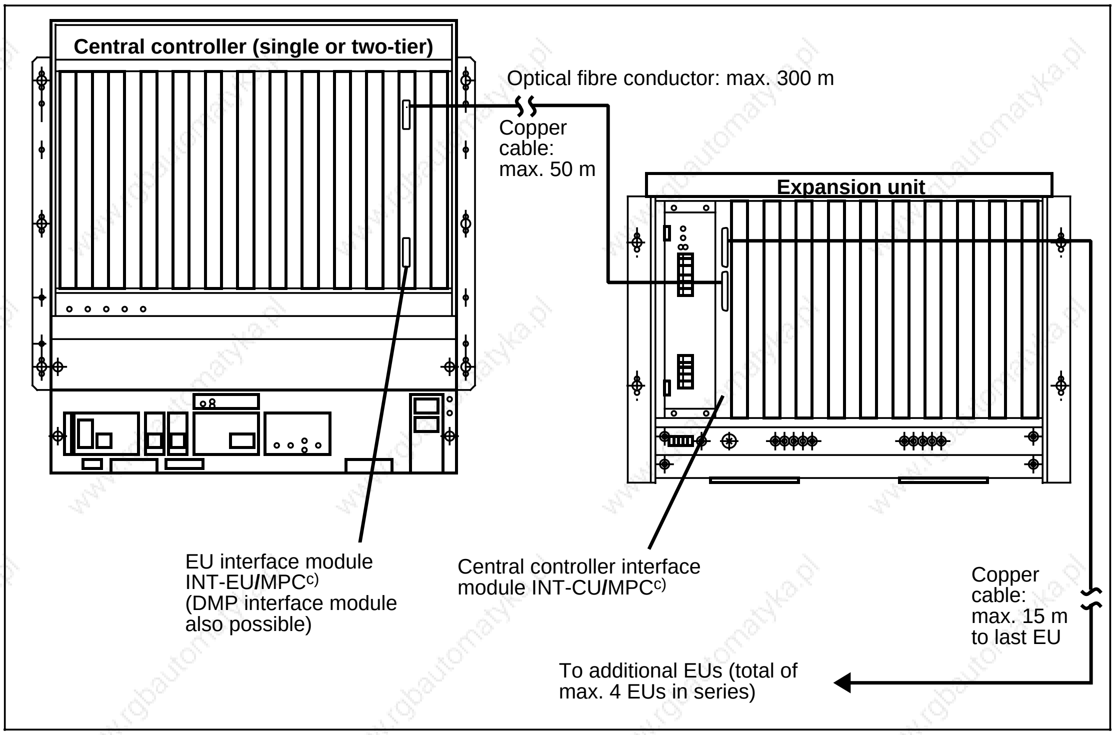
The distributed I/O devices comprise I/O modules located in an expansion unit (EU) and DMP submodules. An EU is required with the SINUMERIK 880 if:

- The I/O modules are to be installed in the vicinity of the machine in order to reduce the amount of cabling
- The number of I/O modules to be used exceeds the number of slots available in the central controller or
- If not only SINUMERIK I/O modules but also SIMATIC modules (see the Catalog for the SINUMERIK 880) are to be used.

The assignment of input/output bytes to the distributed machine peripherals is described in the Installation Instructions, Section 7.6.

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context*

Two sizes of expansion unit are available for the SINUMERIK 880: the Mini EU with ten slots and the EU with 20 slots. The following figure illustrates the connection of EUs to the SINUMERIK 880. 1)



Connecting SINUMERIK expansion units

The expansion units can be linked to the central controller via one of the following interface modules:

- EU interface module EU-MPC (INT EU/MPC)c)
- DMP interface module (interface DMP)
- SIMATIC input/output module INT EU/16B

The interface module contains an image of the state of the inputs and outputs. The PLC operating system cyclically transfers its own process image (I/O area) into the that of the interface module. The interface module transfers the signals automatically. The only difference between accessing input/outputs in the EU and accessing them in the central controller is the delay in serial transmission (approx. 1.5 ms per EU).

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context*

c) *up to and including software version 6*

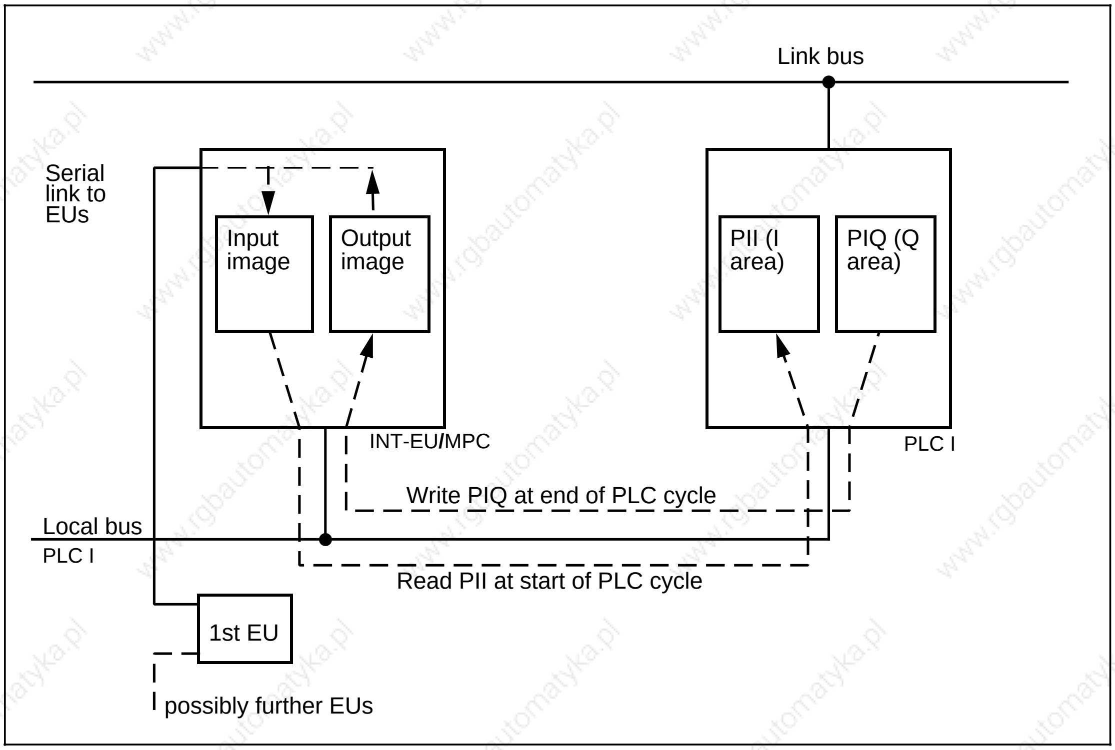
Comments:

- If expansion units are used in conjunction with DMP submodules, the EUs can also be connected to the central controller by means of the DMP interface module that is required in such circumstances.
- Ways of linking expansion units and DMP modules to the central controller are described in the Interface Description, Part 2, Connection Conditions.
- SINUMERIK expansion units can be fitted with SINUMERIK modules or with the permitted SIMATIC modules; it is possible to mix the two types of module (SIMATIC EUs can only be fitted with SIMATIC modules).

Local I/O devices

The interface module that links the EU to the central controller can be connected to a slot in the central controller with either a link bus interface or only a local bus interface.

If the interface module is inserted in a slot with only a local bus interface, only the PLC that is responsible for the local bus concerned can access the I/O devices of the EU.



PLC access to distributed I/O devices via local bus

Assignment of I/O modules to a PLC [c)]

The I/O devices are divided into I/O device groups. Each I/O device group comprises 64 signals, equivalent to 8 peripheral bytes. Up to 20 I/O device groups for inputs and 20 I/O device groups for outputs accordingly exist for the maximum complement of 1280 inputs and 1280 outputs.

The PLC machine data contain assignment tables for assigning an I/O device group to a PLC. The assignment tables indicate whether an I/O device group is to be processed by its own PLC and whether local access is available to the I/O device group of PLC I or PLC II.

Assignment of I/O device groups:

	PLC I	PLC II
Inputs:	MD 6400...MD 6419	MD 6420...MD 6439
Outputs:	MD 6480...MD 6499	MD 6500...MD 6519

The outputs can be processed (in groups in each case) only by one PLC.

Note:

- **Only local** access is available to signals connected via DMP submodules. (Also see "Local I/O devices" Section.)
- Also refer to the "Global I/O devices" Subsection in the "Operation with two PLCs" Section if appropriate.

1.4.3 Interrupt-generating I/O devices [1)]

The SINUMERIK 880 offers two ways of initiating program interrupts owing to I/O device signal changes.

A program interrupt can be triggered by

- Edge changes in alarm bytes or
- Hardware interrupts.

Program interrupts owing to edge changes in alarm bytes are described in the "Reaction to interrupt and alarm signals" Section.

Periodic evaluation of alarm bytes is too slow for some applications. Besides the alarm signals each PLC can process up to 24 or 32[d)] interrupt-generating signals in 3 or 4[d)] interrupt bytes.

The interrupt-generating signals can be connected to the EU-MPC EU interface module[c)] or to DMP submodules. They can be individually masked or enabled by PLC machine data or by "free configation"; the interrupt-generating edge (rising or falling) can also be specified separately for each signal.

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context*

c) *up to and including software version 6*

d) *with GA2, software version 1 and higher with free configuration*

Interrupt-generating signals at the EU-MPC[c)]

Besides the EU link, the EU-MPC interface module contains 8 interrupt inputs. Signal changes at these inputs trigger a group interrupt at the PLC accommodating the local bus to which the EU-MPC is connected. Up to 3 EU-MPC modules can be inserted per PLC.

The interrupt inputs on the EU-MPC are equipped with interference suppression filters with a running time of approx. 2 ms.

Interrupt-generating signals at DMP submodules

One interrupt byte per DMP interface (interface DMP) module can be defined by means of machine data. The interrupt byte is always the first input byte of a DMP submodule. The DMP firmware periodically evaluates the interrupt byte and generates a group interrupt at the PLC in the event of a relevant signal change (correct edge, signal not masked). Up to 3 DMP interfaces (interface DMP) can be connected per PLC.

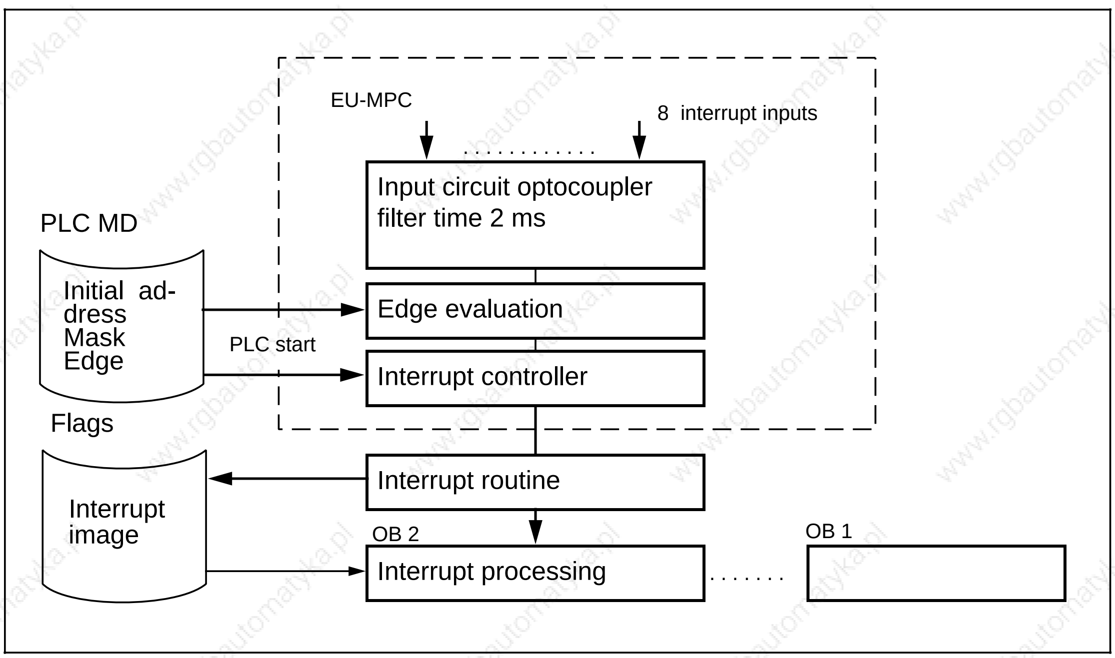
The following applies to GA2 with free configuration:

Up to four interrupt bytes are assigned to the DMP modules in the configuration DB. More than one interrupt byte can assigned to one DMP module.

The interrupt inputs on the interface DMP are equipped with interference suppression filters with a running time of approx. 0.5 ms. Despite the serial mode of data transfer, the reaction time is equivalent to that achieved with interrupts by the EU-MPC.

Interrupt processing

The group interrupt generated by an EU-MPC or DMP interface activates an interrupt routine of the PLC operating system. This routine makes all the required basic signals available in the flag area and calls OB 2 of the PLC user program. In OB 2 the PLC user program can identify which signal triggered the interrupt with reference to an image of the interrupt byte in the basic signals and is thus able to react accordingly.



Principle of interrupt-generating I/O devices with EU-MPC

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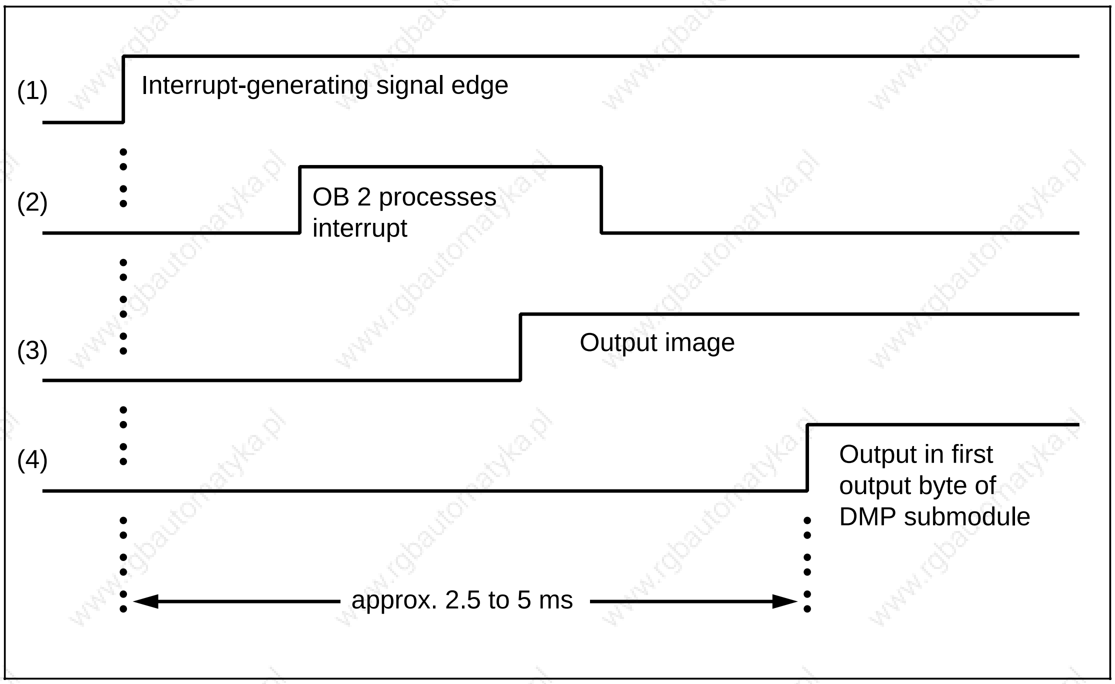
c) up to and including software version 6

Conditions

- Interrupt processing is possible only if the PLC is operated in the special mode. Special mode is set in PLC MD 6051, bit 0.
- One PLC can process a **total** of 3 or 4[d)] interrupt bytes, equivalent to 24 or 32[d)] interrupt-generating signals. The 3 interrupt bytes are distributed between the available EU-MPC or DMP interfaces. One interrupt byte can be defined per interface. On the GA2 with free configuration, the four interrupt bytes are assigned in a configuration DB.
- No expansion unit is allowed in a DMP line in which an interrupt byte is declared because the cycle times for the other DMP submodules in the line are extended from approx. 5 ms to approx. 10 ms by the EU.
- If the interrupt byte is an input byte on a DMP module with 16 inputs/16 outputs, the first output byte of the DMP submodule is also updated with each scan of the interrupt byte (high-speed output channel). The reaction time from a signal change in the interrupt byte to setting an output in the first output byte is approx. 2.5 to 5 ms (typical: 3 ms).



Typical interrupt-controlled reaction with 16 input/16 output DMP submodule

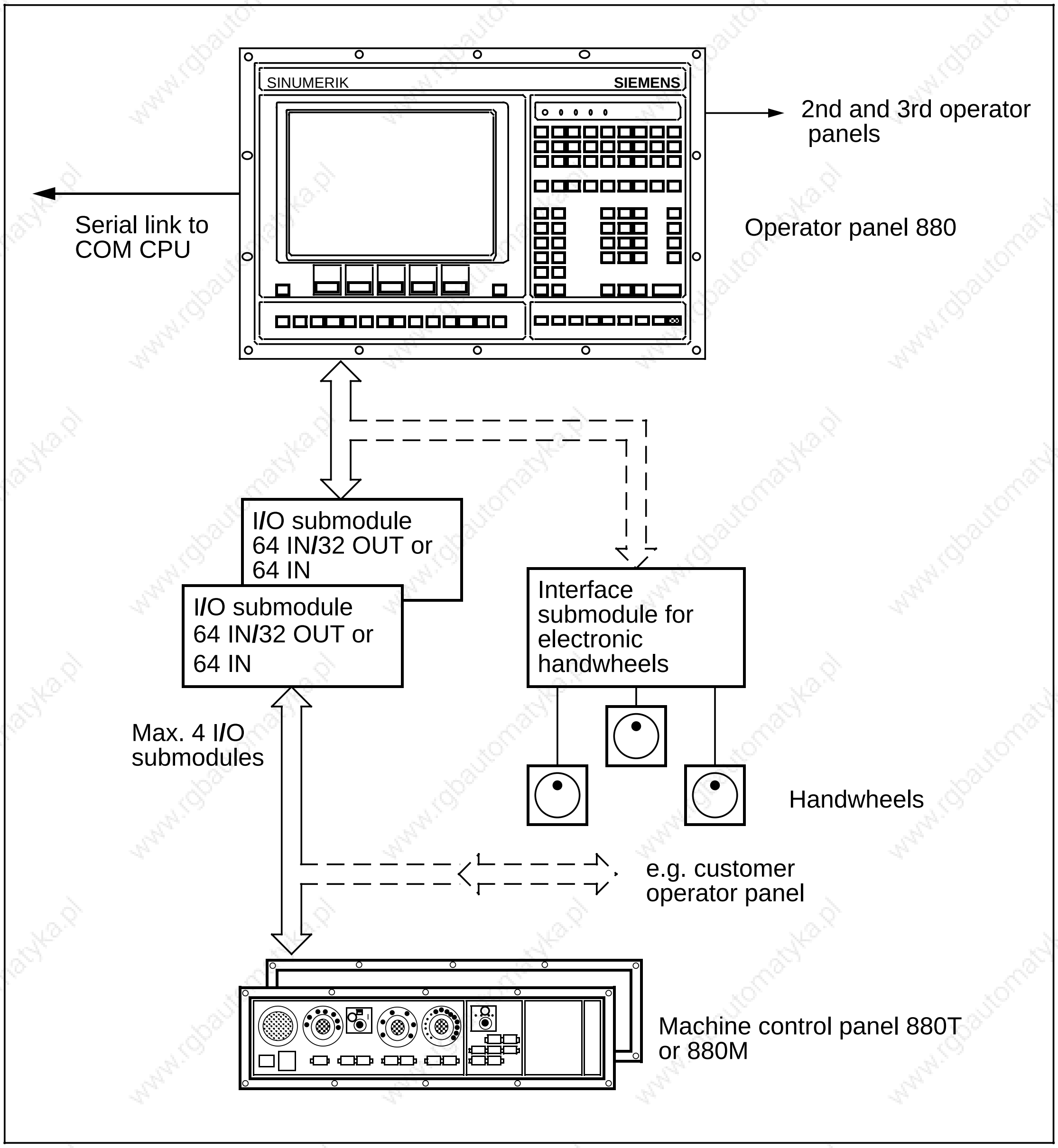
(1) Input signal
(2) OB 2 processes the interrupt and reacts by setting an output signal in the output image.
(3) Image of an output in the first output byte of the DMP submodule
(4) The output is switched according to the output image.

---

d) with GA2, software version 1 and higher with free configuration

1.4.4 Connections on the operator panel

The principal components that are connected to the operator panel are the machine control panel and handwheels. However, signals from other functional units can also be acquired by I/O submodules connected to the operator panel. A maximum of 4 I/O submodules and 3 handwheels can be connected to the operator panel. The handwheels are not counted as PLC I/O devices.



Connecting devices to operator panel

1.5 Operation with two PLCs

1.5.1 NC/PLC interface

When operating with two PLCs, the user must determine whether the NC/PLC interface is to be processed by PLC I or PLC II. This is specified by machine data. The choice can be made channel, axis- and spindle-specific, that is to say each NC channel, axis and spindle is assigned to one of the PLCs.

If a SIMATIC S5-155U is used, it is not possible to use two PLCs.

1.5.2 I/O device assignment with 2 PLCs

I/O submodules at the operator panel

The inputs and outputs that are connected to the operator panel by means of I/O submodules are available to both PLCs. Here again, PLC machine data are used to specify which PLC processes an I/O submodule; outputs can be switched only by one PLC in each case.

Central I/O devices declared global [c)]

The SINUMERIK I/O modules do not have a link bus interface. Signals connected in the central controller can therefore be read and switched only by the PLC whose local bus accommodates the I/O module to which the signals are connected.

If, when operating two PLCs, PLC II is to process signals connected to the local bus of PLC I, PLC I must make these signals available to PLC II. The signal flow for this example is shown in the following figure.

Transfer of input signals to PLC II [c)]

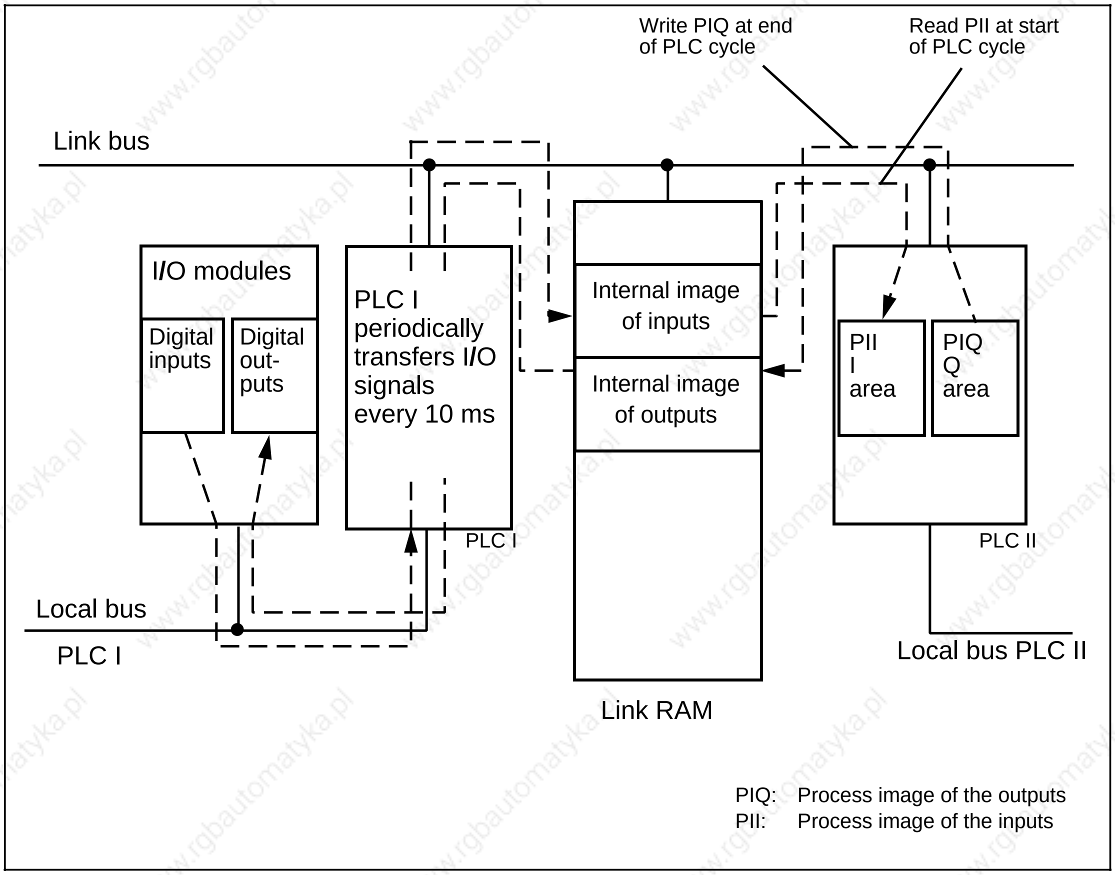
PLC I periodically reads the inputs of the I/O module (in a 10 ms cycle) and transfers the signals to an internal interface in the link RAM. PLC II obtains this internal input image at the start of the cycle and transfers it to its PII where the user program can read the status of the inputs.

c) up to and including software version 6

Transfer of output signals to the I/O module [c)]

At the end of the cycle the PLC II read its PIQ and transfers the output signals for the I/O module at the local bus of PLC I to the internal interface. PLC I reads the output signals from the internal interface (again in a 10 ms cycle) and transfers them to the outputs of the I/O module.

This allows inputs of the central I/O devices to be scanned from both PLCs and permits the utilization of free slots in the area belonging to the partner PLC.

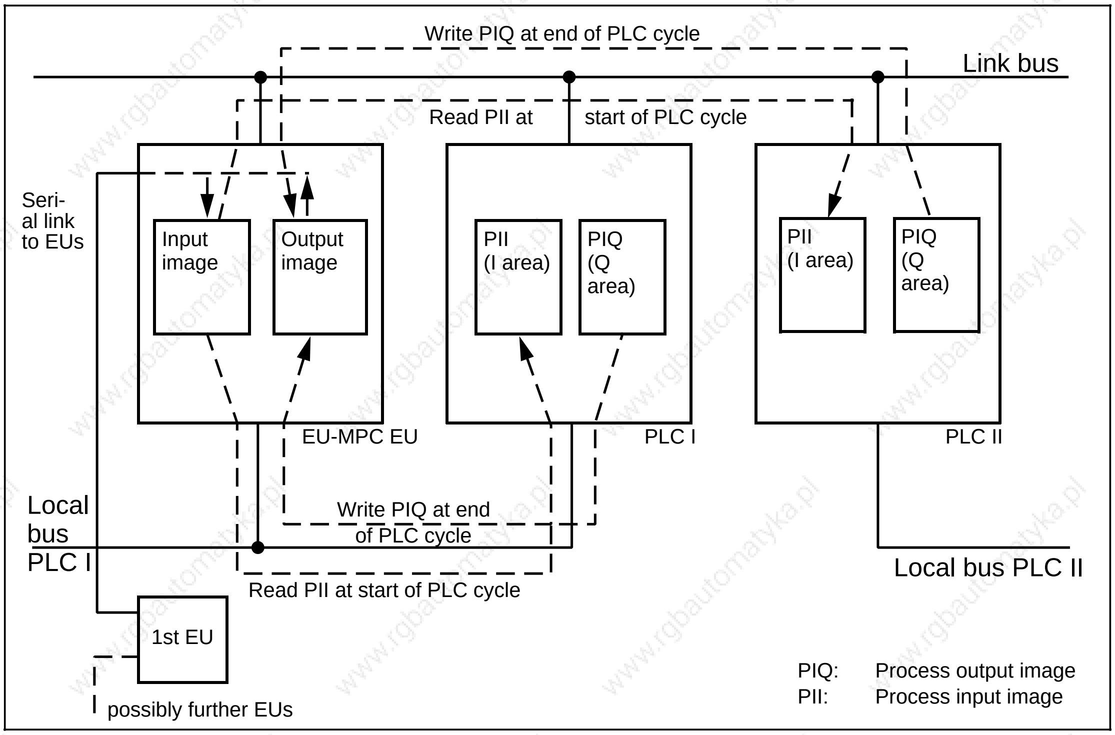


Access to central controller I/O devices declared global

c) *up to and including software version 6*

Global I/O devices [c)]

If the EU-MPC EU interface module[c)] is inserted in a slot with a link bus interface, both PLCs can access the I/O devices in the linked expansion unit where appropriate. Inputs can be evaluated by both PLCs; outputs are assigned to one of the PLCs in groups of 8 bytes each (I/O groups) by means of PLC machine data (see "Central I/O devices" Section).



Access to global distributed I/O devices

c) *up to and including software version 6*

1.5.3 PLC/PLC communication

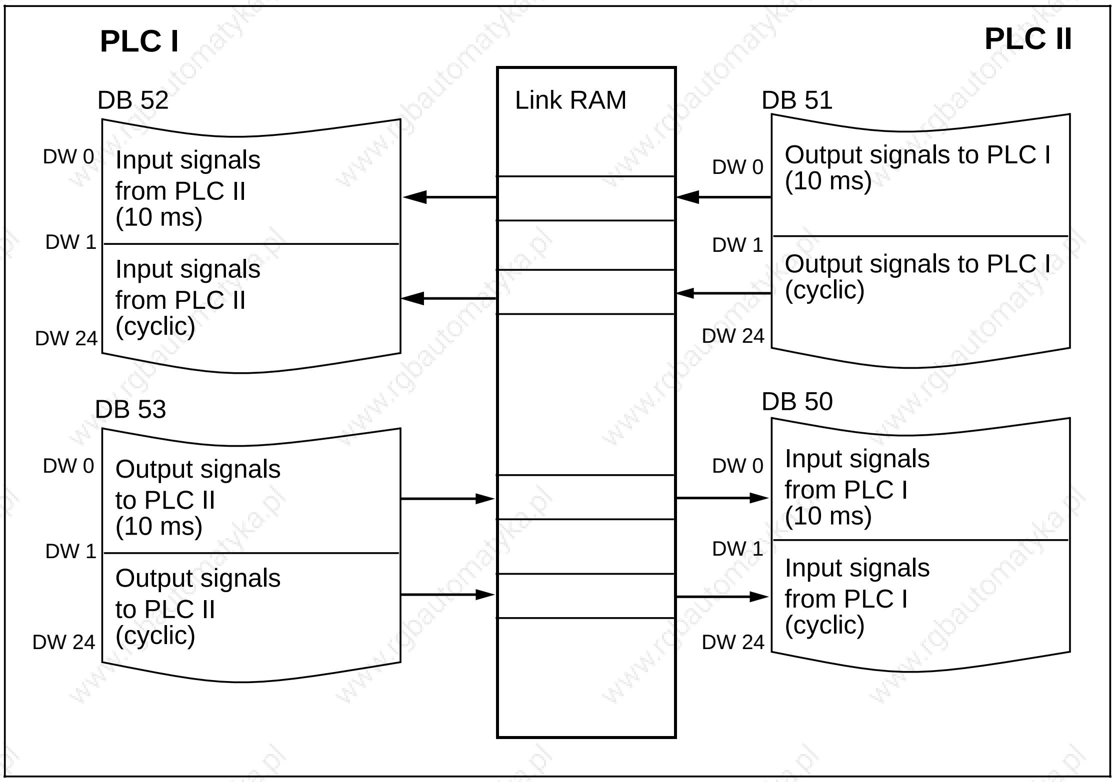
The interface between the PLCs comprises data blocks, whereby the PLC user program can select from various methods of transfer. A separate DB, broken down into sections for the relevant transfer method, exists for each transfer direction.

Transfer direction of data blocks:

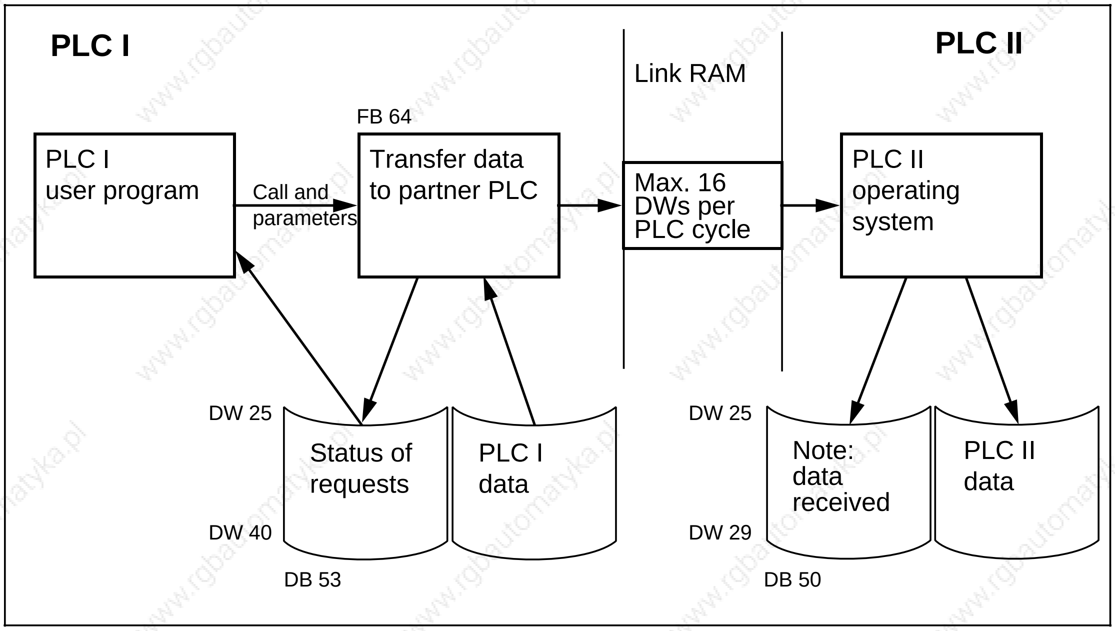
- PLC I:
  DB 50 available only as shell
  DB 51 available only as shell
  DB 52 from PLC II
  DB 53 to PLC II
  DB 59 both directions
- PLC II:
  DB 50 from PLC I
  DB 51 to PLC I
  DB 52 available only as shell
  DB 53 available only as shell
  DB 59 both directions

Transfer methods

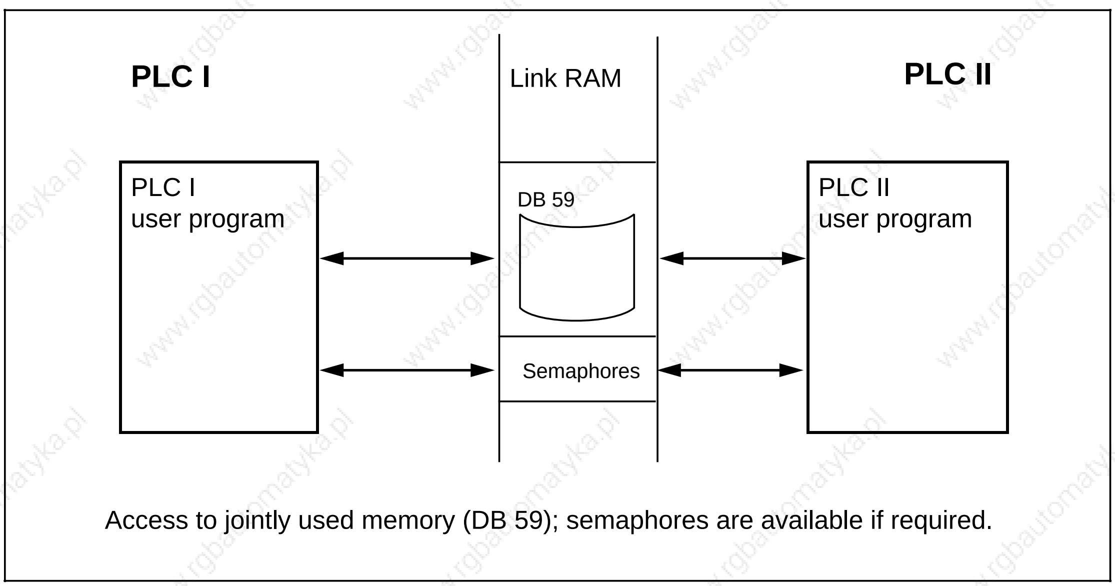
- Time-controlled (10 ms): DB 50...DB 53, DW 0
- Cyclic: DB 50...DB 53, DW 1...DW 24
- Request-controlled: When FB 63 or FB 64 is called, status data on the relevant transfer request are stored in DB 50 - DB 53. The user programs on PLC I and PLC II must agree as regards the data destination and content.
- Direct access to common memory: DB 59 is located directly in the link RAM. The direction and significance of the data must be regulated between the user programs on PLC I and PLC II. Semaphores are available for regulating the access rights to data in DB 59.



PLC/PLC interface: cyclic and periodic signal transfer



PLC/PLC interface: request-controlled data transfer (in this case data transfer to PLC II)



PLC/PLC interface: communication via DB 59 in jointly used memory

2 Reserved Areas

2.1 Data blocks

2.1.1 Class DB data blocks

Data blocks DB 1-189 are reserved for Siemens applications.
Data blocks DB 190-255 can be utilized by the user.
If FB package 1 is used, DBs 150 to 182 are used by the system.

DB No.	DB design.	DB name	Pack.
0		Reserved S5-155U	
1	DIAG-DB	Diagnosis DB (PLC 135WB)	OS
2	STATUS-DB	PLC status channel	OS
3	DATKAN-DB	PLC data channel	OS
4	FM/BM-DB	Error and status messages	OS
5		Reserved S5-155U	
6		Reserved S5-155U	
7			
8			
9			
10 *	NS KN 1	Interface NC channel 1	OS
11 *	NS KN 2	Interface NC channel 2	OS
12 *	NS KN 3	Interface NC channel 3	OS
13 *	NS KN 4	Interface NC channel 4	OS
14 *	NS KN 5	Interface NC channel 5	OS
15 *	NS KN 6	Interface NC channel 6	OS
16 *	NS KN 7	Interface NC channel 7	OS
17 *	NS KN 8	Interface NC channel 8	OS
18 *	NS KN 9	Interface NC channel 9	OS
19 *	NS KN 10	Interface NC channel 10	OS
20 *	NS KN 11	Interface NC channel 11	OS
21 *	NS KN 12	Interface NC channel 12	OS
22 *	NS KN 13	Interface NC channel 13	OS
23 *	NS KN 14	Interface NC channel 14	OS
24 *	NS KN 15	Interface NC channel 15	OS
25 *	NS KN 16	Interface NC channel 16	OS
26			
27			
28			
29 *	NS ELG	Reserved for ELG signals	OS
30 *	DEC MFU	Decoded M functions (list)	OS
31 *	SPI SIG	Interface for spindle-specific signals	OS
32 *	ACHS SIG	Interface for axis-specific signals	OS
33		Reserved for 880 N (tool management)	
34	E-PU	Input buffer, computer link	CL
35	A-PU	Output buffer, computer link	CL
36 *	DUE NC	Interface for data transfer NC, COM<-> PLC	OS
37 *	SER SCH.	Interface for serial interface	OS
38	RK:ZU-DB	Status DB computer link	CL
39			
40 *	NS BEDT.	Interface operator panel	OS
41 *	WS KOMK	Interface command channel	OS

Abbreviations:
OS Operating system
CL Computer link
CP Cycles package

Note: The data blocks marked * are set up and initialized by the PLC operating system at each restart following an overall reset. These blocks are reinitialized in the event of an automatic restart.

DB No.	DB design.	DB name	Pack.
42			
43	DB-ZYKLEN	DB for calculating and measuring	CP
44			
45			
46		Reserved S5-155U	
47		Reserved S5-155U	
48 *	NS COM	Interface to communication area	OS
49		Reserved S5-155U	
50 *	E : PLC I	Input signals from PLC I	OS
51 *	A : PLC I	Output signals to PLC I	OS
52 *	E : PLC II	Input signals from PLC II	OS
53 *	A : PLC II	Output signals to PLC II	OS
54			OS
55			OS
56		Reserved S5-155U	
57		Reserved S5-155U	
58 *	MELD	Interface for general messages	OS
59	DB-Zentral	Central DB in link RAM	OS
60 *	MDG WO	MD words basic program	OS
61 *	MDF WO	MD words function blocks	OS
62 *	MDA WO	MD words user	OS
63 *	MDG BI	MD bits basic program	OS
64 *	MDF BI	MD bits function blocks	OS
65 *	MDA BI	MD bits user	OS
66			
67			
68 *	SEA WO	Set-up user DB words	OS
69			
70			
71 *	SEA BI	Set-up user DB words	OS
72		Reserved S5-155U	
73		Reserved S5-155U	
74		Reserved S5-155U	
75		Reserved S5-155U	
76	QUIT FM	Acknowledgement bytes error messages	0
77	DB FM/BM	DB status words error/operational messages	0
78	QUIT BM	Acknowledgement bytes operational messages	0
79	FLANK FM	Edge bytes error messages	0
80	LMDKN 1	List for M decoding NC channel 1	UR
81	LMDKN 2	List for M decoding NC channel 2	UR
82	LMDKN 3	List for M decoding NC channel 3	UR
83	LMDKN 4	List for M decoding NC channel 4	UR
84	LMDKN 5	List for M decoding NC channel 5	UR
85	LMDKN 6	List for M decoding NC channel 6	UR
86	LMDKN 7	List for M decoding NC channel 7	UR
87	LMDKN 8	List for M decoding NC channel 8	UR
88	LMDKN 9	List for M decoding NC channel 9	UR
89	LMDKN 10	List for M decoding NC channel 10	UR
90	LMDKN 11	List for M decoding NC channel 11	UR
91	LMDKN 12	List for M decoding NC channel 12	UR
92	LMDKN 13	List for M decoding NC channel 13	UR
93	LMDKN 14	List for M decoding NC channel 14	UR
94	LMDKN 15	List for M decoding NC channel 15	UR
95	LMDKN 16	List for M decoding NC channel 16	UR

Abbreviations:

UR User block
OS Operating system
0 FB package 0
CL Computer link
CP Cycles package

Note: The data blocks marked * are set up and initialized by the PLC operating system at each restart following an overall reset. These blocks are reinitialized in the event of an automatic restart.

DB No.	DB design.	DB name		Pack.
96				
97				
98				
99	Log-Part	Assignment user interface/logic partner destination 2)		CL
100		Reserved		
101 *	EIN ASS	Input user interface		CL
102 *	AUS ASS	Output user interface		CL
103	ZWSP-WZD	Buffer memory tool data		5
104	ZU-WZ-KA	Buffer memory tool cartridge dialogs		5
105		Spare		
106		Spare		
107		Spare		
108		Spare		
109		Spare		
110		Spare		
111	E-PU 1	COM input/PLC output buffer 1	in MPR	CL
112	E-PU 2	COM input/PLC output buffer 2	”	CL
113	E-PU 3	COM input/PLC output buffer 3	”	CL
114	E-PU 4	COM input/PLC output buffer 4	”	CL
115	E-PU 5	COM input/PLC output buffer 5	”	CL
116	E-PU 6	COM input/PLC output buffer 6	”	CL
117	A-PU 1	COM output/PLC input buffer 1	in MPR	CL
118	A-PU 2	COM output/PLC input buffer 2	”	CL
119	A-PU 3	COM output/PLC input buffer 3	”	CL
120	A-PU 4	COM output/PLC input buffer 4	”	CL
121	A-PU 5	COM output/PLC input buffer 5	”	CL
122	A-PU 6	COM output/PLC input buffer 6	”	CL
123		Spare		
124		Spare		
125	S-SIGNAL	Standard signals		CL
126	FORM-DB	Format list		6/7
127	ZUSTDB	Status DB		6/7
128	E-PUFFER	User interface input user data DB		6/7
129	A-PUFFER	User interface output data DB		6/7
130		Spare		
131		Spare		
132		Spare		
133	SCH-KASS	Interface cartridge handling		1/2
134	ZW-STAZ	Status DB for tool life, workpiece count		1
135	ZW-LS	Status value DB for punched tape input		1
136	DYNPUFF1	Dynamic buffer		1
137	DYNPUFF2	Dynamic buffer		1
138	DYNPUFF3	Dynamic buffer		1
139	DYNPUFF4	Dynamic buffer		1
140	DYNPUFF5	Dynamic buffer		1
141	DYNPUFF6	Dynamic buffer		1
142	DYNPUFF7	Dynamic buffer		1
143	DYNPUFF8	Dynamic buffer		1
144	ZW-DATVT	Status words DB data distributor 1)		1
145	ZW-BT	Status words DB data for operator panel 1)		1
146	ZW-ANZBT	Display parameter		1
147	ZW-MESS	Measure interface		1
148	TO-DATVT	TO memory distributor		1
149	TO-DATLS	Buffer for TO data read/write (FB 61/FB 62)		1

Abbreviations:
OS Operating system
0 FB package 0
CL Computer link
1...7 FB packages 1...7

Note: The data blocks marked * are set up and initialized by the PLC operating system at each restart following an overall reset. These blocks are reinitialized in the event of an automatic restart.

1) *The data blocks are set up consecutively without gaps depending on the configuration of the tool management.*
2) *Set up by user. Can be stored in EPROM or RAM.*

DB No.	DB design.	DB name	Pack.
150	ZW-WZV	Status values tool management	1
151	KENN1	Identifiers	1
152	KENN2	Identifiers	1
153	KENN3	Identifiers	1
154	IDENT1	Identity number	1
155	IDENT2	Identity number	1
156	DUPLO	Duplo number	1
157	ANWEND1	User data 1)	1
158	ANWEND2	User data 1)	1
159	ANWEND3	User data 1)	1
160	ANWEND4	User data 1)	1
161	ANWEND5	User data 1)	1
162	ANWEND6	User data 1)	1
163	ANWEND7	User data 1)	1
164	D-Nr. 1	Reference list 1)	1
165	D-Nr. 2	Reference list 1)	1
166	D-Nr. 3	Reference list 1)	1
167	D-Nr. 4	Reference list 1)	1
168	D-Nr. 5	Reference list 1)	1
169	D-Nr. 6	Reference list 1)	1
170	D-Nr. 7	Reference list 1)	1
171	D-Nr. 8	Reference list 1)	1
172	D-Nr. 9	Reference list 1)	1
173	ERSATZPL	Spare location number 1)	1
174	WZAUF1L1	Tool holder L1 1)	1
175	WZAUF2L1	Tool holder L1 1)	1
176	WZAUF1L2	Tool holder L2 1)	1
177	WZAUF2L2	Tool holder L2 1)	1
178		Spare	1
179		Spare	1
180		Spare	1
181		Spare	1
182	ADALAGE	Adapter location 1)	1
183	PL/MAG	Location No./magazine No. 2)	1
184	WZ-GR	Tool size 2)	1
185	WZ-KENN	Tool identifier 2)	1
186	RUEST-D	Setup data 2)	1
187	T-HIGH	Ident. No. (decades 4-7) 2)	1
188	T-LOW	Ident. No. (decades 0-3) 2)	1
189	DUPLO	Duplo number 2)	1
190			
191			
192			
193			
194			
195			
196			

If FB package 1 is used, DB 150 - DB 182 are also used by the system.

1) *The data blocks are set up consecutively without gaps depending on the configuration of the tool management.*

2) *The data blocks are assigned by the operating example supplied in package 1 or 2. Otherwise these data blocks are available to the user.*

DB No.	DB design.	DB name	Pack.
197			
198			
199			
200			
201			
202			
203			
204			
205			
206			
207			
208			
209			
210			
211			
212			
213			
214			
215			
216			
217			
218			
219			
220			
221			
222			
223			
224			
225			
226			
227			
228			
229			
230			
231			
232			
233			
234			
235			
236			
237			
238			
239			
240			
241			
242			
243			
244			
245			
246			
247			
248			
249			
250			
251			
252			
253			
254			
255			

2.1.2 Class DX data blocks

Data blocks DX 0 - DX 105 are reserved for Siemens applications.
Data blocks DX 106 - DX 255 can be utilized by the user.

DX No.	DX design.	DX name	Pack.
0		Reserved S5-155U	
1		Reserved S5-155U	
2			
3			
4			
5			
6			
7			
8			
9			
10	DB-T-PRO	DB for part program	8
11	DB-Hilfs	Auxiliary DB	8
12	DB-Nutz	DB for user data	8
13			
14			
15			
16			
17			
18			
19			
20			
21	DB M 1	Mask list for overview image	0
22	DB M 2	Mask list for fault image part 1	0
23	DB M 3	Mask list for fault image part 2	0
24			
25			
26	DAT-AUS 1	Log data input/output	8
27	DAT-AUS 2	Log data input/output	8
28	DAT-DAV	Log data input/output	8
29	DAT-EIN 1	Log data input/output	8
30	DAT-EIN 2	Log data input/output	8
31	DAT-EIN 3	Log data input/output	8
32	DAT-EIN 4	Log data input/output	8
33	UHR-HILFS	Date/time auxiliary DB	8
34			
.			
.			
.			
39			
40		Reserved PG function	
.			
.			
.			
46		Reserved PG function	
47			
.			
.			
.			
.			
102			
103			
104			
105	SCH-RKWV	Interfaces DB computer link/tool management	

Abbreviations:

0 FB package 0
8 FB package 8

2.2 Function blocks

2.2.1 Class FB function blocks

Function blocks FB0 ... 199 are reserved for Siemens applications.
Function blocks FB200 ... 255 can be utilized by the user.

FB No.	FB design.	FB name	Pack.
0		Reserved S5-155U	
1		Reserved S5-155U	
2		Reserved S5-155U	
3		Reserved S5-155U	
4		Reserved S5-155U	
5		Reserved S5-155U	
6		Reserved S5-155U	
7		Reserved S5-155U	
8		Reserved S5-155U	
9		Reserved S5-155U	
10		Reserved S5-155U	
11 *	EINR-DB	Create data blocks	OS
12 *	WDTRG	Retrigger cycle time	OS
13		Reserved S5-155U	
14		Reserved S5-155U	
15		Reserved S5-155U	
16		Reserved S5-155U	
17	STATUS	PLC status channel	0
18		Reserved S5-155U	
19		Reserved S5-155U	
20		Reserved S5-155U	
21		Reserved S5-155U	
22		Reserved S5-155U	
23		Reserved S5-155U	
24		Reserved S5-155U	
25		Reserved S5-155U	
26		Reserved S5-155U	
27		Reserved S5-155U	
28		Reserved S5-155U	
29		Reserved S5-155U	
30	MUL:16	Multiply two binary-coded numbers 16 bits each	0
31		Reserved S5-155U	
32	DIV:16	Divide two binary-coded numbers 16 bits each	0
33	DIV:32	Divide two binary-coded numbers 32 bits each	0
34		Reserved S5-155U	
35	DIV/100	Divide by 100	0
36	ADD:32	Add two binary-coded numbers	0
37	SUB:32	Subtract two binary-coded numbers	0
38		Reserved	
39	DUAL/BCD	Code conversion binary/BCD 4 decades	0
40	COD:16	Convert fixed point binary number (16 bits) into BCD code number	0
41	COD:32	Convert fixed point binary number (32 bits) into BCD code number	0
42	COD:B4	Convert BCD code number (4 decades) into fixed point binary number	0
43	COD:B8	Convert BCD code number (8 decades) into fixed point binary number	0
44		Reserved	

Abbreviations:
OS Operating system
0 FB package 0

Note: The blocks marked * are function macros which are integrated in the PLC operating system on the PLC 135 WB. (See Function Macros Description).

FB No.	FB design.	FB name	Pack.
45	GST-FMBM	Basic setting fault/operational messages	0
46	UP:54/55	Subroutine FB54, FB55	0
47	PSP:FMBM	Buffer memory fault/operational messages	0
48	FMBM:HSG	Auxiliary signals for fault/operational messages	0
49	UP:57/58	Subroutine FB57, FB58	0
50	UP:FB49	Subroutine FB49	0
51	UP:FB45	Subroutine FB45	0
52	BTR_8_16	Block transfer between 8-bit and 16-bit memory	OS
53		Spare	
54	FM-ANZ	Display fault messages	0
55	BM-ANZ	Display operational messages	0
56	MG-ANZ	Display message groups	0
57	FM-ABFR	Interrogate fault messages	0
58	BM-ABFR	Interrogate operational messages	0
59	MG-ABFR	Interrogate message groups	0
60 *	BLOCK-TR	Block transfer	OS
61 *	NCD-LESE	Read NC data	OS
62 *	NCD-SCHR	Write NC data	OS
63 *	PCD-LESE	Read PLC data from PLC I/PLC II	OS
64 *	PCD-SCHR	Write PLC data to PLC I/PLC II	OS
65 *	M->STACK	Transfer flag Flag stack	OS
66 *	STACK->M	Flag stack Transfer flag	OS
67 *	T:MS->ACH	Transfer direction keys (880T) to axes	OS
68 *	AP-RUF	Aperiodic program call	OS
69 *	G-DEKOD	G functions decoding	OS
70 *	T:NS>EAM	Transfer interface DB to I/Q/F	OS
71 *	T:EAM>NS	Transfer I/Q/F to interface DB	OS
72 *	T:NCK>DB	Transfer NC channel DB channel	OS
73 *	T:DB>NCK	Transfer DB channel NC channel	OS
74 *	T:SPI>DB	Transfer spindle DB spindle	OS
75 *	T:DB>SPI	Transfer DB spindle spindle	OS
76 *	T:ACH>DB	Transfer axis DB axis	OS
77 *	T:DB>ACH	Transfer DB axis axis	OS
78 *	T:MS->KN	Transfer machine control panel NC channel	OS
79 *	T:MS>ACH	Transfer machine control panel DB axis (880M)	OS
80		Reserved S5-155U	
81		Reserved S5-155U	
82		Reserved S5-155U	
83		Reserved S5-155U	
84		Reserved S5-155U	
85		Reserved S5-155U	
86		Reserved S5-155U	
87		Reserved S5-155U	
88		Reserved S5-155U	
89 *	BAA-LESE	Read block initial address	OS
90		Reserved S5-155U	
91	AK2:V/R	Sequence cascade forwards/backwards	0
92	AK3:AUT	Sequence cascade automatic	0
93	ALS:V/R	Sequence cascade forwards/backwards Graph 5	0
94	ALS:AUT	Sequence cascade automatic Graph 5	0

Abbreviations:
OS Operating system
0 FB package 0

Note: The blocks marked * are function macros which are integrated in the PLC operating system on the PLC 135 WB. (See Function Macros Description).

FB No.	FB design.	FB name	Pack.
95	RK:S880	Computer link FB	4
96	WZDIALOG	Function distributor for tool dialogs	5
97		Spare	
98		Spare	
99		Spare	
100	RK:GLOBA	Global functions	4
101	RK:MELDG	Messages	4
102	RK:NCDAT	File transfer (operator prompt)	4
103		Spare	
104		Reserved for SIN 805 L2 SEND	
105		Reserved for SIN 805 L2 RECEIVE	
106		Reserved for SIN 805 L2 CONTROL	
107	UP:FB101	Subroutine for FB 101	4
108	UP:RK880	Subroutine	4
109		Reserved SINUMERIK 810	
110	SUCH	Search word	0
111	SUCHROUT	Search routine	1
112	LEERPL 1	Empty location search without presetting	1
113 *	SUCH:WZ	Tool search symmetrical	OS
114	SUCH-VOR	Search direction forwards	1
115	SUCH-RWS	Search direction backwards	1
116	WZV-INIT	Initialization of tool management	1
117	EINR-MAG	Setup of magazine table	1
118	WZ-GR:ST	Tool size standard	1
119	UP:MAG L	Subroutine clear magazine	1
120	LOCHSTAG	Unload by punched tape	1
121	MESSEN	Measure	1
122	LEERPL 2	Empty location search with presetting	1
123	WZ-BS	Provide tool	1
124	UP:T=ID	Subroutine tool search T = ident	1
125	UP:T=PL	Subroutine tool search T = location	1
126	UP:T=IDZ	Alternative search sequence	1
127	UP:ZW-SP	Subroutine	1
128	TRANSFER	Transfer cold restart branch data	1
129		Spare	1
130	TOS-VER	Subroutine	1
131	TOS:MD-B	Subroutine MD bits	1
132	TOS:MD-W	Subroutine MD words	1
133	RI-AUSW	Direction selection	1
134	TO DAT-W	Subroutine	1
135	D-NR:WZW	Make D No. ready after tool change	1
136	WZ DAT-LS	Read tool data	1
137		Spare	1
138	DYN-PUFF	Management of data I/O buffers	1
139	DAT-VER	Management of data I/O buffers	1
140	UP:FB 139	Assigned subroutine of FB 139	1
141	UP:KC 0	Assigned subroutine of FB 139	1
142	UP:KC 1-4	Assigned subroutine of FB 139	1
143	UP:KC 5-7	Assigned subroutine of FB 139	1
144	UP:KC 8+9	Assigned subroutine of FB 139	1

Abbreviations:
OS Operating system
0 FB package 0
1 FB package 1
4 FB package 4
5 FB package 5

Note: The blocks marked * are function macros which are integrated in the PLC operating system on the PLC 135 WB. (See Function Macros Description).

FB No.	FB design.	FB name	Pack.
145	BEL-CDTR	Load tool with code carrier	6
146	ENT-CDTR	Unload tool with code carrier	6
147	CT-FORMAT	Formatting	6
148		Spare	1
149		Spare	1
150		Spare	1
151		Spare	1
152	NP-SIF	Subroutine	1
153	AD-AD	Subroutine	1
154	RK:AW-SS	User interface to computer link/processing	1
155	LOCHSTEG	Punched tape input	1
156	STAZ/VWG	Tool life monitoring/prewarning limit	1
157	STUE/VWG	Workpiece count monitoring/prewarning limit	1
158	WZ-SPER	Tool disable	1
159	BCD-DUAL	BCD-binary conversion	1
160	FB 160	Central call block	1
161	FB 161	Subroutine monitor	1
162		Spare	1
163		Spare	1
164	FB 164	Transfer tool selection	1
165		Spare	1
166	FB 166	Signal: load spindle	1
167	FB 167	Signal: unload spindle	1
168	FB 168	Acknowledge spindle	1
169		Spare	1
170	FB 170	Assignment buffer memory	1
171	FB 171	Magazine assignment	1
172	FB 172	Select tool by T No.	1
173	FB 173	Load/unload magazine from preselection/spindle	1
174		Spare	1
175	FB 175	Display tool data from assignment buffer memory	1
176	FB 176	Change tool data from assignment buffer memory	1
177	FB 177	Display tool data from magazine assignment	1
178	FB 178	Change tool data from magazine assignment	1
179	FB 179	Select tool by cursor position from magazine assignment	1
180	FB 180	Additional edge from buffer memory and magazine	1
181	FB 181	Additional edge from load	1
182	FB 182	Load	1
183	FB 183	Unload	1
184		Spare	1
185	FB 185	Manual acknowledgment	1
186	FB 186	Manual abort magazine/spindle	1
187	FB 187	Display next edge	1
188	FB 188	Reactivate tool	1
189	FB 189	Delete last edge	1
190	FB 190	Select load image punched tape	1
191	FB 191	Acknowledgement punched tape positive/negative	1
192	FB 192	Abort punched tape	1
193		Spare	1
194		Spare	1
195		Spare	1
196		Spare	1
197	WZ-LISTE	Create tool list	1
198	TAUSCHL	Create exchange list	1
199	FIFO	Buffer processing	1

Abbreviations:

1 FB package 1
6 FB package 6

2.2.2 Class FX function blocks

Function blocks FX 0 - FX 99 are reserved for Siemens applications.

FX No.	FX design.	FX name	Pack.
1	SI	Self-installation	OS
2		Reserved S5-155U	
3		Reserved S5-155U	
4		Reserved S5-155U	
5		Reserved S5-155U	
6		Reserved S5-155U	
7	SIMULAT	Part program simulation	1
8	WZ-GRIEP	Presetting of tool size by EPROM	1
9		Spare	1
10		Spare	1
11		Spare	1
12		Spare	1
13		Spare	
14	BEL-CDTR	Load code carrier	7
15	ENT-CDTR	Unload code carrier	7
16	UP-CDTR	Subroutine code carrier	7
17		Spare	CL
18		Spare	CL
19		Spare	CL
20		Spare	CL
21		Spare	CL
22		Reserved S5-155U	
23		Reserved S5-155U	
24	BALKEN	Bar charts	0
25		Reserved	
26	DAT-EIN	PLC-controlled data input	8
27	DAT-AUS	PLC-controlled data output	8
28	DAT-UHR	Date/time	8
29		Spare	CL
30		Spare	CL
31	GRAYDUAL	Code converter GRAY/BINARY	0
32	DUALGRAY	Code converter BINARY/GRAY	0
33	RECHNEN	Contour/technology calculation	CP
34	MESSEN	Measurement in JOG mode	CP
35		Spare	CL
36		Spare	CL
37		Spare	CL
38	PRO-K01	Program coordination	0
39	PRO-K02	Subroutine FX 38	0
40	CL:WZABF	Computer link, tool scan	5
41	CL:WZM	Computer link, report tool	5
42	CL:WZBEL	Computer link, load tool	5
43	CL:WZENT	Computer link, unload tool	5
44	CL:WZBGB	Computer link, load magazine assignment data	5
45	CL:KASSE	Tool cartridge processing	5
46		Spare	
47		Spare	
48	UPWZKASS	Subroutine tool cartridge processing	5
49	E/A-TRAN	Data transfer I/O buffer tool management	5
50	UPWZDIAL	Subroutine TOOL DIALOG	5
51		Spare	
52		Spare	
53		Spare	
54		Spare	

Abbreviations:
0 FB package 0
1 FB package 1
5 FB package 5
7 FB package 7
8 FB package 8
OS Operating system
CP Cycles package
CL Computer link

FX No.	FX design.	FX name	Pack.
55	DIAGNOSE	Diagnostics main submodule	
56	ALLFUNK 1	General functions 1	
57	ALLFUNK 2	General functions 2	
58	SINFUNKT	SINUMERIK-dependent functions	
59	PLCFUNKT	PLC-dependent function	
60		Spare	
61	GRA-SERV	FB package Gracis-Server	
62	FEH-SERV	FB package Gracis-Server	
63	PAR-SERV	FB package Gracis-Server	
64	GRA-CLNT	FB package Gracis-Client	
65	FEH-CLNT	FB package Gracis-Client	
66	PAR-CLNT	FB package Gracis-Client	
67		Spare	
68	PRO-MESS	Logging measured data	8
69	TP-UEB	Transfer part program	8
70	TP-BEARB	Process part program	8
71	DRU-AUSG	Print output	8
72	PRO-UP1	Subroutine	8
73		Spare	
74		Spare	
75		Spare	
76		Spare	
77		Reserved address calculation flag area	
78		Reserved FB package 880G	
79		Reserved FB package 880G	
80		Spare	
81		Spare	
82		Reserved PG functions	
83		Reserved PG functions	
84		Reserved PG functions	
85		Reserved PG functions	
86		Reserved PG functions	
87		Reserved PG functions	
88		Reserved PG functions	
89		Spare	
90		Spare	
91		Spare	
92		Spare	
93		Spare	
94		Spare	
95		Spare	
96		Spare	
97		Spare	
98		Spare	
99		Spare	

Abbreviations:
8 FB package 8

Caution:

1. Make sure that the risk of confusion with SINUMERIK blocks is ruled out. Users must not use SINUMERIK standard block names or assign SINUMERIK library numbers to their user blocks.
2. In the range FB 0 - FB 199
   FX 0 - FX 99, SINUMERIK blocks have absolute priority.
   If SINUMERIK blocks with numbers that coincide with user block numbers have to be used subsequently, the user block numbers have to be renamed.
3. The SINUMERIK 880 with PLC 135 WB does not have a basic program implemented in Step 5 as the SINUMERIK 850 does. The relevant functions are implemented in the PLC operating system.

3 Signal Overview

3.1 Assignment of I/O submodule inputs

No. of input signal								
Byte No.	Bit No. 7	6	5	4	3	2	1	0
IB m	Connector X02404 Pin No. 10	9	8	7	6	5	4	3
IB m +1	Connector X02404 Pin No. 18	17	16	15	14	13	12	11
IB m +2	Connector X02404 Pin No. 26	25	24	23	22	21	20	19
IB m +3	Connector X02404 Pin No. 34	33	32	31	30	29	28	27
IB m +4	Connector X02405 Pin No. 10	9	8	7	6	5	4	3
IB m +5	Connector X02405 Pin No. 18	17	16	15	14	13	12	11
IB m +6	Connector X02405 Pin No. 26	25	24	23	22	21	20	19
IB m +7	Connector X02405 Pin No. 34	33	32	31	30	29	28	27

The address m is derived from the position of selector switch S1 on the I/O submodule and from the PLC MD "Start of operator panel inputs" (PLC I: 0006, PLC II: 0106)

Selector switch position S1	m (valid values: 64 ... 96)	Assignment of inputs to a PLC: PLC I	PLC II
0	m	MD 6027.0	MD 6127.0
1	m+8	.1	.1
2	m+16	.2	.2
3	m+24	.3	.3

The inputs of the I/O submodules can be assigned to both PLCs.

Notes:

- In the event of CPU failure (F24.4=1), the inputs of the I/O submodules are reset.
- The input bytes (m+4), (m+5, bit 0, bit 1) must be assigned by connector X02405 **or** X02406 only. Dual assignment is not permitted. If expansion blocks for the machine control panel are used, the assignment is made by X02406.

IB m	X02404
IB m+4	X02405/X02406
IB m+5	X02405
IB m+6	
IB m+7	X02405

Assignment of inputs in IB m+4, IB m+5 by connector X02405/X02406.

3.2 Assignment of I/O submodule outputs

No. of output signal								
Byte No.	**Bit No.**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
QB m	Connector X02402 Pin No.							
	10	9	8	7	6	5	4	3
QB m+1	Connector X02402 Pin No.							
	18	17	16	15	14	13	12	11
QB m+2	Connector X02402 Pin No.							
	26	25	24	23	22	21	20	19
QB m+3	Connector X02402 Pin No.							
	34	33	32	31	30	29	28	27

The address m is derived from the position of selector switch S2 on the I/O submodule and from the PLC MD "Start of operator panel outputs" (PLC I: 0007, PLC II: 0107).

Selector switch position S2	m (valid values: 64 ... 96)	Assignment of outputs to a PLC: PLC I	PLC II
0	m	MD 6028.0	MD 6128.0
1	m+4	.1	.1
2	m+8	.2	.2
3	m+12	.3	.3

Notes:

- The PLC MD can be set **only** for PLC I **or** PLC II.
- In the event of CPU failure (F24.4 = 1), the outputs are no longer transferred to the I/O submodules.

3.3 Assignment of inputs by machine control panel

3.3.1 SINUMERIK 880T

Machine control panel basic key group (Section 4.1)
(Connector X 02404 on I/O submodule)

Byte No.	Bit No. 7	6	5	4	3	2	1	0
IB m	Spindle override switch				Mode switch			
	D	C	B	A	D	C	B	A
	Pin No. 10	Pin No. 9	Pin No. 8	Pin No. 7	Pin No. 6	Pin No. 5	Pin No. 4	Pin No. 3
IB m+1	Direction keys		Rapid traverse	Direction keys			00 Handwheel X 01 Handwheel C 10 Handwheel Z	
	X+	X-		C+	C-			
	Pin No. 18	Pin No. 17	Pin No.16	Pin No. 15	Pin No. 14	Pin No. 13	Pin No. 12	Pin No. 11
IB m+2	Direction keys		Spindle		Feed		NC start	*NC stop
	Z+	Z-	On	*Off	On	*Off		
	Pin No. 26	Pin No. 25	Pin No. 24	Pin No. 23	Pin No. 22	Pin No. 21	Pin No. 20	Pin No. 19
IB m+3	Reset	Keyswitch	Single block	Feedrate override switch				
				E	D	C	B	A
	Pin No. 34	Pin No. 33	Pin No. 32	Pin No. 31	Pin No. 30	Pin No. 29	Pin No. 28	Pin No. 27

3.3.2 SINUMERIK 880M

Machine control panel basic key group (Section 4.2)
(Connector X 02404 on I/O submodule)

Byte No.	Bit No. 7	6	5	4	3	2	1	0
IB m	Spindle override switch				Mode switch			
	D	C	B	A	D	C	B	A
	Pin No. 10	Pin No. 9	Pin No. 8	Pin No. 7	Pin No. 6	Pin No. 5	Pin No. 4	Pin No. 3
IB m+1	Direction keys		Rapid traverse	Axis selector switch				
	+	-		E	D	C	B	A
	Pin No. 18	Pin No. 17	Pin No. 16	Pin No. 15	Pin No. 14	Pin No. 13	Pin No. 12	Pin No.11
IB m+2			Spindle		Feed		NC start	*NC stop
			On	*Off	On	*Off		
	Pin No. 26	Pin No. 25	Pin No. 24	Pin No. 23	Pin No. 22	Pin No. 21	Pin No. 20	Pin No. 19
IB m+3	Reset	Keyswitch	Single block	Feedrate override switch				
				E	D	C	B	A
	Pin No. 34	Pin No. 33	Pin No. 32	Pin No. 31	Pin No. 30	Pin No. 29	Pin No. 28	Pin No. 27

---
* *Signal is 0 active*

Notes:

- The machine control panel signals are not automatically transferred to the NC/PLC interface by the system program. However, the following macros are available for this purpose:
  - FB 78 for transfer of spindle override and operating mode to the NC channel
  - FB 79 for transfer of direction keys (880 M) to the axes
  - FB 67 for transfer of direction keys (880 T) to the axes
- Address m is explained in the "Assignment of I/O submodule inputs" Section.

3.3.3 Machine control panel expansion key group

Double slide key group (Section 4.3)
(SINUMERIK 880T, connector X 02406 on I/O submodule)

Byte No.	Bit No. 7	6	5	4	3	2	1	0
IB m+4	Hand-wheel Bit 1 Pin No.10	Direction keys X+ Pin No. 9	Direction keys X- Pin No. 8	Direction keys Z+ Pin No. 7	Direction keys Z- Pin No. 6	Rapid traverse Pin No. 5	Direction keys C+ Pin No. 4	Direction keys C- Pin No. 3
IB m+5	User assignable via connector X02405 pin No. 18	17	16	15	14	13	12	Hand-wheel Bit 2 Pin No. 11

Auxiliary axes key group (Section 4.4)
(SINUMERIK 880T/880M, connector X 02406 on I/O submodule)

Byte No.	Bit No. 7	6	5	4	3	2	1	0
IB m+4	Direction keys + Pin No.10	Direction keys - Pin No. 9	Rapid traverse Pin No. 8	Axis selector switch E Pin No. 7	Axis selector switch D Pin No. 6	Axis selector switch C Pin No. 5	Axis selector switch B Pin No. 4	Axis selector switch A Pin No. 3
IB m+5	User assignable via connector X02405 pin No. 18	17	16	15	14	13	Spare auxiliary axes block Pin No. 12	Spare auxiliary axes block Pin No. 11

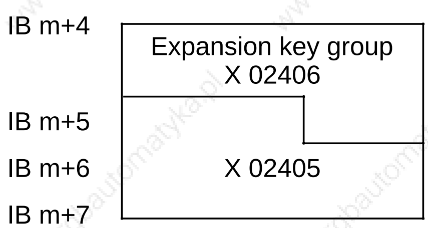
Rapid traverse override key group (Section 4.5)

(SINUMERIK 880T, connector X 02406 on I/O submodule)

Byte No.	Bit No. 7	6	5	4	3	2	1	0
IB m+4	User assignable via connector X02405 pin No..					Rapid traverse override		
	10	9	8	7	6	C Pin No. 5	B Pin No. 4	A Pin No. 3
IB m+5	User assignable via connector X02405 pin No							
	18	17	16	15	14	13	12	11

Notes:

- The axis selector switch for the auxiliary axes key group can be decoded with function macro FB 79.
- The direction key for the double slide key group can be transferred with function macro FB 67.
- The expansion key group is linked up by means of connector X02406. Connectors X02405 and X02406 are ORed (hardware) from pin 3 to pin 12; this means that the pins assigned by the expansion key group must not be assigned by the user on X02405.



- Address m is explained in the "Assignment of I/O submodule inputs" Section.
- Coding of signal HANDWHEEL BIT 1, BIT 2:

Axis	Bit 1	Bit 2
X	0	0
C	0	1
Z	1	0

3.4 Basic signals [1)]

PLC auxiliary signals (Section 5.1)								
Byte No.	Bit No. 7	6	5	4	3	2	1	0
FY 0	Flashing frequency 0.5 Hz						One	Zero
FY 1	Current OB No.							
FY 2	Initial setting							
	OB 7	OB 6	OB 5	OB 4	OB 3	OB 2	OB 1	
FY 3	Restart							
	OB 7	OB 6	OB 5	OB 4	OB 3	OB 2	OB 1	OB 20
FY 4	Parameter test							
	OB 7	OB 6	OB 5	OB 4	OB 3	OB 2	OB 1	
FY 5	Addres-sing error recogni-tion	Segment exceeded with blocks					PLC operation PLC II	PLC I
FY 6	Processing delay							
	OB 7	OB 6	OB 5	OB 4	OB 3	OB 2	Group message LIM/SIM	I/O devic-es not ready

PLC ready signals (Section 5.2)								
Byte No.	Bit No. 7	6	5	4	3	2	1	0
FY 7							PLC CPU ready PLC II	PLC I

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.*

Signals for alarm-controlled processing (Section 5.3)

Byte No.	Bit No. 7	6	5	4	3	2	1	0
FY 8	Interrupt inputs 1st EU interface or DMP interface							
	7	6	5	4	3	2	1	0
FY 9	Interrupt inputs 2nd EU interface or DMP interface							
	7	6	5	4	3	2	1	0
FY 10	Interrupt inputs 3rd EU interface or DMP interface							
	7	6	5	4	3	2	1	0
FY 11	4th interrupt byte d)							
	7	6	5	4	3	2	1	0
FY 12	Negative edge of process alarm byte Byte No. n							
FY 13	Byte No. (n+1)							
FY 14	Byte No. (n+2)							
FY 15	Byte No. (n+3)							
FY 16	Positive edge of process alarm byte Byte No. n							
FY 17	Byte No. (n+1)							
FY 18	Byte No. (n+2)							
FY 19	Byte No. (n+3)							

d) with GA2, software version 1 and higher with free configuration

NC ready signals (Section 5.4)								
Byte No.	Bit No.							
	7	6	5	4	3	2	1	0
FY 20						3rd operator panel ready	2nd operator panel ready	1st operator panel ready
FY 21	2nd interface CL	1st interface CL						COM CPU ready
FY 22	Self installation manual[c)]	SI automatic[c)]			NC CPU ready			
					NC 4[c)]	NC 3[c)]	NC 2	NC 1
FY 23					Servo CPU ready			
					Servo 4	Servo 3	Servo 2	Servo 1

Individual signals (Section 5.5)								
Byte No.	Bit No.							
	7	6	5	4	3	2	1	0
FY 24	Probe selected 1	Probe selected 2	C alarm with processing stop	CPU failure	Start-up mode for S5-155U	*Temperature fault	Battery fault	NC alarm

c) *up to and including software version 6*
* *Signal is 0 active*

3.5 Diagnostics (DB 1) 1)

Diagnostics signals (Section 5.6)		
Data word No.	High byte (DL)	Low byte (DR)
DW 0	Current cycle time d) (KF in ms)	
DW 1	Minimum cycle time d) (KF in ms)	
DW 2	Maximum cycle time d) (KF in ms)	
:		
DW 10	Spare	
DW 11	Identification of the type of I/O d)	

Diagnostics signals (Section 5.6)								
Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL 12	15	Input I/O group not ready 14	13	12	11	10	9	8
DR 12	7	6	5	4	3	2	1	0
DL 13								
DR 13					19	18	17	16
DL 14	15	Output I/O group not ready 14	13	12	11	10	9	8
DR 14	7	6	5	4	3	2	1	0
DL 15								
DR 15					19	18	17	16

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.*

d) *with GA2, software version 1 and higher*

Diagnostics signals (Section 5.6)		
DW No. PLC	**High byte (DL)**	**Low byte (DR)**
DW 16	Number of lost requests during LIN/SIM	OB 2
DL 13	Number of lost requests during LIN/SIM	OB 3
DR 13	Number of lost requests during LIN/SIM	OB 4
DR 14	Number of lost requests during LIN/SIM	OB 5
DL 15	Number of lost requests during LIN/SIM	OB 6
DR 15	Number of lost requests during LIN/SIM	OB 7
DW 22	Event counter processing timeout in OB 2[d)]	
DW 23	Event counter processing timeout in OB 3[d)]	
DW 24	Event counter processing timeout in OB 4[d)]	
DW 25	Event counter processing timeout in OB 5[d)]	
DW 26	Event counter processing timeout in OB 6[d)]	
DW 27	Event counter processing timeout in OB 7[d)]	
DW 28	Spare	
DW 29	Spare	

d) with GA2, software version 1 and higher

Diagnostics signals (Section 5.6)		
DW No. PLC	**High byte (DL)**	**Low byte (DR)**
DW 30	Input byte not ready[d)]	
:	Input byte not ready[d)]	
DW 45	Input byte not ready[d)]	
DW 46	Output byte not ready[d)]	
:	Output byte not ready[d)]	
DW 61	Output byte not ready[d)]	
DW 62	Spare	
:	Spare	
DW 69	Spare	
DW 70	Image of the status registers of the DMP modules[d)]	
:	Image of the status registers of the DMP modules[d)]	
DW 159	Image of the status registers of the DMP modules[d)]	

d) *with GA2, software version 1 and higher*

Diagnostics signals (Section 5.6)		
DW No. PLC	**High byte (DL)**	**Low byte (DR)**
DW 160	Detailed error coding in diagnostics DB	Error number
DW 161	Supplementary error data 1st word	
DW 162	Supplementary error data 2nd word	
DW 163	Supplementary error data 3rd word	
DW 164	Supplementary error data 4th word d)	
DW 165	Spare	
DW 166	ACCU 1, low word d)	
DW 167	ACCU 2, low word d)	
DW 168	PLC software Software version d)	Version number d)
DW 169	Spare	

d) with GA2, software version 1 and higher

Diagnostics signals (Section 5.6)		
DW No. PLC	**High byte (DL)**	**Low byte (DR)**
DW 170	1st interface module Software version[d)]	Version number[d)]
DW 171	1st interface module Module code[d)]	Slot number[d)]
DW 172	2nd interface module Software version[d)]	Version number[d)]
DW 173	2nd interface module Module code[d)]	Slot number[d)]
DW 174	3rd interface module Software version[d)]	Version number[d)]
DW 175	3rd interface module Module code[d)]	Slot number[d)]
DW 176	Spare	
DW 177	Spare	

d) *with GA2, software version 1 and higher*

3.6 NC/PLC interface (DB 10...DB 25)

3.6.1 Channel-specific signals

Interface data blocks DB 10 to DB 25 are assigned to NC channels 1 to 16. The PLC that is to process the NC must be specified in machine data MD 6000 - 6001 and MD 6100 - 6101, for PLC I and PLC II respectively.

Note:

On GA2, software version 1 and higher, you can only select up to eight channels out of 16 because no more than two NC CPUs can be used.

Channel	DB	PLC MD for assignment to	
		PLC I	PLC II
1	DB 10	6000.0	6100.0
2	DB 11	.1	.1
3	DB 12	.2	.2
4	DB 13	.3	.3
5	DB 14	.4	.4
6	DB 15	.5	.5
7	DB 16	.6	.6
8	DB 17	.7	.7
9	DB 18	6001.0	6101.0
10	DB 19	.1	.1
11	DB 20	.2	.2
12	DB 21	.3	.3
13	DB 22	.4	.4
14	DB 23	.5	.5
15	DB 24	.6	.6
16	DB 25	.7	.7

3.6.1.1 Signals to NC channel (DB 10...DB 25)

Operating modes (Section 6.4.1)

Byte No. / Bit No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0	DRF active 1)	Reset 1)			Mode switch 1) D	Mode switch 1) C	Mode switch 1) B	Mode switch 1) A

Submodes (Section 6.4.2)

Byte No. / Bit No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DR 0	Skip block	Single block	Decoding single block	Dry run feedrate	Active M01			

Feedrate modification (Section 6.4.3)

Byte No. / Bit No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 1			Feedrate override active	Feedrate override E	Feedrate override D	Feedrate override C	Feedrate override B	Feedrate override A
DR 1			Rapid traverse override active		Rapid traverse override D	Rapid traverse override C	Rapid traverse override B	Rapid traverse override A

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1) *If these signals are selected in the 1st channel (master channel) of an operating mode group, they also apply to all other channels in the group. The reset signal specific to the operating mode group and the mode can be selected only in the master channel.*

Program modification (Section 6.4.4)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 2	External execution	Block search with calculation	Block search with calculation from last main block					
DR 2					Delete distance to go	Delete number of subroutine	NC stop	NC start
DL 3						Spindle number C	Spindle number B	Spindle number A
DR 3								
DL 4	/8	/7	/6	/5	/4	/3	/2	/1
	Block skip							
DR 4								
DL 5								
DR 5								

General feed disable (Section 6.4.5)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 6	General feed disable							
	m+7	m+6	m+5	m+4	m+3	m+2	m+1	m+0
DR 6	General feed disable							
	m+15	m+14	m+13	m+12	m+11	m+10	m+9	m+8

General feed disable and read-in disable (Section 6.4.5)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 7	General feed disable and read-in disable							
	m+23	m+22	m+21	m+20	m+19	m+18	m+17	m+16
DR 7	General feed disable and read-in disable							
	m+31	m+30	m+29	m+28	m+27	m+26	m+25	m+24
DL 8	General feed disable and read-in disable							
	m+39	m+38	m+37	m+36	m+35	m+34	m+33	m+32
DR 8	General feed disable and read-in disable							
	m+47	m+46	m+45	m+44	m+43	m+42	m+41	m+40

Read-in disable (Section 6.4.6)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 9	Read-in disable							
	m+55	m+54	m+53	m+52	m+51	m+50	m+49	m+48
DR 9	Read-in disable							
	m+63	m+62	m+61	m+60	m+59	m+58	m+57	m+56
DL 10	Read-in disable							
	m+71	m+70	m+69	m+68	m+67	m+66	m+65	m+64
DR 10	Read-in disable							
	m+79	m+78	m+77	m+76	m+75	m+74	m+73	m+72

NC start disable (Section 6.4.7)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 11	NC start disable							
	m+87	m+86	m+85	m+84	m+83	m+82	m+81	m+80
DR 11	NC start disable							
	m+95	m+94	m+93	m+92	m+91	m+90	m+89	m+88

The variable m in the above tables states the initial address of the message texts assigned to the signals. It is channel-specific; refer to the following tables for the relevant value.

Chan.	DB	m	Chan.	DB	m	Chan.	DB	m	Chan.	NS-DB	m
1	DB 10	6000	5	DB 14	6400	9	DB 18	6800	13	DB 22	7200
2	DB 11	6100	6	DB 15	6500	10	DB 19	6900	14	DB 23	7300
3	DB 12	6200	7	DB 16	6600	11	DB 20	7000	15	DB 24	7400
4	DB 13	6300	8	DB 17	6700	12	DB 21	7100	16	DB 25	7500

The messages that belong to the signals are enabled byte by byte, separately for error and operational messages, by machine data:

Error messages:	MD 6032 ... MD 6047	PLC I
	MD 6132 ... MD 6147	PLC II

Status word for user (Section 6.4.8)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 12								
DR 12								

3.6.1.2 Signals from NC channel (DB 10...DB 25)

Program commands (Section 6.5.1)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 13	M00/M01	M02/M30	G33/G63	G00	G96	Block search active	Program interrupted	Program running
DR 13	Transform-ation active			Tapping or compensa-tion chuck active d)				Coupled-motion active d)

Softkey selection (Section 6.5.2)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 14	Skip block selected	Reserved	Decoding single block selected	Dry run feedrate selected	M01 selected	Feedrate override for rapid traverse selected	DRF selected	TEACH IN/PLAY-BACK selected
DR 14	Execution from external selected	Block se-arch with calclation selected	Block sear-ch with calcula. from last main block selected					

Acknowledgements (Section 6.5.3)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 15		Block search with calcula-tion without error	Block search with calcula-tion from last main block without error					
DR 15		Error on block search with calcula-tion	Error on block search with calculation from last main block					

Ready signals (Section 6.5.4)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 16	NC start disable		NC alarm with proc. stop	NC start possible	NC channel in reset state		Mode group ready1)	NC alarm
DR 16								

1) The signal MODE GROUP READY can be scanned in the master channel.
d) with GA2, software version 1 and higher

3.6.1.3 Auxiliary functions from NC channel (DB 10...DB 25)

Modification signals (Section 6.6.3)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 17	F Modifi-cation	D Modifi-cation	H Modifi-cation	T Modifi-cation	S Modifi-cation	M word 3 Modifi-cation	M word 2 Modifi-cation	M word 1 Modifi-cation
DR 17	Last in-formation					M word 3 not decoded	M word 2 not decoded	M word 1 not decoded

Decoded M functions (Section 6.6.3)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 18	Dynamic M signals							
	M7	M6	M5	M4	M3	M2	M1	M0
DR 18	Static M signals							
	M7	M6	M5	M4	M3	M2	M1	M0
DL 19	Dynamic M signals							
	M15	M14	M13	M12	M11	M10	M9	M8
DR 19	Static M signals							
	M15	M14	M13	M12	M11	M10	M9	M8
DL 20	Dynamic M signals							
	M23	M22	M21	M20	M19	M18	M17	M16
DR 20	Static M signals							
	M23	M22	M21	M20	M19	M18	M17	M16
DL 21	Dynamic M signals							
	M31	M30	M29	M28	M27	M26	M25	M24
DR 21	Static M signals							
	M31	M30	M29	M28	M27	M26	M25	M24

Decoded M functions (Section 6.6.3)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 22	Dynamic M signals							
	M39	M38	M37	M36	M35	M34	M33	M32
DR 22	Static M signals							
	M39	M38	M37	M36	M35	M34	M33	M32
DL 23	Dynamic M signals							
	M47	M46	M45	M44	M43	M42	M41	M40
DR 23	Static M signals							
	M47	M46	M45	M44	M43	M42	M41	M40
DL 24	Dynamic M signals							
	M55	M54	M53	M52	M51	M50	M49	M48
DR 24	Static M signals							
	M55	M54	M53	M52	M51	M50	M49	M48
DL 25	Dynamic M signals							
	M63	M62	M61	M60	M59	M58	M57	M56
DR 25	Static M signals							
	M63	M62	M61	M60	M59	M58	M57	M56
DL 26	Dynamic M signals							
	M71	M70	M69	M68	M67	M66	M65	M64
DR 26	Static M signals							
	M71	M70	M69	M68	M67	M66	M65	M64
DL 27	Dynamic M signals							
	M79	M78	M77	M76	M75	M74	M73	M72
DR 27	Static M signals							
	M79	M78	M77	M76	M75	M74	M73	M72
DL 28	Dynamic M signals							
	M87	M86	M85	M84	M83	M82	M81	M80
DR 28	Static M signals							
	M87	M86	M85	M84	M83	M82	M81	M80
DL 29	Dynamic M signals							
	M95	M94	M93	M92	M91	M90	M89	M88
DR 29	Static M signals							
	M95	M94	M93	M92	M91	M90	M89	M88
DL 30	Dynamic M signals							
					M99	M98	M97	M96
DR 30	Static M signals							
					M99	M98	M97	M96

Stored words of block information (Section 6.6.3)		
Data word No.	High byte (DL)	Low byte (DR)
DW 31	Bit 15 — Extended address M word 1 (binary)	Bit 0
DW 32	Bit 15 — M word 1 (binary)	Bit 0
DW 33	Bit 15 — Extended address M word 2 (binary)	Bit 0
DW 34	Bit 15 — M word 2 (binary)	Bit 0
DW 35	Bit 15 — Extended address M word 3 (binary)	Bit 0
DW 36	Bit 15 — M word 3 (binary)	Bit 0
DW 37	Bit 15 — Extended S address (binary or BCD)	10^1 10^0 Bit 0
DW 38	Bit 31 — S word (binary or BCD) 10^7 10^6	10^5 10^4 Bit 16
DW 39	Bit 15 — S word (binary or BCD) 10^3 10^2	10^1 10^0 Bit 0

Selection of number format:

Channel	DB	NC MD for BCD output S	T	D	H	F
1	DB 10	5440.3	-.4	-.5	-.6	-.7
2	DB 11	5441.3	-.4	-.5	-.6	-.7
3	DB 12	5442.3	-.4	-.5	-.6	-.7
4	DB 13	5443.3	-.4	-.5	-.6	-.7
5	DB 14	5444.3	-.4	-.5	-.6	-.7
6	DB 15	5445.3	-.4	-.5	-.6	-.7
7	DB 16	5446.3	-.4	-.5	-.6	-.7
8	DB 17	5447.3	-.4	-.5	-.6	-.7

Channel	DB	NC MD for BCD output S	T	D	H	F
9	DB 18	5448.3	-.4	-.5	-.6	-.7
10	DB 19	5449.3	-.4	-.5	-.6	-.7
11	DB 20	5450.3	-.4	-.5	-.6	-.7
12	DB 21	5451.3	-.4	-.5	-.6	-.7
13	DB 22	5452.3	-.4	-.5	-.6	-.7
15	DB 23	5453.3	-.4	-.5	-.6	-.7
15	DB 24	5454.3	-.4	-.5	-.6	-.7
16	DB 25	5455.3	-.4	-.5	-.6	-.7

Stored words of block information (Section 6.6.3)

Data word No.	High-order byte (DL)	Low-order byte (DR)
DW 40	Bit 15 Extended T address (binary or BCD)	10^1 10^0 Bit 0
DW 41	Bit 31 T word (binary or BCD) 10^7 10^6	10^5 10^4 Bit 16
DW 42	Bit 15 T word (binary or BCD) 10^3 10^2	10^1 10^0 Bit 0
DW 43	Bit 15 Extended H address (binary or BCD)	10^1 10^0 Bit 0
DW 44	Bit 31 H word (binary or BCD) 10^7 10^6	10^5 10^4 Bit 16
DW 45	Bit 15 H word (binary or BCD) 10^3 10^2	10^1 10^0 Bit 0
DW 46	Bit 15 D word (binary or BCD) 10^2	10^1 10^0 Bit 0
DW 47	Bit 15 Extended F address	10^1 10^0 Bit 0
DW 48	Bit 31 F word 10^5 10^4	10^3 10^2 Bit 16
DW 49	Bit 15 F word 10^1 10^0	10^{-1} 10^{-2} Bit 0
DW 50	Reserved	

Selection of number format:

Chan-nel	DB	NC MD for BCD output S	T	D	H	F
1	DB 10	5440.3	-.4	-.5	-.6	-.7
2	DB 11	5441.3	-.4	-.5	-.6	-.7
3	DB 12	5442.3	-.4	-.5	-.6	-.7
4	DB 13	5443.3	-.4	-.5	-.6	-.7
5	DB 14	5444.3	-.4	-.5	-.6	-.7
6	DB 15	5445.3	-.4	-.5	-.6	-.7
7	DB 16	5446.3	-.4	-.5	-.6	-.7
8	DB 17	5447.3	-.4	-.5	-.6	-.7

Chan-nel	DB	NC MD for BCD output S	T	D	H	F
9	DB 18	5448.3	-.4	-.5	-.6	-.7
10	DB 19	5449.3	-.4	-.5	-.6	-.7
11	DB 20	5450.3	-.4	-.5	-.6	-.7
12	DB 21	5451.3	-.4	-.5	-.6	-.7
13	DB 22	5452.3	-.4	-.5	-.6	-.7
15	DB 23	5453.3	-.4	-.5	-.6	-.7
15	DB 24	5454.3	-.4	-.5	-.6	-.7
16	DB 25	5455.3	-.4	-.5	-.6	-.7

Softkey selection (Section 6.6.3)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 51	/8	/7	/6	/5	/4	/3	/2	/1
	Block skip selected							
DR 51	Spare							

Program coordination *)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 52								Program coord. change
DR 52	Command code							
DL 53	Label/program number (BCD) 10^7				Label/program number (BCD) 10^6			
DR 53	Label/program number (BCD) 10^5				Label/program number (BCD) 10^4			
DL 54	Label/program number (BCD) 10^3				Label/program number (BCD) 10^2			
DR 54	Label/program number (BCD) 10^1				Label/program number (BCD) 10^0			
DL 55	Program coordination (SET) active in							
	Chan. 16	Chan. 15	Chan. 14	Chan. 13	Chan. 12	Chan. 11	Chan. 10	Chan. 9
DR 55	Program coordination (SET) active in							
	Chan. 8	Chan. 7	Chan. 6	Chan. 5	Chan. 4	Chan. 3	Chan. 2	Chan. 1
:	Spare							
DR 62	Spare							

*) *These signals are used by the function blocks for program coordination.*

T/H word routing (Section 6.6.4)

Byte No. / Bit No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL63	Suppress routing d)	Reserved						
DR63	Coordina-tion error	Routing suppres-sed d)					H word valid	T word valid
DW64	Number of source channel (BINARY)							
DW65	Routed T word 10^3				Routed T word 10^2			
DW66	Routed T word 10^1				Routed T word 10^0			
DW67	Routed H word 10^1				Routed H word 10^0			
DW68	Routed H word 10^3				Routed H word 10^2			
DW69	Routed H word 10^1				Routed H word 10^0			

d) with GA2, software version 1 and higher

3.6.2 ELG-specific signals (DB 29)

Signals from ELG (Section 7.2)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL K	New $K_{\ddot{U}}$ calculated	Acceler-ation limit-ation syn-chronous active	Emer-gency retraction enabled	Compens-atory controller active	Spare	FA overlay active	Synchro-nization enabled	LINK ACTIVE
DR K	New $K_{\ddot{U}}$ defective	Automati-cally con-trolled cor-rection of FA	Maximum acceler-ation	Maximum velocity	Accelerati-on warning threshold reached	Velocity warning threshold reached	Synchro-nism fine	Synchro-nism coarse
DL K+1		Synchro-nization reached	Emergen-cy retrac-tion active		Centre position reached	2nd flank stored	1st flank stored	SAC active
DR K+1								

Signals to ELG (Section 7.3)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL K+2	Calculate new $K_{\ddot{U}}$	Acceler-ation limit-ation syn-chronous	Enable emergency retraction	Compens-atory con-troller ON/OFF	Spare	FA overlay on	Synchron-ization ON	LINK ON
DR K+2	Activate new $K_{\ddot{U}}$	Spare	Synchron-ization START		Spare	FA overlay off	Synchron-ization OFF	LINK OFF
DL K+3	Spare					2nd flank approach-ed	1st flank approach-ed	SAC on/off
DR K+3								

Address K for the following axes as follows:

1st FA	***K= 0***
2nd FA	***K= 4***
3rd FA	***K= 8***

3.6.3 M signals (DB 30) decoded according to list

Signals decoded according to list (Section 18)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0	Dynamic M signals							
DR 0	Static M signals							
DL 1	Dynamic M signals							
DR 1	Static M signals							
DL 127	Dynamic M signals							
DR 127	Static M signals							

The bit field is common to **all** channels. A maximum of 64 M functions per channel can be decoded according to the list. DB 80...DB 95 are provided for the decoding lists.

Channel	Decoding list	PLC MD for decoding PLC I	PLC II
1	DB 80	6009.0	6109.0
2	DB 81	.1	.1
3	DB 82	.2	.2
4	DB 83	.3	.3
5	DB 84	.4	.4
6	DB 85	.5	.5
7	DB 86	.6	.6
8	DB 87	.7	.7
9	DB 88	6010.0	6110.0
10	DB 89	.1	.1
11	DB 90	.2	.2
12	DB 91	.3	.3
13	DB 92	.4	.4
14	DB 93	.5	.5
15	DB 94	.6	.6
16	DB 95	.7	.7

3.6.4 Spindle-specific signals (DB 31)

3.6.4.1 Spindle basic functions

Signals from spindle (Section 8.2)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL K	Actual rotation cw	Prog. speed too high	Spindle in set range	Spindle position reached	Spindle stop	Spindle syn-chronized	Spindle position-ing active	Speed limit exceeded
DR K	Change gear					Set gear stage C	Set gear stage B	Set gear stage A

Signals to spindle (Section 8.3)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL K+1	Change gain factor 1)	Servo enable	Input set value 0	Spindle override active	Spindle override D	Spindle override C	Spindle override B	Spindle override A
DR K+1	Resynch-ronize spindle 1)	Acknow-ledge M19 1)	Spindle reset	Invert M03/M04	Actuate C axis opera-tion 1)	Actual gear stage C	Actual gear stage B	Actual gear stage A
DL K+2				Channel number E	Channel number D	Channel number C	Channel number B	Channel number A
DR K+2	Set rota-tion cw	Oscillation speed	Basic speed	Position spindle	Resyn-chronize spindle 2)	Acknow-ledge M19 2)	Reserved	PLC spindle control
DL K+3	Spindle disable n+7	n+6	n+5	n+4	n+3	n+2	n+1	n+0
DR K+3	Spindle disable n+15	n+14	n+13	n+12	n+11	n+10	n+9	n+8

Spindle	Address K	Message text address n	PLC-MD for processing PLC I	PLC II
1	0	8000	6012.0	6112.0
2	4	8020	.1	.1
3	8	8040	.2	.2
4	12	8060	.3	.3
5	16	8080	.4	.4
6	20	8100	.5	.5

1) Valid only for 32-bit servo CPU
2) Valid only for 16-bit servo CPU (up to and including software version 6)

Notes:

- A maximum of 30 measuring circuits (axes and spindles) is permitted.
- Message text address n is required for the error and operational messages. The SPINDLE DISABLE messages can also be analyzed for error messages by means of PLC MD 6034 (PLC I) and 6134 (PLC II). Evaluation for operational messages can be set by means of PLC MD 6042 (PLC I) and 6142 (PLC II).

3.6.4.2 Extended spindle basic functions

DB 31 is extended upwards for the additional status and control signals of the extended spindle functions. The extended spindle functions are available only with a 32-bit servo CPU.

Status signals from synchronous spindle (Section 8.4)

Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL L+24	New transmission ratio calculated	Defined angular offset reached	Emergency retraction active				Reserved	Following spindle in synchronous mode
DR L+24	New transmission ratio defective	Automatically controlled correction	Maximum acceleration	Maximum speed	Acceleration warning threshold reached	Speed warning threshold reached	Synchronism fine	Synchronism coarse

Control signals to synchronous spindle (Section 8.5)

Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL L+25	Calculate new transmission ratio				Interlock synchronous mode			
DR L+25	Activate new transmission ratio							
:					Spare			
DL L+59					Spare			

Spindle	Address L	Message text address n	PLC MD for processing PLC I	PLC II
1	0	8000	6012.0	6112.0
2	2	8020	.1	.1
3	4	8040	.2	.2
4	6	8060	.3	.3
5	8	8080	.4	.4
6	10	8100	.5	.5

3.6.5 Axis-specific signals (DB 32)

Signals from axis (Section 9.2)

Byte No.	15	14	13	12	11	10	9	8
Bit No.	7	6	5	4	3	2	1	0
DL K	Speed controller active	Position control active	Release SI brake c)	Reference point reached	Travel command +	Travel command –	Position reached with exact stop fine	coarse
DR K	Motor/actuator overtemp. c)	Terminal 63/64, termin. 65 c) IKA warn. limit d)		Rounding axis in position		Axis is C-axis d)		

Signals to axis (Section 9.3)

Byte No.	15	14	13	12	11	10	9	8
Bit No.	7	6	5	4	3	2	1	0
DL K+1	Mirroring	Follow-up operation		*Deceleration reference point approach	Parking axis	Controller enable	2nd software limit switch +	–
DR K+1	Jog +	–	Rapid traverse overlay	Feedrate 1:100	Axis disable	Handwheel active 3	2	1
DL K+2				Measuring system 1/2d)	SI Brake released c)	SI Safety signal c)	Travel limit +	–
DR K+2								
DL K+3	Feed disable n+7	n+6	n+5	n+4	n+3	n+2	n+1	n+0
DR K+3	Feed disable n+15	n+14	n+13	n+12	n+11	n+10	n+9	n+8

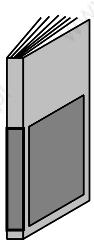
c) *up to and including software version 6*
d) *with GA2, software version 1 and higher*
* *Signal is 0 active*

Axis	Address K	Message text address n	PLC MD for processing PLC I	PLC II
1	0	8200	6016.0	6116.0
2	4	20	.1	.1
3	8	40	.2	.2
4	12	60	.3	.3
5	16	80	.4	.4
6	20	8300	.5	.5
7	24	20	.6	.6
8	28	40	.7	.7
9	32	60	6017.0	6117.0
10	36	80	.1	.1
11	40	8400	.2	.2
12	44	20	.3	.3
13	48	40	.4	.4
14	52	60	.5	.5
15	56	80	.6	.6
16	60	8500	.7	.7
17	64	20	6018.0	6118.0
18	68	40	.1	.1
19	72	60	.2	.2
20	76	80	.3	.3
21	80	8600	.4	.4
22	84	20	.5	.5
23	88	40	.6	.6
24	92	60	.7	.7

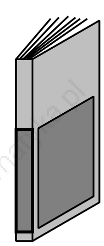
Notes:

- A maximum of 30 measuring circuits (axes and spindles) is permitted.
- Message text address n is required for the error and operational messages. The FEED DISABLE messages can also be analyzed for error messages by means of PLC MD 6035 (PLC I) and 6135 (PLC I). Evaluation for operational messages can be set by means of PLC MD 6043 (PLC I) and 6143 (PLC II). The function blocks required for scanning are contained in FB package 0.
- The FEED DISABLE signals are ignored as long as the PLC operating system is active for self-installation[c]. The PLC operating system itself generates a FEED DISABLE signal to the NC.
- The axis-specific SERVO ENABLE signal is ignored in the self-installation mode[c]. The PLC operating system itself generates a SERVO ENABLE signal for self-installation.

3.6.6 Tool management for SINUMERIK 880N (DB 33)



The signals of the tool management of the SINUMERIK 880N (DB 33) are described in the document SINUMERIK 880N, Interface Description, Part 1: Signals, Difference Description.



c) *up to and including software version 6*

3.7 Data transfer interface PLC/NC/COM (DB 36)

Status data transfer (Section 11.2.2)									
No. interface byte	Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
1	DL 0	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
2	DR 0	Error Vaue. 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
3	DL 1	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
4	DR 1	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
5	DL 2	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
62	DR 30	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
63	DL 31	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
64	DR 31	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested

Data transfer alarm-controlled									
No. interface byte	Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
65	DL 32	Error Value 1-Value 3	Number format	Access disabled	Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested

Notes:

- If the PLC goes into the stop state because of a parameterization error, the number of the interface byte is entered in the high-order byte of ACCU 2.
- If several jobs are entered in the buffer for data transfer, a job with the number 65 will be processed before the others.
- Data transfer is effected by function blocks FB 61 (read) and FB 62 (write).

3.8 Serial interface (DB 37)

Interface signals (Section 12.1)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0			RS232C (V.24) busy		4	3	2	1
DR 0								

Signals for data transfer initiative PLC (Section 12.1)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 1						RS232C (V.24) abort	Data start output	Data start input
DR 1							Error during data transfer	Data transfer ended
DW 2	Data type for data output							
DW 3	Data type for data output							
DW 4	Initial number							
DW 5	End number							
DL 6	Channel number							

3.9 Operator panel/PLC interface

3.9.1 Key signals from operator panel (DB 40)

Key signals from operator panel (Section 13.2)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0		Group A softkeys (dynamic signals)						
		Recall	ETC	Softkey 5	Softkey 4	Softkey 3	Softkey 2	Softkey 1
DR 0		Group A softkeys (static signals)						
		Recall	ETC	Softkey 5	Softkey 4	Softkey 3	Softkey 2	Softkey 1
DL 1		Group B freely assignable keys (dynamic signals)						
	1	2	3	4	5	6	7	8
DR 1		Group B freely assignable keys (static signals)						
	1	2	3	4	5	6	7	8
DL 2		Group B freely assignable keys (dynamic signals)						
			9	10	11	12	13	14
DR 2		Group B freely assignable keys (static signals)						
			9	10	11	12	13	14
DL 3			Group E cursor (dynamic signals)					
			V		>	<	Page V	Page
DR 3			Group E cursor (static signals)					
			V		>	<	Page V	Page
DL 4				Group G individual functions (dynamic signals)				
				Select NC channel	Start-up	Acknow-ledge alarms	Actual value display	Select
DR 4				Group G individual functions (static signals)				
				Select NC channel	Start-up	Acknow-ledge alarms	Actual value display	Select
DL 5	Group I select operating mode groups (dynamic signals)				Group H editing (dynamic signals)			
	4	3	2	1	Clear	Cancel	Edit	Input
DR 5	Group I select operating mode groups (static signals)				Group H edit (static signals)			
	4	3	2	1	Clear	Cancel	Edit	Input
DL 6				Group I select mode groups (dynamic signals)				
					8	7	6	5
DR 6				Group I select mode groups (static signals)				
					8	7	6	5

Key codes (Section 13.2)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 7	Key hexadecimal code							
DR 7	Mode group							

Softkey function signals (Section 13.3)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 8	Dynamic function signals							
	7	6	5	4	3	2	1	0
DR 8	Static function signals							
	7	6	5	4	3	2	1	0
DL 9	Dynamic function signals							
	15	14	13	12	11	10	9	8
DR 9	Static function signals							
	15	14	13	12	11	10	9	8
DL 39	Dynamic function signals							
	255	254	253	252	251	250	249	248
DR 39	Static function signals							
	255	254	253	252	251	250	249	248
DL 40								
DR 40								Softkey function number change
DL 41	Bit 15 Softkey function number Bit 8							
DR 41	Bit 7 Softkey function number Bit 0							
DL 42					Status display PLC selected	Start-up menu	Menu number change	User menu
DR 42	Menu number							

3.9.2 Operator panel switchover (DB 40)

Key signals from operator panel (Section13.3)								
Byte No. / Bit No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 43						Selection operator panel 3	Selection operator panel 2	Selection operator panel 1
DR 43	Error in 3rd OP d)	Error in 2nd OP d)				Active message operator panel 3	Active message operator panel 2	Active message operator panel 1
DL 44	Assigned by internal signals							
DR 44								
DL 45								
DR 45								
DL 46								
DR 46								
DL 47								
DR 47								
DL 48								
DR 48								

d) *with GA2, software version 1 and higher*

3.9.3 Display dialog line (DB 40)

Display dialog line (DB 40) (Section 13.3)								
Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 49	Acknowl. function result valid	Softkey function number change						
DR 49	Function number							
DL 50	Function result							
DR 50	Dialog text number							

3.9.4 Menu selection (DB 40)

Menu selection (Section 13.4)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 51								Start signal from user
DR 51	Insertion from other PLC act.	Own insertion active				Acknowledgements: Insertion already active	Acknowledgements: Fault	Insertion executed
DL 52 / **DR 52**	Job number (1...15)							
DL 53 / **DR 53**	Menu number (1...65535)							
DL 54	Mode group number (1...8)							
DR 54	Channel number (1...16)							
DL 55	Request for key disable					Key lock to NC: INPUT	Key lock to NC: EDIT	Key lock to NC: CANCEL
DR 55	Unassigned							
DL 56								Special recall
DR 56	Displayed channel from NC (1...16)							

3.9.5 Cursor data (DB 40)

Cursor data to PLC (Section 13.5)								
Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL 57	Data group base							
DR 57	Data type base							
DL 58	DB/DX number base (0...255)							
DR 58	Unassigned							
DL 59 DR 59	DW number base (0...65535)							
DL 60	Data group pointer							
DR 60	Data type pointer							
DL 61	DB/DX number pointer (0...255)							
DR 61	Unassigned							
DL 62 DR 62	DW number pointer (0...65535)							
DL 63 DR 63	Block number (0...65535)							

3.10 Command channel (DB 41)

Command channel (DB 41) (Section 14.2)								
Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0	Unassigned							
DR 0	Request bits 8th UI	7th UI	6th UI	5th UI	4th UI	3rd UI	2nd UI	1st UI
DL 1	Unassigned							
DR 1	Error bits 8th UI	7th UI	6th UI	5th UI	4th UI	3rd UI	2nd UI	1st UI
DL 2	Unassigned							
DR 2	Unassigned							
DL 3	Unassigned							
DR 3	Unassigned							
DL 4	Unassigned							
DR 4	Unassigned							
DL 5	Unassigned							
DR 5	Unassigned							

Note:

The number of user interfaces (UI) is set with PLC MD 0033 (PLC I) and 0133 (PLC II).

Command channel (DB 41) (Section 14.3)

Byte No.	Bit No. 15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL m	(High) Function number							
DR m	(Low)							
DL m +1	(High) Error number							
DR m +1	(Low)							
DL m +2	DB = 0 DX = 1							
DR m +2	Useful data DB/DX number							
DL m +3	(High) Data word number in useful data DB/DX							
DR m +3	(Low)							
DL m +4	DB = 0 DX = 1 d)							
DR m +4	Target DB/DX number d)							
DL m +5	(High) Data word number in target DB/DX d)							
DR m +5	(Low)							
DL m +6	Unassigned							
DR m +6								

UIF	m
1. UIF	6
2. UIF	13
3. UIF	20
4. UIF	27
5. UIF	34
6. UIF	41
7. UIF	48
8. UIF	55

Note:

The format of the user data for the functions of the command channel is outlined with the signal descriptions.

d) *with GA2, software version 1 and higher*

3.11 COM/PLC interface (DB 48)

Signals to COM (Section 15.1)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0	Status disable	Keyswitch	Screen darkening	Operator plane disable	Cycle disable	Control without operator panel		Warm restart
DR 0	Initiate REORG							

Signals from COM (Section 15.2)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 1	REORG activated	REORG by file transfer active					REORG by file transfer ended	REORG ended
DR 1						File transfer running		Warm restart ended
DL 2	VT340 active[d)]				Connec-tion active [d)]	TELE-S input[d)]	TELE-S display[d)]	TELE-S active[d)]
DR 2								

---

d) with GA2, software version 1 and higher

3.12 PLC/PLC interface

3.12.1 Input signals from PLC I (DB 50) and PLC II (DB 52)

Signals time-controlled 10 ms (Section 16.2)		
Data word No.	High byte (DL)	Low byte (DR)
DW 0		

Signals cyclic (Section 16.2)		
Data word No.	High byte (DL)	Low byte (DR)
DW 1		
DW 2		
DW 3		
DW 4		
DW 5		
DW 6		
DW 7		
DW 8		
DW 9		
DW 10		
DW 11		
DW 12		
DW 13		

Signals cyclic (Section 16.2)

Data word No.	High byte (DL)	Low byte (DR)
DW 14		
DW 15		
DW 16		
DW 17		
DW 18		
DW 19		
DW 20		
DW 21		
DW 22		
DW 23		
DW 24		

Data transfer PLC/PLC effected by interface byte (Section 16.3.2)

(No. of interface byte)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 25	Data transfer effected (dynamically)							
	DR 28 (8)	DL 28 (7)	DR 27 (6)	DL 27 (5)	DR 26 (4)	DL 26 (3)	DR 25 (2)	DL 25 (1)
DR 25	Data transfer effected (statically)							
	DR 28 (8)	DL 28 (7)	DR 27 (6)	DL 27 (5)	DR 26 (4)	DL 26 (3)	DR 25 (2)	DL 25 (1)
DL 28	DR 40 (32)	DL 40 (31)	DR 39 (30)	DL 39 (29)	DR 38 (28)	DL 38 (27)	DR 37 (26)	DL 37 (25)
DR 28	DR 40 (32)	DL 40 (31)	DR 39 (30)	DL 39 (29)	DR 38 (28)	DL 38 (27)	DR 37 (26)	DL 37 (25)

3.12.2 Output signals to PLC I (DB 51) and PLC II (DB 53)

Signals time-controlled 10 ms (Section 16.2)		
Data word No.	**High byte (DL)**	**Low byte (DR)**
DW 0		

Signals cyclic (Section 16.2)		
Data word No.	**High byte (DL)**	**Low byte (DR)**
DW 1		
DW 2		
DW 3		
DW 4		
DW 5		
DW 6		
DW 7		
DW 8		
DW 9		
DW 10		
DW 11		
DW 12		
DW 13		

Signals cyclic (Section 16.2)		
Data word No.	High byte (DL)	Low byte (DR)
DW 14		
DW 15		
DW 16		
DW 17		
DW 18		
DW 19		
DW 20		
DW 21		
DW 22		
DW 23		
DW 24		

Status data transfer (Section 16.3.3)									
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 25				Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
2	DR 25				Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested
32	DR 40				Data transfer ended	Data transfer assigned	Data transfer busy	FIFO full	Data transfer requested

Notes:

- PLC/PLC data transfer is effected by function macros FB63 and FB64. These function blocks are contained PLC operating in the system. The transfer of cyclic and time-controlled signals is effected by the PLC operating system.
- The number of the interface byte has to be stated if the function blocks FB 63/FB 64 for PLC/PLC data transfer are parameterized by flags.

Configuration form

No. interface byte	Byte No.	FB 63 read	FB 64 write	Data type	Data source	Data desti-nation	Function
1	DL 25						
2	DR 25						
3	DL 26						
4	DR 26						
5	DL 27						
6	DR 27						
7	DL 28						
8	DR 28						

3.13 PLC messages (DB 58)

Control signals (Section 19.4)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0	Acknow-ledge NC emergency stop		Display in message line: Error messages	Display in message line: Operational messages	Display in message line: Page		Acknow-ledge PLC error message	

States (Section 19.4)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DR 0	NC in emergency stop state					PLC emergency stop message	PLC error message	PLC ope-rational message

Emergency stop to NC (Section 19.4)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 1 (Message m+)	7	6	5	4	3	2	1	0
DR 1 (Message m+)	15	14	13	12	11	10	9	8
DL 2 (Message m+)	23	22	21	20	19	18	17	16
DR 2 (Message m+)	31	30	29	28	27	26	25	24

Notes:

- Address **m** depends on the assigned message area (see Section 19.3.3).
- PLC machine data are used to determine whether messages are to be treated as error or operational messages.
- The function blocks for message interrogation and display are contained in FB package 0.

Messages (Section 19.4)								
Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL 3	Message m+							
	39	38	37	36	35	34	33	32
DR 3	Message m+							
	47	46	45	44	43	42	41	40
DL 4	Message m+							
	55	54	53	52	51	50	49	48
DR 4	Message m+							
	63	62	61	60	59	58	57	56
DL 5	Message m+							
	71	70	69	68	67	66	65	64
DR 5	Message m+							
	79	78	77	76	75	74	73	72
DL 6	Message m+							
	87	86	85	84	83	82	81	80
DR 6	Message m+							
	95	94	93	92	91	90	89	88
DL 7	Message m+							
	103	102	101	100	99	98	97	96
DR 7	Message m+							
	111	110	109	108	107	106	105	104

Notes:

- Address **m** depends on the assigned message area (see Section 19.3.3).
- PLC machine data are used to determine whether messages are to be treated as error or operational messages.
- The function blocks for message interrogation and display are contained in FB package 0.

Messages (Section 19.4)

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 8	Message m+							
	119	118	117	116	115	114	113	112
DR 8	Message m+							
	127	126	125	124	123	122	121	120
DL 9	Message m+							
	135	134	133	132	131	130	129	128
DR 9	Message m+							
	143	142	141	140	139	138	137	136
DL 10	Message m+							
	151	150	149	148	147	146	145	144
DR 10	Message m+							
	159	158	157	156	155	154	153	152
DL 11	Message m+							
	167	166	165	164	163	162	161	160
DR 11	Message m+							
	175	174	173	172	171	170	169	168
DL 12	Message m+							
	183	182	181	180	179	178	177	176
DR 12	Message m+							
	191	190	189	188	187	186	185	184
DL 13	Message m+							
	199	198	197	196	195	194	193	192
DR 13	Message m+							
	207	206	205	204	203	202	201	200
DL 14	Message m+							
	215	214	213	212	211	210	209	208
DR 14	Message m+							
	223	222	221	220	219	218	217	216
DL 15	Message m+							
	231	230	229	228	227	226	225	224
DR 15	Message m+							
	239	238	237	236	235	234	233	232
DL 16	Message m+							
	247	246	245	244	243	242	241	240
DR 16	Spare							
DL 17	Message m+							
	257	256	255	254	253	252	251	250
DR 17	Message m+							
	265	264	263	262	261	260	259	258

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 18	Message m+ 273	272	271	270	269	268	267	266
DR 18	Message m+ 281	280	279	278	277	276	275	274
DL 19	Message m+ 289	288	287	286	285	284	283	282
DR 19	Message m+ 297	296	295	294	293	292	291	290
DL 20	Message m+ 305	304	303	302	301	300	299	298
DR 20	Message m+ 313	312	311	310	309	308	307	306
DL 21	Message m+ 321	320	319	318	317	316	315	314
DR 21	Message m+ 329	328	327	326	325	324	323	322
DL 22	Message m+ 337	336	335	334	333	332	331	330
DR 22	Message m+ 345	344	343	342	341	340	339	338
DL 23	Message m+ 353	352	351	350	349	348	347	346
DR 23	Message m+ 361	360	359	358	357	356	355	354
DL 24	Message m+ 369	368	367	366	365	364	363	362
DR 24	Message m+ 377	376	375	374	373	372	371	370
DL 25	Message m+ 385	384	383	382	381	380	379	378
DR 25	Message m+ 393	392	391	390	389	388	387	386
DL 26	Message m+ 401	400	399	398	397	396	395	394
DR 26	Message m+ 409	408	407	406	405	404	403	402
DL 27	Message m+ 417	416	415	414	413	412	411	410
DR 27	Message m+ 425	424	423	422	421	420	419	418

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
				Bit No.				
DL 28	Message m+							
	433	432	431	430	429	428	427	426
DR 28	Message m+							
	441	440	439	438	437	436	435	434
DL 29	Message m+							
	449	448	447	446	445	444	443	442
DR 29	Message m+							
	457	456	455	454	453	452	451	450
DL 30	Message m+							
	465	464	463	462	461	460	459	458
DR 30	Message m+							
	473	472	471	470	469	468	467	466
DL 31	Message m+							
	481	480	479	478	477	476	475	474
DR 31	Message m+							
	489	488	487	486	485	484	483	482
DL 32	Message m+							
	497	496	495	494	493	492	491	490
DR 32	Spare							

Notes:

- Address **m** depends on the assigned message area (see Section 19.3.3).
- PLC machine data are used to determine whether messages are to be treated as error or operational messages.
- The function blocks for message interrogation and display are contained in FB package 0.

3.14 Central user DB (DB 59)

The 128 data words of DB 59 can be addressed by both PLCs (PLC I and PLC II) (PLC 135 W and PLC 135 WB only).

Data bits for user (Section 16.4)								
	15	14	13	12	11	10	9	8
Byte No.	Bit No.							
	7	6	5	4	3	2	1	0
DL 0								
DR 0								
DL 1								
DR 1								
DL 2								
DR 2								
DL 3								
DR 3								
DL 4								
DR 4								
DL 5								
DR 5								
⋮								
DL 127								
DR 127								

3.15 PLC machine data

3.15.1 PLC machine data words for PLC operating system (DB 60)

Machine data words for PLC operating system (IA)		
DW No. PLC MD No.	High byte (DL)	Low byte (DR)
DW 0 m+0		
DW 1 m+1		
DW 2 m+2	1) Call time reference OB 5 n * 2,5 ms Default setting n = 1	(n = 1...3)
DW 3 m+3	1) Call time reference OB 6 m * 10 ms Default setting m = 1	(m = 1...9)
DW 4 m+4	1) Call time reference OB 7 p * 100 ms Default setting p = 1	(p = 1...255)
DW 5 m+5	2) Last STEP 5 time Default setting = 64	(-1 to 255)
DW 6 m+6	Start of operator panel inputs Default setting = 64	(64...96)
DW 7 m+7	Start of operator panel outputs Default setting = 64	(64...112)
DW 8 m+8	Last active channel Default setting = 16	(1...16)
DW 9 m+9	Last active spindle Default setting = 6	(1...6)
DW 10 m+10	Last active axis Default setting = 24	(1...24)
DW 11 m+11	Delete limit input image Default setting = 127	(63...127)
DW 12 m+12	Delete limit output image Default setting = 127	(63...127)
DW 13 m+13	c) Number of EUs at EU interface 1 Default setting =0	(0...4)
DW 14 m+14	c) Number of EUs at EU interface 2 Default setting =0	(0...4)
DW 15 m+15	c) Number of EUs at EU interface 3 Default setting =0	(0...4)

PLC	Address m
1	0
2	200

1) Input = 0 is not permitted
2) -1 means that all timers are disabled
IA: Explanation of the machine data in the Installation Guide for the SINUMERIK 880

c) *up to and including software version 6*

Machine data words for PLC operating system (IA)

DW No. PLC MD No.	High byte (DL)	Low byte (DR)
DW 16 m+16		
DW 17 m+17	No. of wait cycles with user interface assigned Default = 1 max. = 10	
DW 18 m+18	No. of user interface processed during synchronization Default = 0 max. = 31	
DW 19 m+19	Reserved for computer link	
DW 20 m+20	Function No. for core sequence initiation Default = 25 max. = 255	
DW 21 m+21	Function No. for core sequence initiation Default = 26 max. = 255	
DW 22 m+22	Function No. for core sequence initiation Default = 30 max. = 255	
DW 23 m+23	Function No. for core sequence initiation Default = 0 max. = 255	
DW 24 m+24	Function No. for core sequence initiation Default = 0 max. = 255	
DW 25 m+25	Function No. for core sequence initiation Default = 0 max. = 255	
DW 26 m+26	Function No. for core sequence initiation Default = 0 max. = 255	
DW 27 m+27	Function No. for core sequence initiation Default = 0 max. = 255	
DW 28 m+28	Function No. for core sequence initiation Default = 0 max. = 255	
DW 29 m+29	Function No. for core sequence initiation Default = 0 max. = 255	
DW 30 m+30	No. of interrupt byte of 1st EU interface (-1 to 127) Default setting = -1	
DW 31 m+31	c) No. of interrupt byte of 2nd EU interface (-1 to 127) Default setting = -1	
DW 32 m+32	c) No. of interrupt byte of 3rd EU interface (-1 to 127) Default setting = -1	
DW 33 m+33	c) Number of user interfaces for command channel 0 - 8 Default setting = 0	

PLC	Address m
1	0
2	200

c) *up to and including software version 6*

Machine data words for PLC operating system (IA)

DW No. PLC MD No.	High byte (DL)	Low byte (DR)
DW 34 m+34	Initial address 1st DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 35 m+35	Initial address 2nd DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 36 m+36	Initial address 3rd DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 37 m+37	Initial address 4th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 38 m+38	Initial address 5th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 39 m+39	Initial address 6th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 40 m+40	Initial address 7th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 41 m+41	Initial address 8th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 42 m+42	Initial address 9th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 43 m+43	Initial address 10th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 44 m+44	Initial address 11th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 45 m+45	Initial address 12th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 46 m+46	Initial address 13th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 47 m+47	Initial address 14th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 48 m+48	Initial address 15th DMP submodule, 1st DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 49 m+49	Initial address 1st DMP submodule, 1st DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 50 m+50	Initial address 2nd DMP submodule, 1st DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 51 m+51	Initial address 3rd DMP submodule, 1st DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 52 m+52	Initial address 4th DMP submodule, 1st DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	

c) up to and including software version 6
d) with GA2, software version 1 and higher

Machine data words for PLC operating system (IA)		
DW No. PLC MD No.	**High byte (DL)**	**Low byte (DR)**
DW 53 m+53	Initial address 5th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 54 m+54	Initial address 6th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 55 m+55	Initial address 7th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 56 m+56	Initial address 8th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 57 m+57	Initial address 9th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 58 m+58	Initial address 10th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 59 m+59	Initial address 11th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 60 m+60	Initial address 12th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 61 m+61	Initial address 13th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 62 m+62	Initial address 14th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 63 m+63	Initial address 15th DMP submodule, 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 64 m+64	Initial address 1st DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 65 m+65	Initial address 2nd DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 66 m+66	Initial address 3rd DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 67 m+67	Initial address 4th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 68 m+68	Initial address 5th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 69 m+69	Initial address 6th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 70 m+70	Initial address 7th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 71 m+71	Initial address 8th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	

c) up to and including software version 6
d) with GA2, software version 1 and higher

Machine data words for PLC operating system (IA)		
DW No. PLC MD No.	High byte (DL)	Low byte (DR)
DW 72 m+72	Initial address 9th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 73 m+73	Initial address 10th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 74 m+74	Initial address 11th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 75 m+75	Initial address 12th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 76 m+76	Initial address 13th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 77 m+77	Initial address 14th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 78 m+78	Initial address 15th DMP submodule, 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 79 m+79	Initial address 1st DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 80 m+80	Initial address 2nd DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 81 m+81	Initial address 3rd DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 82 m+82	Initial address 4th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 83 m+83	Initial address 5th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 84 m+84	Initial address 6th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 85 m+85	Initial address 7th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 86 m+86	Initial address 8th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 87 m+87	Initial address 9th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 88 m+88	Initial address 10th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 89 m+89	Initial address 11th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 90 m+90	Initial address 12th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	

c) *up to and including software version 6*
d) *with GA2, software version 1 and higher*

Machine data words for PLC operating system (IA)

DW No. PLC MD No.	High byte (DL)	Low byte (DR)
DW 91 m+91	Initial address 13th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 92 m+92	Initial address 14th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 93 m+93	Initial address 15th DMP submodule, 2nd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 94 m+94	Initial address 1st DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 95 m+95	Initial address 2nd DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 96 m+96	Initial address 3rd DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 97 m+97	Initial address 4th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 98 m+98	Initial address 5th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 99 m+99	Initial address 6th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 100 m+100	Initial address 7th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 101 m+101	Initial address 8th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 102 m+102	Initial address 9th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 103 m+103	Initial address 10th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 104 m+104	Initial address 11th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 105 m+105	Initial address 12th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 106 m+106	Initial address 13th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 107 m+107	Initial address 14th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 108 m+108	Initial address 15th DMP submodule, 3rd DMP interface module, 1st line (–1...158 [c], 254 [d]) Default setting = –1	
DW 109 m+109	Initial address 1st DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	

c) up to and including software version 6
d) with GA2, software version 1 and higher

Machine data words for PLC operating system (IA)

DW No. PLC MD No.	High byte (DL)	Low byte (DR)
DW 110 m+110	Initial address 2nd DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 111 m+111	Initial address 3rd DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 112 m+112	Initial address 4th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 113 m+113	Initial address 5th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 114 m+114	Initial address 6th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 115 m+115	Initial address 7th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 116 m+116	Initial address 8th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 117 m+117	Initial address 9th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 118 m+118	Initial address 10th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 119 m+119	Initial address 11th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 120 m+120	Initial address 12th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 121 m+121	Initial address 13th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 122 m+122	Initial address 14th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 123 m+123	Initial address 15th DMP submodule, 3rd DMP interface module, 2nd line (–1...158 [c], 254 [d]) Default setting = –1	
DW 124 m+124	Byte number of the 1st alarm byte (–1...127) Default setting = –1	
DW 125 m+125	Byte number of the 2nd alarm byte (–1...127) Default setting = –1	
DW 126 m+126	Byte number of the 3rd alarm byte (–1...127) Default setting = –1	
DW 127 m+127	Byte number of the 4th alarm byte (–1...127) Default setting = –1	

c) up to and including software version 6
d) with GA2, software version 1 and higher

Machine data words for PLC operating system (IA)		
DW No. PLC MD No.	**High byte (DL)**	**Low byte (DR)**
DW 128 m+128	Spare	
DW 129 m+129	Spare	
DW 130 m+130	No. of interrupt byte of 1st DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 131 m+131	No. of interrupt byte of 1st DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 132 m+132	No. of interrupt byte of 2nd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 133 m+133	No. of interrupt byte of 2nd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 134 m+134	No. of interrupt byte of 3rd DMP interface module, 1st line (–1...158 c), 254 d)) Default setting = –1	
DW 135 m+135	No. of interrupt byte of 3rd DMP interface module, 2nd line (–1...158 c), 254 d)) Default setting = –1	
DW 136 m+136	No. of the configuration block for free configuration Default setting = 0 (no DB)	

Notes:

- Only 1 interrupt byte is permitted per DMP interface module. Only one of the two machine data for each interface module can therefore contain a value other than -1.
- A total of 3 interrupt bytes is permitted.
- The interrupt byte in the DMP line is always the **first** input byte of a DMP submodule.
- Interrupt signals can be connected **either** by up to 3 EU-MPC c) modules in the central controller (1 interrupt byte each) or by DMP submodules. The mixed use of interrupt inputs at the EU-MPC and DMP submodules is not permitted.
- Free configuration of the DMPs
  - It is ensured that MD 34 to 135 and 6068 to 6079 can be processed by the IF DMP as they could previously. In this case MD 136 = 0.
  - For the extended addressing of the DMP modules, the user puts together the MD in a DB of the user program. The user enters the number of the DB or DX used in the MD 136.
  - The configuration data block permits the configuration of individual slots for inputs and outputs of the DMP modules and separate setting of the inputs and outputs of conventional DMP modules.
  - For further explanations of the configuration DBs (free configuration), see SINUMERIK 880 GA2 Installation Guide, PLC MD 136.

c) up to and including software version 6

d) with GA2, software version 1 and higher

3.15.2 PLC machine data words for function blocks (DB 61)

Machine data words for function blocks (IA)		
DW No. PLC MD No.	**High byte (DL)**	**Low byte (DR)**
DW 0 2000 : : DW 77 2077	Reserved for tool management . . . Reserved for tool management	
DW 78 2078 : : DW 89 2089	Reserved for computer link . . . Reserved for computer link	
DW 90 2090	Reserved for load/unload code carrier	
DW 91 2091 : : DW 95 2095	Reserved . . . Reserved	
DW 96 2096 : : DW 119 2119	Reserved for computer link . . . Reserved for computer link	
DW 120 2120 : : DW 139 2139	Reserved for tool management . . . Reserved for tool management	
DW 140 2140 : : DW 149 2149	Reserved . . . Reserved	

Note:

For further explanations, see the documentation of the individual FB packages.

PLC	Address m
1	2000
2	2250

3.15.3 PLC machine data words for users (DB 62)

Machine data words for users		
DW No. PLC MD No.	High byte (DL)	Low byte (DR)
DW 0 m+0		
DW 1 m+1		
DW 2 m+2		
DW 3 m+3		
DW 4 m+4		
DW 5 m+5		
DW 6 m+6		
DW 7 m+7		
DW 8 m+8		
DW 9 m+9		
DW 10 m+10		
DW 11 m+11		
DW 12 m+12		
DW 13 m+13		
:		
DW 49 m+49		

PLC	Address m
1	4000
2	4100

3.15.4 PLC machine data bits for PLC operating system (DB 63)

Channel-specific machining (IA)

Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
PLC MD No.	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DL 0 m	Signals from *I* to NC channel							
	8	7	6	5	4	3	2	1
DR 0 m+1	16	15	14	13	12	11	10	9
DL 1 m+2								
DR 1 m+3	Signals from NC channel							
	8	7	6	5	4	3	2	1
DL 2 m+4	16	15	14	13	12	11	10	9
DR 2 m+5								
DL 3 m+6	Feed disable and read-in disable to NC channel							
	8	7	6	5	4	3	2	1
DR 3 m+7	16	15	14	13	12	11	10	9
DL 4 m+8								
DR 4 m+9	M decoding with extended address for NC channel							
	8	7	6	5	4	3	2	1
DL 5 m+10	16	15	14	13	12	11	10	9
DR 5 m+11								

PLC	Address m
1	6000
2	6100

Spindle-specific machining (IA)

Byte No. / PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 6 m+12 (Signals from / to spindle)			6	5	4	3	2	1
DR 6 m+13								
DL 7 m+14 (Signals from spindle)			6	5	4	3	2	1
DR 7 m+15								

Axis-specific machining (IA)

Byte No. / PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 8 m+16 (Signals from / to axis)	8	7	6	5	4	3	2	1
DR 8 m+17 (Signals from / to axis)	16	15	14	13	12	11	10	9
DL 9 m+18 (Signals from / to axis)	24	23	22	21	20	19	18	17
DR 9 m+19								
DL 10 m+20								
DR 10 m+21 (Signals from axis)	8	7	6	5	4	3	2	1
DL 11 m+22 (Signals from axis)	16	15	14	13	12	11	10	9
DR 11 m+23 (Signals from axis)	24	23	22	21	20	19	18	17
DL 12 m+24								
DR 12 m+25								

PLC	Address m
1	6000
2	6100

General machine data (IA)

Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 13 m+ 26	Serial interface	Reserved S5-155U	Deselect automatic NC start disable	Operator panel switchover active	Save FY 200 to 223 c) to 255 d)	Access by @ com-mands disabled	Command channel active	
DR 13 m+27					Access to I/O submodule (inputs) 4	3	2	1
DL 14 m+28					Access to I/O submodule (outputs)	3	2	1
DR 14 m+29					Message in source/ target chann. d)	ELG signals to NC		T/H word routing
DL 15 m+30	Error / operational messages with non-active channels 8	7	6	5	4	3	2	1
DR 15 m+31	16	15	14	13	12	11	10	9

Processing error messages (IA)

Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 16 m+32	Error messages SIGNALS TO NC CHANNEL DR 9	DL 9	DR 8	DL 8	DR 7	DL 7	DR 6	DL 6
DR 16 m+33					DR 11	DL 11	DR 10	DL 10
DL 17 m+34	Error messages SIGNALS TO SPINDLE						DR K+3	DL K+3
DR 17 m+35	Error messages SIGNALS TO AXIS						DR K+3	DL K+3
DL 18 m+36	Error messages DB 58 MESSAGES DR 4	DL 4	DR 3	DL 3	DR 2	DL 2	DR 1	DL 1
DR 18 m+37	Error messages DB 58 MESSAGES DR 8	DL 8	DR 7	DL 7	DR 6	DL 6	DR 5	DL 5
DL 19 m+38	Error messages DB 58 MESSAGES DR 12	DL 12	DR 11	DL 11	DR 10	DL 10	DR 9	DL 9
DR 19 m+39	Error messages DB 58 MESSAGES	DL 16	DR 15	DL 15	DR 14	DL 14	DR 13	DL 13

PLC	Address m
1	6000
2	6100

d) with GA2, software version 1 and higher
c) up to and including software version 6

Processing operational messages (IA)

Byte No. PLC MD No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL 20 m+40	Operational messages SIGNALS TO NC CHANNEL							
	DR 9	DL 9	DR 8	DL 8	DR 7	DL 7	DR 6	DL 6
DR 20 m+41	Operational messages SIGNALS TO NC CHANNEL							
					DR 11	DL 11	DR 10	DL 10
DL 21 m+42	Operational messages SIGNALS TO SPINDLE							
							DR K+3	DL K+3
DR 21 m+43	Operational messages SIGNALS TO AXIS							
							DR K+3	DR K+3
DL 22 m+44	Operational messages DB 58 MESSAGES							
	DR 4	DL 4	DR 3	DL 3	DR 2	DL 2	DR 1	DL 1
DR 22 m+45	Operational messages DB 58 MESSAGES							
	DR 8	DL 8	DR 7	DL 7	DR 6	DL 6	DR 5	DL 5
DL 23 m+46	Operational messages DB 58 MESSAGES							
	DR 12	DL 12	DR 11	DL 11	DR 10	DL 10	DR 9	DL 9
DR 23 m+47	Operational messages DB 58 MESSAGES							
		DL 16	DR 15	DL 15	DR 14	DL 14	DR 13	DL 13

PLC operating behaviour (IA)

Byte No. PLC MD No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL 24 m+48	Stop with processing delay by							
	OB7	OB6	OB5	OB4	OB3	OB2		
DR 24 m+49							Use IP/WF module[d)]	Access to PLC I/O devices
DL 25 m+50	Disable of							
	OB7	OB6	OB5	OB4	OB3	OB2		
DR 25 m+51							PG mode	PLC mode

PLC	Address m
1	6000
2	6100

---

d) with GA2, software version 1 and higher

PLC operating behaviour (IA)								
Byte No. PLC MD No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL 26 m+52	Enable of interrupt inputs of 1st EU interface c)							
	7	6	5	4	3	2	1	0
DR 26 m+53	Enable of interrupt inputs of 2nd EU interface c)							
	7	6	5	4	3	2	1	0
DL 27 m+54	Enable of interrupt inputs of 3rd EU interface c)							
	7	6	5	4	3	2	1	0
DR 27 m+55	Interrupt-generating edges for interrupt inputs of 1st EU interface c)							
	7	6	5	4	3	2	1	0
DL 28 m+56	Interrupt-generating edges for interrupt inputs of 2nd EU interface c)							
	7	6	5	4	3	2	1	0
DR 28 m+57	Interrupt-generating edges for interrupt inputs of 3rd EU interface c)							
	7	6	5	4	3	2	1	0
DL 29 m+58	Spare							
DR 29 m+59	Spare							
DL 30 m+60	PLC stop on failure of				Servo CPU 4	Servo CPU 3	Servo CPU 2	Servo CPU 1
DR 30 m+61	PLC stop on failure of				NC CPU 4c)	NC CPU 3c)	NC CPU 2	NC CPU 1
DL 31 m+62	Spare							
DR 31 m+63	Spare							
DL 32 m+64	Spare							
DR 32 m+65	Spare							

PLC	Address m
1	6000
2	6100

c) *up to and including software version 6*

PLC operating behaviour (IA)

Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 33 m+66	Spare							
DR 33 m+67	Spare							
DL 34 m+68	Interrupt-generating edge for interrupt inputs 1st DMP interface module					1st line, bits 0 - 7		
DR 34 m+69	Interrupt-generating edge for interrupt inputs 1st DMP interface module					2nd line, bits 0 - 7		
DL 35 m+70	Interrupt-generating edge for interrupt inputs 2nd DMP interface module					1st line, bits 0 - 7		
DR 35 m+71	Interrupt-generating edge for interrupt inputs 2nd DMP interface module					2nd line, bits 0 - 7		
DL 36 m+72	Interrupt-generating edge for interrupt inputs 3rd DMP interface module					1st line, bits 0 - 7		
DR 36 m+73	Interrupt-generating edge for interrupt inputs 3rd DMP interface module					2nd line, bits 0 - 7		
DL 37 m+74	Enable of interrupt inputs 1st DMP interface module					1st line, bits 0 - 7		
DR 37 m+75	Enable of interrupt inputs 1st DMP interface module					2nd line, bits 0 - 7		
DL 38 m+76	Enable of interrupt inputs 2nd DMP interface module					1st line, bits 0 - 7		
DR 38 m+77	Enable of interrupt inputs 2nd DMP interface module					2nd line, bits 0 - 7		
DL 39 m+78	Enable of interrupt inputs 3rd DMP interface module					1st line, bits 0 - 7		
DR 39 m+79	Enable of interrupt inputs 3rd DMP interface module					2nd line, bits 0 - 7		

PLC	Address m
1	6000
2	6100

Processing operational messages (IA)

Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 40 m+80	Error messages DB 58 MESSAGES							
	DR 20	DL 20	DR 19	DL 19	DR 18	DL 18	DR 17	DL 17
DR 40 m+81	Error messages DB 58 MESSAGES							
	DR 24	DL 24	DR 23	DL 23	DR 22	DL 22	DR 21	DL 21
DL 41 m+82	Error messages DB 58 MESSAGES							
	DR 28	DL 28	DR 27	DL 27	DR 26	DL 26	DR 25	DL 25
DR 41 m+83	Error messages DB 58 MESSAGES							
		DL 32	DR 31	DL 31	DR 30	DL 30	DR 29	DL 29
DL 42 m+84	Operational messages DB 58 MESSAGES							
	DR 20	DL 20	DR 19	DL 19	DR 18	DL 18	DR 17	DL 17
DR 42 m+85	Operational messages DB 58 MESSAGES							
	DR 24	DL 24	DR 23	DL 23	DR 22	DL 22	DR 21	DL 21
DL 43 m+86	Operational messages DB 58 MESSAGES							
	DR 28	DL 28	DR 27	DL 27	DR 26	DL 26	DR 25	DL 25
DR 43 m+87	Operational messages DB 58 MESSAGES							
		DL 32	DR 31	DL 31	DR 30	DL 30	DR 29	DL 29
DL 44 m+88	Spare							
DR 44 m+89	Spare							
DL 45 m+90	Spare							
DR 45 m+91	Spare							
DL 46 m+92	Spare							
DR 46 m+93	Spare							
DL 47 m+94	Spare							
DR 47 m+95	Spare							

PLC	Address m
1	6000
2	6100

PLC operating behaviour (IA)

Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
				Bit No.				
DL 48 m+96	Spare							
DR 48 m+97	Spare							
DL 49 m+98	Spare							
DR 49 m+99	Spare							

PLC	Address m
1	6000
2	6100

Default setting of machine data bits for the PLC operating system

MD	PLC I	PLC II	
m+00	11111111		i.e. signals from/to NC channel 1 ... 8
m+06	11111111		i.e. feed disable and read-in disable to NC channel 1 ... 8
m+12	00000001		i.e. signals from/to spindle 1
m+16	00000111		i.e. signals from/to axis 1 ... 3
m+26	10000000		i.e. serial interface for PLC 1
m+27	00000001		i.e. inputs of I/O submodule 1
m+28	00000001		i.e. outputs of I/O submodule 1
m+48	11111100	11111100	i.e. STOP processing delay OB 2 ... 7
m+50	11111100	11111100	i.e. disable of relevant OBs
m+51	00000001	00000001	i.e. normal mode for changing processing levels

The machine data that are not listed here or have no entry are given the default setting 00000000 as standard.

3.15.5 PLC machine data bits for function blocks (DB 64)

Machine data bits for function blocks (IA)

Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
DL 0 m+0	Reserved for computer link							
DR 0 m+1	For explanation, see documentation FB package 4+5							
:	:							
DR 2 m+5	:							
:								
DL 5 m+10	Reserved for tool management							
DR 5 m+11	For explanation, see documentation FB package 1+2							
:	:							
DR 21 m+43	:							
DL 22 m+44	Reserved for FB package 0, signal groups For explanation, see documentation interface signals Section 19.3.3							
DR 22 m+45								
DL 23 m+46	Reserved for computer link							
DR 23 m+47	For explanation, see documentation FB package 4+5							
:								
DR 39 m+79								

PLC	Address m
1	7000
2	7250

3.15.6 PLC machine data bits for users (DB 65)

Machine data bits for users								
Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 0 m+0								
DR 0 m+1								
DL 1 m+2								
DR 1 m+3								
DL 2 m+4								
DR 2 m+5								
DL 3 m+6								
DR 3 m+7								
DL 4 m+8								
DR 4 m+9								
DL 5 m+10								
DR 5 m+11								
DL 6 m+12								
DR 6 m+13								
. : :								
DR 24 m+49								

PLC	Address m
1	8000
2	8050

 6ZB5 410-0HE02

3.16 Set-up DBs for users

3.16.1 Set-up user DB, words DB 68

Set-up user DB, words (Section 17)								
DW No. PLC MD No.	High byte (DL)				Low byte (DR)			
DW 0								
DW 1								
DW 2								
DW 3								
DW 4								
DW 5								
DW 6								
DW 7								
DW 8								
DW 9								
DW 10								
DW 11								
DL 12								
. . .								
DL 63								

3.16.2 Set-up user DB, bits (DB 71)

Set-up user DB, bits (Section 17)

Byte No. PLC MD No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 0								
DR 0								
DL 1								
DR 1								
DL 2								
DR 2								
DL 3								
DR 3								
DL 4								
DR 4								
DL 5								
DR 5								
:								
DL 15								
DR 15								

3.17 Decoding lists for M signals (DB 80 ... DB 95)

Decoding lists for M signals (Section 18)		
DW No. PLC	High byte (DL)	Low byte (DR)
DW m+0	Extended address	
DW m+1	M address	
DW m+2	Bit address, DW No.	Bit address, bit No.

Notes:

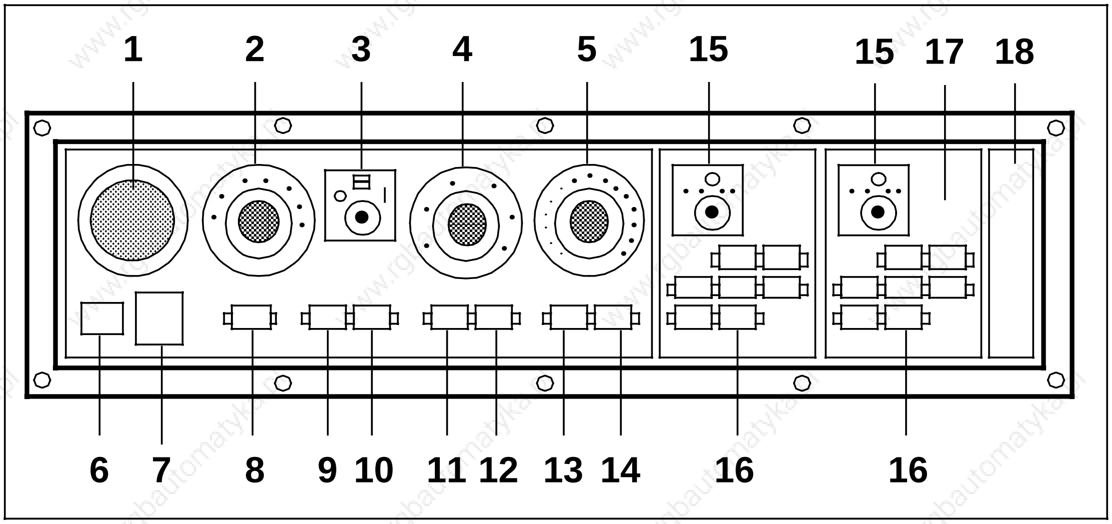
- Address m is derived from the following number of the M function definition:

M function	m
1	0
2	3
3	6
⋮	⋮
64	189

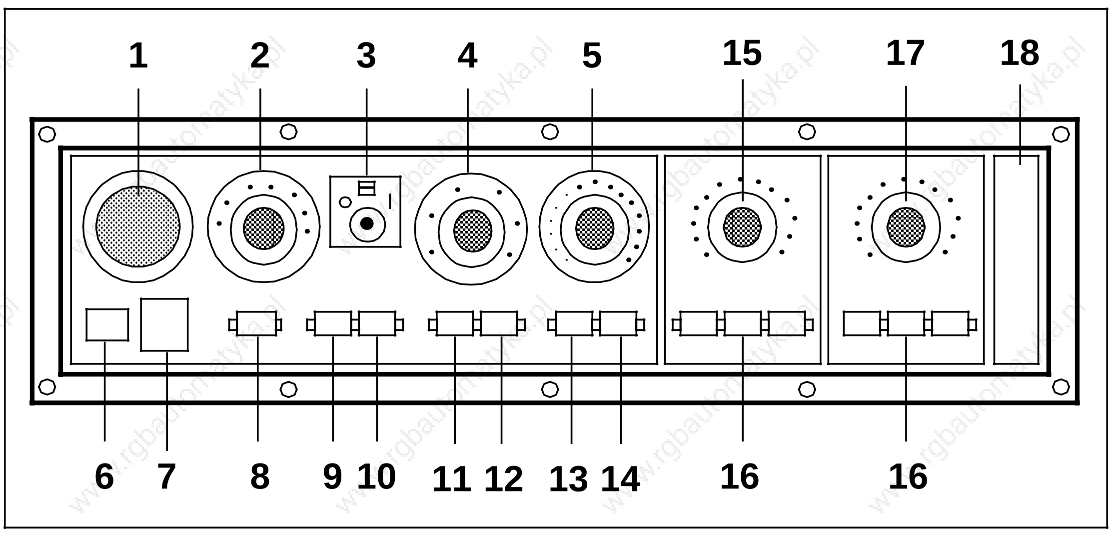
- The table must be completed consecutively starting with the first entry. No gaps are allowed between entries. If fewer than 64 M functions are defined, the remaining entries must be pre-assigned with 0. All unavailable entries are at the end of the table.
- The decoding lists are channel-specific; decoding list DB 80 is intended for NC channel 1, so that DB 95 accordingly belongs to NC channel 16.
- M decoding according to list is activated as a channel-specific function by means of MDs.

4 Description of Machine Control Panel Signals

The following figures show the mechanical layout of the function keys and switches on the machine control panel for the SINUMERIK 880T and 880M. The function of the individual operator controls is stated in the tables on the following pages.



Machine control panel SINUMERIK 880T



Machine control panel SINUMERIK 880M

The numbers 1 to 18 identifying the function keys and switches are written in brackets behind the signal names in the descriptions of the signals.

Operator controls for 880T and 880M

Number	Operator control element
1	Emergency stop switch
2	Mode selection switch
3	Single block changeover switch
4	Spindle speed override switch
5	Feedrate/rapid traverse override switch
6	NC ON key
7	Keyswitch
8	RESET key
9	NC stop key (program hold)
10	NC start key (program start)
11	Spindle stop key
12	Spindle start key
13	Feed hold key
14	Feed start key

Operator controls for 880T

Number	Operator control element
15	Handwheel selector switch
16	Direction keys, rapid traverse key
17	Expansion submodule double slide (Option, an auxiliary axes expansion submodule can also be located here)
18	Serial interface

Operator controls for 880M

Number	Operator control element
15	Axis selector switch
16	Direction keys, rapid traverse key
17	Expansion submodule auxiliary axes
18	Serial interface

4.1 Machine control panel signals 880T

Notes:

- The MODE SELECTION SWITCH, NC STOP, NC START, KEYSWITCH, SINGLE BLOCK and SPINDLE SPEED and FEEDRATE OVERRIDE SWITCHES can be transferred to the NC/PLC interface with FB 78.
- The DIRECTION KEYS and RAPID TRAVERSE can be transferred with FB 67.
- Address m is derived from the position of the selector switch on the I/O submodule and the initial address of the operator panel inputs in the PLC machine data (PLC I: MD 0006, PLC II: MD 0106).

SPINDLE OVERRIDE SWITCH (4) **IB m, bit 4 to 7**

The position of the spindle speed override switch is indicated in the SPINDLE OVERRIDE SWITCH signals by the following 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

Note:

The percentage values given in the table are standard values which are stored as machine data. They can be changed if required.

MODE SELECTION SWITCH (2) — IB m, bit 0 to 3

The position of the mode selection switch is indicated in the MODE SELECTION SWITCH signals by the following code:

Position	Code D	C	B	A	Operating mode
1	0	0	0	1	PRESET
2	0	0	1	1	MDA
3	0	0	1	0	MDA
4	0	1	1	0	KONV
5	0	1	1	1	INCR 1
6	0	1	0	1	INCR 10
7	0	1	0	0	INCR 100
8	1	1	0	0	INCR 1000
9	1	1	0	1	INCR 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 MODE SELECTION SWITCH signals can be transferred to the NC/PLC interface with FB 78.

DIRECTION KEYS X +, X - (16) — IB m+1, bit 6 and 7

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

RAPID TRAVERSE (16) — IB m+1, bit 5

1 signal: Rapid traverse key pressed.
0 signal: Rapid traverse key not pressed.

DIRECTION KEYS C +, C - (16) — IB m+1, bit 3 and 4

1 signal: Key C + or C - pressed.
0 signal: Key C + or C - not pressed.

HANDWHEEL (15) **IB m+1, bit 0 and 1**

The position of the handwheel selector switch is indicated by the following code:

Position	Code B A	Meaning
X axis	0 0	Handwheel active in X axis
C axis	0 1	Handwheel active in C axis
Z axis	1 0	Handwheel active in Z axis

Note:
A "HANDWHEEL ACTIVE" bit has to be set at the axis-specific interface (DB 32) in accordance with the code.

DIRECTION KEYS Z +, Z - (16) **IB m+2, bit 6 and 7**

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

SPINDLE ON (12) **IB m + 2, bit 5**

1 signal: Spindle start key pressed.
0 signal: Spindle start key not pressed.

***SPINDLE OFF (11)** **IB m + 2, bit 4**

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

FEED ON (14) **IB m + 2, bit 3**

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

***FEED OFF (13)** **IB m + 2, bit 2**

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

---

* *Signal is 0 active*

NC START (10) IB m+2, bit 1

1 signal: NC START key pressed.
0 signal: NC START key not pressed.

***NC STOP (9) IB m+2, bit 0**

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

RESET (8) IB m+3, bit 7

1 signal: RESET key pressed.
0 signal: RESET key not pressed.

KEYSWITCH (7) IB m+3, bit 6

1 signal: Keyswitch in position 1.
0 signal: Keyswitch in position 0.

SINGLE BLOCK (3) IB m+3, bit 5

1 signal: SINGLE BLOCK switch in position 1.
0 signal: SINGLE BLOCK switch in position 0.

---

* *Signal is 0 active*

FEEDRATE OVERRIDE SWITCH (5) **IB m+3, bit 0 to 4**

The position of the feedrate/rapid traverse override switch is indicated in the FEEDRATE OVERRIDE SWITCH signals by the following (Gray) code:

Position	Code E	D	C	B	A	Override value in %
1	0	0	0	0	1	0
2	0	0	1	1	0	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 other machine data can be entered subsequently if required. This also enables code switches with 31 positions to be evaluated and simulated by the PLC user program.
- The FEEDRATE OVERRIDE SWITCH signals can be transferred to the PLC/NC interface with FB 78.

4.2 Machine control panel signals 880M

Notes:

- The MODE SELECTION SWITCH, NC STOP, NC START, KEYSWITCH, SINGLE BLOCK and FEEDRATE OVERRIDE SWITCHES can be transferred to the NC/PLC interface with FB 78.
- Address m is derived from the position of the selector switch on the I/O submodule and the initial address of the operator panel inputs in the PLC machine data (PLC I: MD 0006, PLC II: MD 0106).

SPINDLE OVERRIDE SWITCH (4) **IB m, bit 4 to 7**

The position of the spindle speed override switch is indicated in the SPINDLE OVERRIDE SWITCH signals by the following code:

Position	Code D	C	B	A	Override value in %
1	0	0	0	0	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

Note:

The percentage values given in the table are standard values which are stored as machine data. They can be changed if required.

MODE SELECTION SWITCH (2) **IB m, bit 0 to 3**

The position of the mode selection switch is indicated in the MODE SELECTION SWITCH signals by following code:

Position	Code D	C	B	A	Override value in %	
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	INCR	10
7	0	1	0	0	INCR	100
8	1	1	0	0	INCR	1000
9	1	1	0	1	INCR	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 MODE SELECTION SWITCH signals can be transferred to the PLC/NC interface with FB 78.

DIRECTION KEYS+, - (16) **IB m+1, bit 6 and 7**

1 signal: Key + or - pressed.
0 signal: Key + or - not pressed.

RAPID TRAVERSE (16) **IB m+1, bit 5**

1 signal: Rapid traverse key pressed.
0 signal: Rapid traverse key not pressed.

AXIS SELECTION SWITCH (15) **IB m + 1, bit 0 to 4**

The position of the axis selection switch is indicated in the AXIS SELECTION SWITCH signals by the following (Gray) code:

Position	Code E	D	C	B	A	Selected axis
1	0	0	0	0	1	X- axis
2	0	0	0	1	1	Y- axis
3	0	0	0	1	0	Z- axis
4	0	0	1	1	0	4th axis
5	0	0	1	1	1	5th axis
6	0	0	1	0	1	6th axis
7	0	0	1	0	0	7th axis
8	0	1	1	0	0	8th axis
9	0	1	1	0	1	9th axis
10	0	1	1	1	1	10th axis
11	0	1	1	1	0	11th axis
12	0	1	0	1	0	12th axis
13	0	1	0	1	1	13th axis
14	0	1	0	0	1	14th axis
15	0	1	0	0	0	15th axis
16	1	1	0	0	0	16th axis

Notes:

- These signals select the axis in which the handwheel and the + and - direction keys are to be effective.
- FB 79 evaluates the AXIS SELECTION SWITCH signals and transfers the DIRECTION KEYS and RAPID TRAVERSE signals to the interface of the selected axis.

SPINDLE ON (12) **IB m + 2, bit 5**

1 signal: Spindle start key pressed.
0 signal: Spindle start key not pressed.

***SPINDLE OFF (11)** **IB m + 2, bit 4**

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

* *Signal is 0 active*

FEED ON (14)	**IB m + 2, bit 3**

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

***FEED OFF (13)**	**IB m + 2, bit 2**

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

NC START (10)	**IB m+2, bit 1**

1 signal: NC START key pressed.
0 signal: NC START key not pressed.

***NC STOP (9)**	**IB m+2, bit 0**

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

RESET (8)	**IB m+3, bit 7**

1 signal: RESET key pressed.
0 signal: RESET key not pressed.

KEYSWITCH (7)	**IB m+3, bit 6**

1 signal: Key operated switch in position 1.
0 signal: Key operated switch in position 0.

SINGLE BLOCK (3)	**IB m+3, bit 5**

1 signal: SINGLE BLOCK switch in position 1.
0 signal: SINGLE BLOCK switch in position 0.

* *Signal is 0 active*

FEEDRATE OVERRIDE SWITCH (5) IB m+3, bit 0 to 4

The position of the feedrate/rapid traverse override switch is indicated in the FEEDRATE OVERRIDE SWITCH signals by the following (Gray) code:

Position	Code E	D	C	B	A	Override value in %
1	0	0	0	0	1	0
2	0	0	1	1	0	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 standard values which are stored as machine data. They can be changed if required.
  The switch positions without values in the table are not used with the machine control panel (the override switch has only 23 positions). The machine data are available for other code switches with up to 31 positions.
- The FEEDRATE OVERRIDE SWITCH signals can be transferred to the PLC/NC interface with FB 78.

4.3 Double slide expansion key group

HANDWHEEL (15) **IB m+4, bit 7, IB m+5, bit 1**

The position of the handwheel selector is indicated in the HANDWHEEL signals by the following code:

Position	Code B	Code A	Meaning
X axis	0	0	Handwheel active in X axis
C axis	0	1	Handwheel active in C axis
Z axis	1	0	Handwheel active in Z axis

Note:

A "HANDWHEEL ACTIVE" bit has to be set at the axis-specific interface (DB 32) in accordance with the position of the handwheel selctor switch.

DIRECTION KEYS X +, X - (16) **IB m+4, bit 5 and 6**

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

DIRECTION KEYS Z +, Z - (16) **IB m+4, bit 3 and 4**

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

RAPID TRAVERSE (16) **IB m+4, bit 2**

1 signal: Rapid traverse key pressed.
0 signal: Rapid traverse key not pressed.

DIRECTION KEYS C +, C - (16) **IB m+4, bit 0 and 1**

1 signal: Key C + or C - pressed.
0 signal: Key C + or C - not pressed.

Note:

The DIRECTION KEYS and RAPID TRAVERSE signals can be transferred to the PLC/axis interface with FB 67.

4.4 Auxiliary axes expansion key group

DIRECTION KEYS +, – (16) **IB m+4, bit 6 and 7**

1 signal: Key + or - pressed.
0 signal: Key + or - not pressed.

RAPID TRAVERSE (16) **IB m+4, bit 5**

1 signal: Rapid traverse key pressed.
0 signal: Rapid traverse key not pressed.

AXIS SELECTION SWITCH (15) **IB m+4, bit 0 to 4**

The position of the axis selection switch is indicated in the AXIS SELECTION SWITCH signals by the following (Gray) code:

Position	Code E	D	C	B	A	Selected axis
1	0	0	0	0	1	1st axis
2	0	0	0	1	1	2nd axis
3	0	0	0	1	0	3rd axis
4	0	0	1	1	0	4th axis
5	0	0	1	1	1	5th axis
6	0	0	1	0	1	6th axis
7	0	0	1	0	0	7th axis
8	0	1	1	0	0	8th axis
9	0	1	1	0	1	9th axis
10	0	1	1	1	1	10th axis
11	0	1	1	1	0	11th axis
12	0	1	0	1	0	12th axis
13	0	1	0	1	1	13th axis
14	0	1	0	0	1	14th axis
15	0	1	0	0	0	15th axis
16	1	1	0	0	0	16th axis

Notes:

- These signals select the axis in which the handwheel and the + and - direction keys are to be effective.
- FB 79 evaluates the AXIS SELECTION SWITCH signals and transfers the DIRECTION KEYS and RAPID TRAVERSE signals to the interface of the selected axis.

4.5 Rapid traverse override expansion key group

RAPID TRAVERSE OVERRIDE **IB m+4, bit 0 to 2**

The position of the rapid traverse override switch is indicated in the RAPID TRAVERSE OVERRIDE signals by the following code:

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:

- The percentage values given in the table are standard values which are stored as machine data. They can be changed if required.
- The rapid traverse override switch codes can be transferred unchanged from input byte m + 4 to the PLC/NC interface.
- Rapid traverse override replaces the axis selection switch in the rapid traverse override key group. The other operator controls are deleted.

5 Description of Basic Signals (FY 0 ... FY 24)

5.1 PLC auxiliary signals

FLASHING FREQUENCY 0.5 Hz **FY 0, bit 7**

The system program provides a flashing signal with a frequency of 0.5 Hz in flag F 0.7. The mark-to-space ratio is 1:1.

ONE **FY 0, bit 1**

Flag with defined one signal.

ZERO **FY 0, bit 0**

Flag with defined zero signal.

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

CURRENT OB NO. **FY 1**

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

No.	Allocated OBs [1]		
1	OB 1	Cyclic	program
2	OB 2*	Alarm-controlled	program
3	OB 3	Alarm-controlled	program
4	OB 4	Aperiodic	program
5	OB 5*	Time-controlled	program
6	OB 6	Time-controlled	program
7	OB 7	Time-controlled	program

* These OBs are processed only in special mode (PLC-MD 6051.0=0 for PLC I, 6151.0 for PLC II).

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.*

INITIAL SETTING (OB 1 to OB 7) [1)] **FY 2, bit 1 to 7**

1 signal: A warm restart has taken place. The processing level of the relevant OB is called for the first time after the warm restart.

0 signal: The relevant OB has been fully executed at least once since the last warm restart.

After a PLC warm restart the initial setting signals are set for the duration of the first complete program execution of the relevant processing plane.

After the first complete execution of the relevant processing plane the initial setting signals are reset to zero by the PLC operating system.

Note on application:

These signals can be used to obtain a defined initial setting for program parts after Power On. For example, an initialization routine can be called in every OB depending on the initial setting signals.

Notes:

- Processing level interrupted by Power Off:

  The initial setting signal of the processing plane interrupted by the power failure (e.g. owing to Power Off) is not immediately set with the warm restart. The initial setting signal for this processing level is set after the remaining execution of the processing level so that it is set for the duration of the next execution of the relevant OB.

  The initial setting signal for an OB is not, therefore, set while the relevant processing level is active.

- Several processing levels active with Power Off:

  If several processing levels were active when the program was interrupted (e.g. owing to Power Off), their initial setting signals are not set until the remainder of all the interrupted processing levels has been executed following the warm restart. This is explained in greater detail in the following example.

---

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.*

Example: Time alarm with Power Off

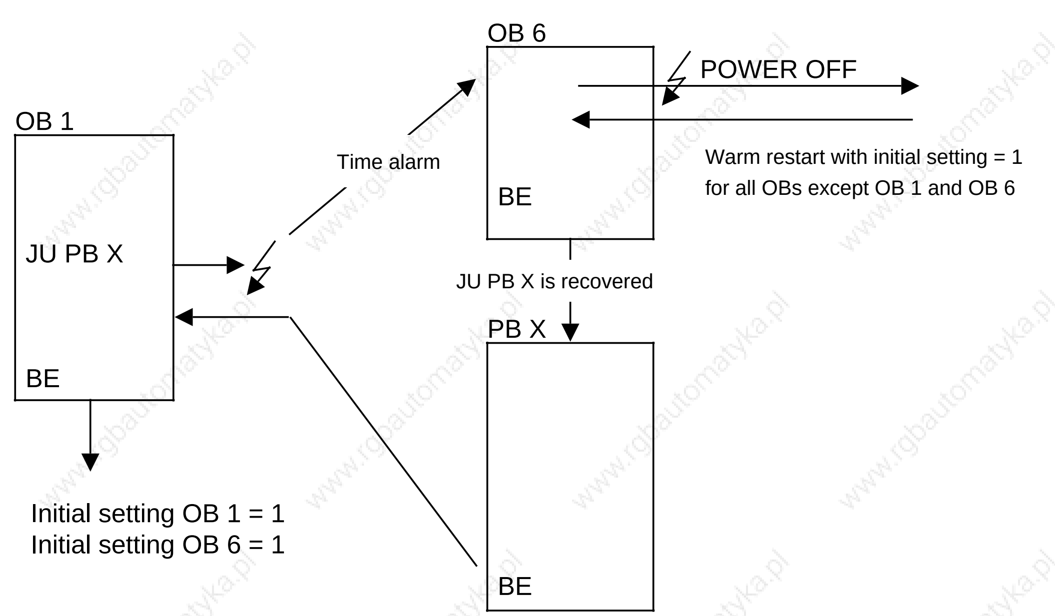
The PLC is operating in normal mode. A branch is made from OB 1 to a program block (in this case represented by PB X).

Situation before warm restart:

A time alarm is present when program block PB X is called. The PLC operating system therefore initially branches to OB 6. While OB 6 is being processed, the power supply to the PLC fails. The processing levels of OB 1 and OB 6 are thus active at the time of the program interrupt caused by the power failure.

Situation on warm restart:

The initial setting signals of all processing levels except OB 1 and OB 6 are set. Program execution is resumed at the interruption point in OB 6. At the end of OB 6, OB 1 is reactivated; that is to say the JU PB X command that was interrupted by the time alarm is first concluded and routed to PB X. After the block end of OB 1 the PLC operating system sets the initial setting signals for OB 1 and OB 6.



The initial setting signals of the processing levels interrupted by Power Off (OB 1 and OB 6 in this example) are not set until their remainder has been executed.

Setting initial setting signals on warm restart, example with interrupted time alarm

COLD RESTART (OB1 to OB7, OB20) FY 3

1 signal: After initiation of cold restart by PLC operator.

0 signal: After first complete processing of the relevant block.

Note on application:

Using this signal, program parts can be put into a defined initial state after a cold restart. After a cold restart, data records usually also have to be normalized (in contrast to warm restart) because the PLC has very often been generally reset before a cold restart. The cold restart signals indicate a preceding cold restart during initial state processing; i.e. they remain set until the relevant processing time has been fully executed for the first time following a cold restart.

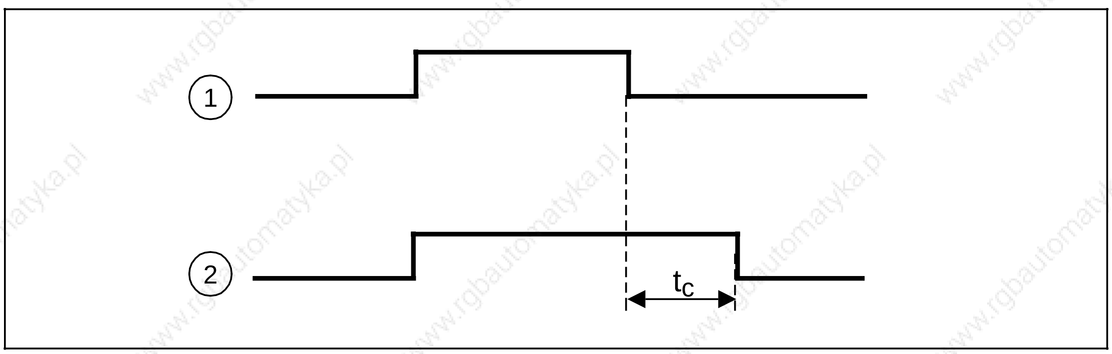
Note on OB 20

The OB 20 has its own cold restart signal. If the signal is zero, this means that the OB 20 was called in the warm restart branch. If the OB 20 is interrupted in the warm restart branch with F 3.0 = 0 (i.e. OB 20 undergoing warm restart), the initiated command sequence is not continued. Instead, the OB 20 is executed again from the beginning with a cold restart (F 3.0 = 1).

PARAMETER TEST (OB1 to OB7) FY 4, bit 1 to 7

1 signal: a) After warm restart
b) After cold restart
c) After a transfer of blocks from the programmer to the PLC

0 signal: a) After first complete processing of the plane concerned following a warm or cold restart.
b) After completion of data transfer from the programmer to the PLC **and** complete processing of the relevant organization block.



Signal chart for block transfer

1 Block transfer from the programmer to the PLC
2 PARAMETER TEST (t_c = PLC cycle time)

Note on application:

After a cold or warm restart and after the PG has transferred blocks during operation, the parameterization of the function blocks may have been modified.

The PARAMETER TEST signals for OB 1 to OB 7 allow the parameters to be checked exclusively for possible changes. This restricted parameter test reduces the processing time of a block during normal operation.

Example:

```
:
AN F 4.1
JC=FORT
:
Test routine
:
```

ADDRESSING ERROR RECOGNITION	FY 5, bit 7

1 signal: Addressing error recognition selected.
0 signal: Addressing error recognition not selected.

Note:

Addressing error recognition can be switched in function blocks with the S-5 commands RAE and IAE.

SEGMENT OVERRANGE WITH BLOCKS	FY 5, bit 6

1 signal: Segment overrange with blocks permitted.
0 signal: Segment overrange with blocks not permitted.

Since a block can be located outside the segment limits from SW 6 onwards, not only the offset address but also the segment number has to be taken into account with absolute address calculation.

PLC OPERATION (PLC I, PLC II) 1)	FY 5, bit 0 and 1

Bit 0=1: PLC I selected (programmer in on-line mode or PLC status of the NC).
Bit 1=1: PLC II selected (programmer in on-line mode or PLC status of the NC).

PROCESSING DELAY (OB 2 to OB 7)	FY 6, bit 2 to 7

1 signal: Processing delay effected by the relevant OB.
0 signal: No meaning.

Note:

If time or process-alarm controlled program execution is called again before it has been completed, the system program sets the relevant PROCESSING DELAY bit (depending on PLC MD 6048 for PLC I). These bits are reset with a cold or warm restart. When the bit is set the corresponding event counter processing delay in the diagnostics DB (DW 1, DW 22 to DW 27) is incremented by one[d].

---

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.*

d) *with GA2, software version 1 and higher*

The user can set bits within MD 6048 in accordance with the OB No. (except OB 1). If he sets bit 4 and bit 5, for example, the system program causes the control to assume stop status in the event of a processing delay activated by OB 4 or OB 5; however, the relevant bits in FY 6 are not set. A processing delay activated by the other OBs does not lead to the stop condition; instead, the bit corresponding to the OB No. in FY 6 is set.

GROUP MESSAGE LIM/SIM	**FY 6, bit 1**

1 signal: One or several bits in DB 1 "Lost requests during LIM/SIM OB 2 ... OB 7" are set.
0 signal: No bits set in DB 1 "Lost requests during LIM/SIM OB 2 ... OB 7" are set.

I/O DEVICES NOT READY	**FY 6, bit 0**

(not with S5-155U)

1 signal: One or several I/O groups are unclear.
0 signal: No meaning.

This signal is significant when operating with two PLCs in cases where the I/Os have been declared distributed or global [c] by means of PLC MD. Information on which I/O groups are not ready is entered in DB 1.

By dividing the I/O modules into groups, it is possible to discriminate in the event of I/O faults (e.g. failure of a module). The PLC machine data can be used to divide the I/Os into "important" and "unimportant" groups, thus giving rise to different reactions to a fault. In the event of a fault, either cyclic operation of the PLC can be continued and the user receives a message to this effect or the PLC can enter the STOP mode.

User messages are stored in DB 1, with one bit provided for each I/O group. In the basic signal flag area (F 6.0), the user is told whether a message has been entered in DB 1. Entries are made only for groups actually assigned to the PLC by means of machine data.

5.2 PLC ready signals

PLC CPU READY (PLC I, PLC II) [1]	**FY 7, bit 0 and 1**

1 signal: PLC CPU declared available via machine data **and** PLC CPU cyclically contacts the COM CPU.
0 signal: a) PLC CPU not available according to machine data.
b) PLC CPU failure.

---

1) If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.

c) up to and including software version 6

5.3 Signals for alarm-controlled processing [1)]

INTERRUPT INPUTS	FY 8 to FY 11

1 signal: Signal change at interrupt input.
0 signal: No signal change.

After processing the reaction program (OB 2), the signal change bits must be reset by the user. If this is omitted, the PLC branches to the stop state with a error message (fine error coding F9).

Note:

- Interrupts can be processed only in the special mode of the PLC (PLC-MD 6051.0).
- Interrupts from **either** up to 3 EU-MPC EU interface modules[c)] or up to 3 DMP interface modules can be acquired.
- The fourth interrupt byte (MB 11) is only possible in GA2 with "free configuration".

NEGATIVE EDGE	FY 12 to FY 15

1 signal: A change in signal state from 1 to 0 has occurred at the relevant bit of the alarm byte.

0 signal: Otherwise.

POSITIVE EDGE	FY 16 to FY 19

1 signal: A change in signal state from 0 to 1 has occurred at the relevant bit of the alarm byte.

0 signal: Otherwise.

Notes:

Using PLC MD 124 and 127 (PLC I), the user defines a maximum of 4 contiguous process alarm bytes within the available inputs. The process alarm bytes can be in the range of central or distributed I**/**Os.

The PLC operating system checks the alarm bytes for modifications. If a modification is found, the active program is interrupted either at the block or command limit, depending on the setting of the PLC mode (PLC MD 6051 for PLC I), and OB 3 is called (depending on special**/**normal mode).

The **user interface** for alarm-controlled programs is OB 3.

The operating system stores 0   1 transitions of the alarm byte in FY 16 to FY 19 and the 1   0 transitions in FY 12 to FY 15. The signals are present until the next alarm or cancelled by user. The user can branch his program using the "Signals for alarm processing".

---

1) If using a SIMATIC S5-155U, see SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.

c) up to and including software version 6

If, for example, the inputs I 0.0 to I 0.7 are interrogated in the processing program, the following instructions must be programmed, e.g. at the **start** of the alarm program: (I/O scan and PII update):

```
: L    PY 0
: T    IB 0
```

If outputs have to be switched off because of an alarm, these must be output to the process I/Os at the end of the OB 3 (example):

```
: L    QB 5
: T    PY 5
```

Example of application

Program branching depending on the activating signal change, e.g. in IB 0.

```
:
A      F12.0
JC     PB 5
A      F16.0
JC     PB 6
:
```

5.4 NC ready signals

OPERATOR PANEL 1-3 READY	**FY 20, bit 0 to 3**

1 signal: The relevant operator panel is declared available via machine data **and** cyclically contacts the COM CPU.

0 signal: a) Operator panel not available according to machine data.
b) Operator panel failure.

INTERFACE CL 1, 2	**FY 21, bit 6 and 7**

1 signal: The computer link module is available and cyclically contacts the PLC CPU.

0 signal: a) Computer link module not available.
b) Computer link module failure.

COM CPU READY	**FY 21, bit 0**

1 signal: COM CPU cyclically contacts the PLC.
0 signal: COM CPU failure.

MANUAL SELF-INSTALLATION[c)]	**FY 22, bit 7**

1 signal: The interactively operated variant of the self-installation function of the integrated drive control (IAR) is active.

0 signal: Manual self-installation is not active.

Notes:

- In the self-installation mode, the PLC operating system ignores the FEED DISABLE and SERVO ENABLE interface signals. The PLC operating system itself generates these signals for self-installation.
- With self-installation of the integrated drive control, the PLC user program must operate or simulate the axis brakes (see RELEASE SI BRAKE).
- The PLC user program can abort the self-installation with the SI SAFETY SIGNAL if necessary.

---

c) up to and including software version 6

AUTOMATIC SELF-INSTALLATION[c)]	**FY 22, bit 6**

1 signal: Automatic self-installation of the integrated drive control is active.
0 signal: Automatic self-installation is not active.

Notes:

See the notes on MANUAL SELF-INSTALLATION[c)].

NC CPU READY	**FY 22, bit 0 to 3**

1 signal: NC CPU declared available via machine data **and** NC CPU cyclically contacts the COM CPU.

0 signal: a) NC CPU not available according to machine data.
b) NC CPU failure.

SERVO CPU READY	**FY 23, bit 0 to 3**

1 signal: The relevant servo CPU is declared available via machine data **and** cyclically contacts the COM CPU.

0 signal: a) Servo CPU not available according to machine data.
b) Servo CPU failure.

Notes:

- In the event of failure of an operator panel, NC CPU, Servo CPU or PLC CPU, System 880 assumes the "Not ready" state; i.e. the drives are stopped, the NC READY hardware signal is cancelled and the NC/PLC interface is no longer processed. If emergency operation is required despite a CPU failure, the machine data for the relevant CPU has to be cancelled (NC MD 5030 - 5038). The system can then be restarted.
- No operation is possible in the event of COM CPU failure; the PLC also assumes the stop state.
- See also CPU FAILURE signal.

Examples of application:

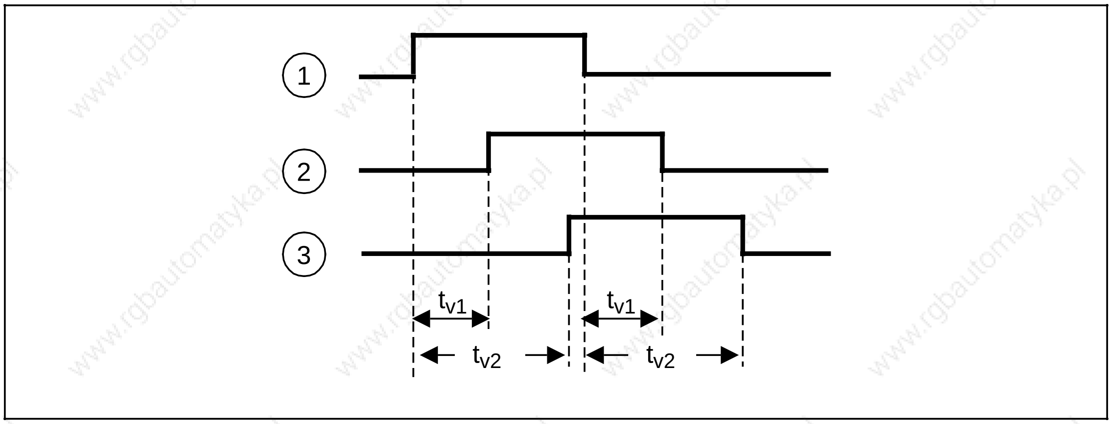
- Activation of alternative strategies in the event of CPU failure.
- Branches in the PLC program depending on the number of NC CPUs.

c) up to and including software version 6

5.5 Individual signals

PROBE SELECTED	**FY 24, bit 6 and 7**

1 signal: Probe selected
0 signal: Probe not or no longer selected



1: Probe signal at NC input
2: Recognition of probe signal in NC (t_{v1} at least 300 ns)
3: PROBE SELECTED signal at interface (t_{v2} approx. 20 ms)

Notes:

- To permit output of the interface signal, the probe has to give the signal for at least one PLC cycle otherwise the "Probe selected" signal cannot be scanned by the user. The probe signal has the following effects:
  a) Delete distance to go
  b) The momentary position of the axes is immediately stored in the intermediate memory and transferred from there to R parameters that can be interpreted by NC cycles. The address of the R parameters can be preset by the NC cycle.
- By means of hardware jumpering on the link RAM, it can be established whether the probe is treated as an NC or NO contact.
- The probe must be activated for the NC by the CL 800 command "MEAS M".

Example of application:

Checking proper operation of the probe before measuring.

NC ALARM CAUSES PROCESSING STOP	**FY 24, bit 5**

1 signal: At least one NC alarm, comprising block- or sequence-related alarms from all channels, with the effect of stopping processing by the control is active.

0 signal: No NC alarm to stop processing is currently active.

CPU FAILURE — FY 24, bit 4

1 signal: Failure of operator panel, COM CPU, NC CPU, Servo CPU or PLC CPU during operation.

0 signal: No CPU failure.

Example of application:

To initiate orderly machine stoppage in the event of CPU failure.

INSTALLATION MODE FOR S5-155U — FY 24, bit 3

1 signal: SINUMERIK 880 is in installation mode.
0 signal: SINUMERIK 880 is in normal mode.

Notes:

- SINUMERIK 880 branches into installation mode only by appropriate operation (selection switch position 1 on the COM-CPU).
- During INSTALLATION machine data, etc., can be entered.
- The NC**/**PLC interface is **not** processed, so it is a good idea to call program parts, such as the FB 61**/**62 or tool management (FB package 1) conditionally depending on this bit.
- Reciprocal CPU monitoring is not active during installation.

*TEMPERATURE FAULT — FY 24, bit 2

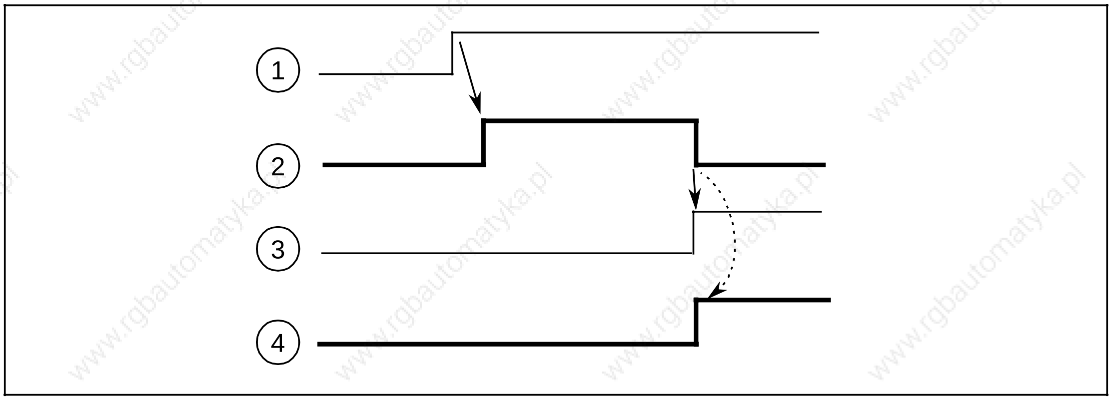
1 signal: After Power On and build-up of all voltages.
0 signal: Temperature limit exceeded in the SINUMERIK.

Example of application:

Output of READ-IN DISABLE with the 0 signal; the current NC block is executed to the end. The next program block is not executed.

---

* *Signal is 0 active*



1: Mains voltage
2: *TEMPERATURE FAULT
3: Warning signal
4: READ-IN DISABLE

BATTERY FAULT	**FY 24, bit 1**

After Power On, the voltage of the installed batteries is cyclically checked for compliance with a permissible lower limit. This permits a battery failure to be identified in good time during extended periods of NC operation (in the power supply unit).

1 signal: Battery voltage below limit value.
0 signal: Battery voltage above lower limit value.

Note:

The NC should always be switched on when the battery is being changed, to avoid data loss due to the absence of memory back-up.

NC ALARM ACTIVE	**FY 24, bit 0**

1 signal: At least one NC alarm is active. (block or sequence related alarm).

0 signal: No NC alarm.

5.6 Diagnostics (DB 1)

(Not with S5-155U)

CURRENT CYCLE TIME	**DW 0**
MINIMUM CYCLE TIME	**DW 1**
MAXIMUM CYCLE TIME	**DW 2**

In these data words, the cycle time (time that the PLC program requires for one program pass) is displayed in msec in KF format. These values are deleted on every time the PLC is started up (cold and warm restart). Use of FB 12 falsifies these values.

IDENTIFICATION OF THE TYPE OF I/O d)	**DW 10**

You can enter the following I/O identifications in the diagnostics DB:

01: central I/O, TPx, LPx
03: 16-bit link (INT EU/16B)
04: DMP interface module (interface DMP)

INPUT I/O GROUP NOT READY	**DW 12, bit 0 ... 15** **DW 13, bit 0 ... 3**
OUTPUT I/O GROUP NOT READY	**DW 14, bit 0 ... 15** **DW 15, bit 0 ... 3**

1 signal: The I/O group corresponding to the set bit is not ready.
0 signal: No I/O group malfunction.

Notes:

- One I/O group comprises 8 bytes of address space in the I/O area.
- An error is also identified if the I/O device has changed, that is to say if the I/O device identified by the PLC does not correspond to the I/O device anticipated according to the information in the machine data. This situation can occur, for instance, if modules are rearranged.
- Also see signal description for FY 6, bit 0.

NUMBER OF LOST **REQUESTS DURING LIM/SIM (OB 2 ... OB 7)**	**DW 16 ... DW 21**

A program section can be protected against interrupts caused by program levels OB 2 to OB 7 by means of the Step-5 commands LIM and SIM. In this context the PLC user program disables the processing of requests for OBs that could interfere with the program section.

---

d) with GA2, software version 1 and higher

The PLC operating system counts the number of requests for a disabled OB. When the PLC user program enables processing of the OBs again, the PLC operating system checks whether the disabled OB was requested in the intervening period. A distinction is made between the following cases:

Disabled OB not requested during processing disable.

No special measures are necessary in this case.

Disabled OB requested once during processing disable.

In this case the disabled OB is activated now, when processing is enabled. Therefore, no request for the OB has been lost.

Disabled OB requested several times during processing disable.

The most recent request for the OB during the processing disable can now be implemented; the OB is activated. First of all the number of lost requests for the OB is entered in the relevant data word, DW 16 ... DW 21, in DB 1. Stated more accurately, the number is added to the contents of the data word.

With reference to the counter contents in NUMBER OF LOST REQUESTS OB 2 ... OB 7, the PLC user program can therefore determine, for example, whether time slices or interrupts have been lost and then trigger appropriate reactions as necessary.

Notes:

The counter contents in NUMBER OF LOST REQUESTS OB 2 ... OB 7 are not reset by the PLC operating system; where applicable, the PLC operating system adds new values to the current counter contents. The PLC user program can reset the counter contents in NUMBER OF LOST REQUESTS OB 2 ... OB 7 to zero if required.

EVENT COUNTER PROCESSING TIMEOUT[d)]	
TIMEOUT IN OB 2 TO OB 7	**DW 22...DW 27**

If an processing timeout occurs in OB 2 to OB 7 and no stop is set in PLC MD 6048 (PLC I), the appropriate bit is set in flag byte FY 6 and the associated event counter is incremented by one. No overflow is detected.

INPUT BYTE NOT READY[d)]	**DW 30...DW 45**
OUTPUT BYTE NOT READY[d)]	**DW 46...DW 61**

1-signal: An error was detected in an I/O byte.
0-signal: No fault in the I/O byte.

See also the description of the signal INPUT/OUTPUT GROUP NOT READY.

IMAGE OF THE STATUS REGISTERS OF THE DMP MODULES[d)]	**DW 70...DW 159**

If a DMP interface module initiates the error message "I/O fault on start-up", the images of the status register of the DMP modules are transferred to the diagnostics DB starting from DW 70.

d) with GA2, software version 1 and higher

Assignment of the status registers:

Bit	Meaning
0	DEZNAU
1	Wire-break
2	Transmission error
3	Overtemperature
4	OUTDS
5	Change of configuration input
6	Change of configuration output
7	Module started

Detailed error coding in diagnostics DB (DB 1)

In order to display the PLC detailed error coding on the NC screen ERRCODE error numbers and the supplementary error data in the diagnostics DB (DB 1) are stored in the data words 160 to 163[c] or DW 160 to 164[d] (equivalent to PG function OUTPUT ADDR:PLC, F0000). The contents of ACCU 1 and ACCU 2 (low words) are stored in data words 166 and 167[d].

	Diagnostics DB DB 1		Same as address with OUTPUT ADDR:PLC
DW 160		Error number	F0000
DW 161	Supplementary error data	1st word	F0001
DW 162	Supplementary error data	2nd word	F0002
DW 163	Supplementary error data	3rd word	F0003
DW 164	Supplementary error data	4th word[d]	F0004
DW 165	Spare		
DW 166	ACCU 1, Low word[d]		
DW 167	ACCU 2, Low word[d]		

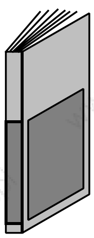
c) up to and including software version 6
d) with GA2, software version 1 and higher

Example:

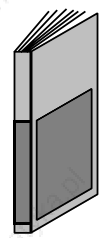
Diagnostics DB
DB 1

DW 160		00 79 H
DW 161	00 00 H	
DW 162	00 00 H	
DW 163	00 00 H	
DW 164	00 00 H	

00 79 H means PLC stop by means of mode selection switch. No supplementary error data exist for this error.



An explanation of detailed error coding is contained in "Installation Guide, Lists".



Software versions and slot numbers[d)]

The software version and the version number of the PLC software in DW 168 are stored in the diagnostics DB.

The software version and the version number of the interface DMP firmware, the module code and the slot number (hexadecimal) of EU interface modules 1 to 3 are stored in DW 170 to DW 175.

The PLC operating system enters the module code as a binary number in the following form:

1010 01xx DMP interface module (interface DMP)
0110 11xx SIMATIC input/output module INT EU/16B
(xx hardware version)

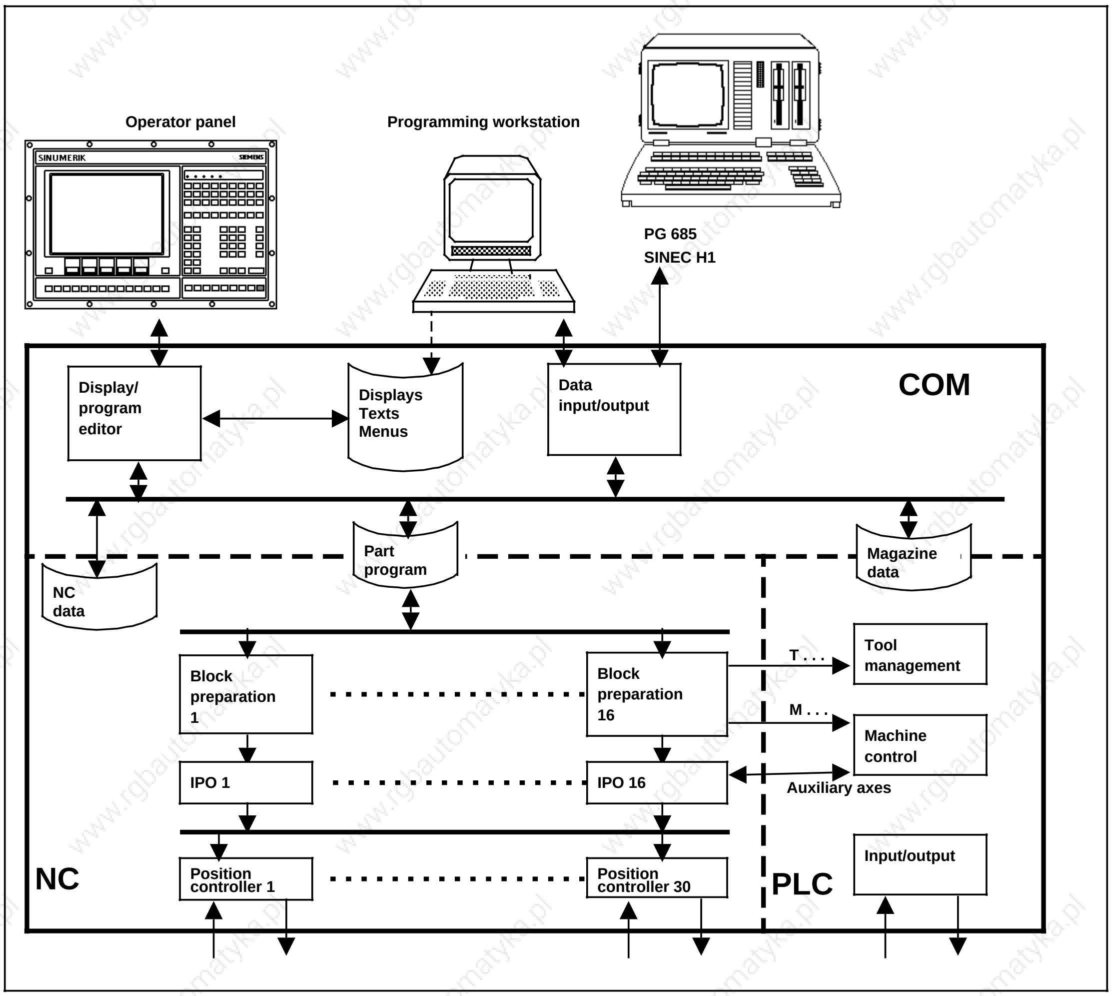
d) with GA2, software version 1 and higher

6 NC Channel/PLC Interface (DB 10 ... DB 25)

6.1 Introduction to channel structure

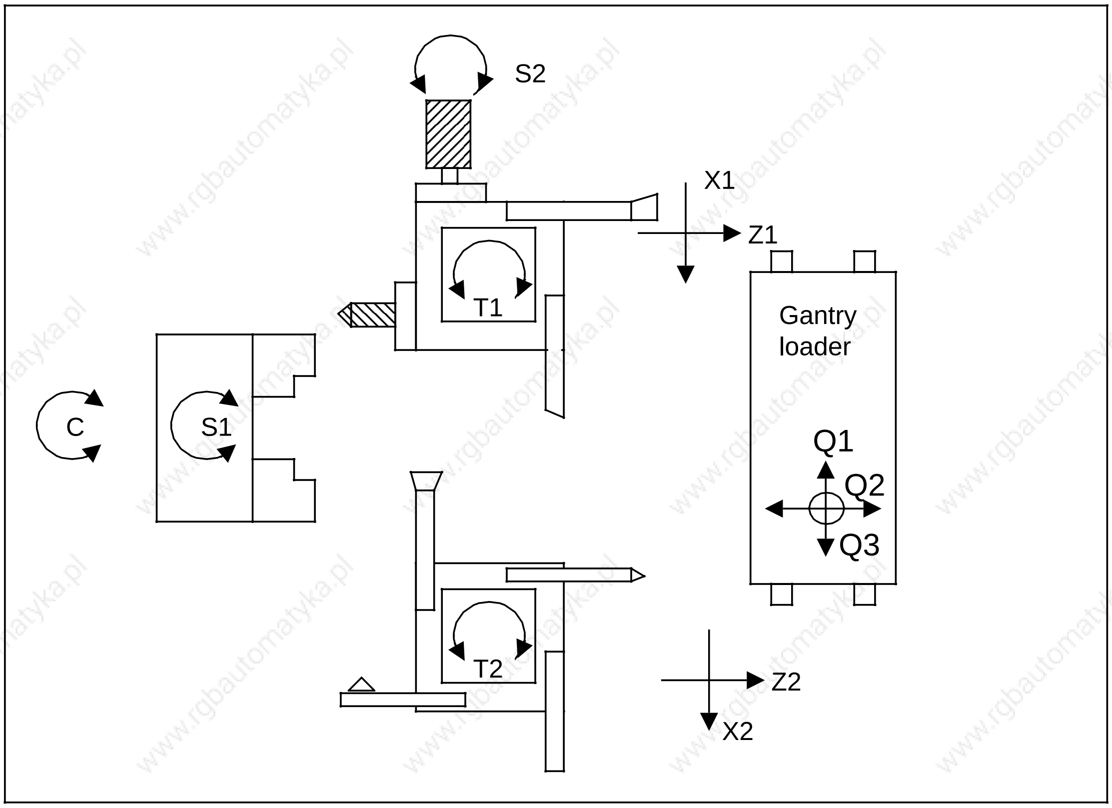
Simultaneous working with several tools and the integration of loaders in the machine tool increase the number of numerically controlled axes many times compared with conventional standard machines. The SINUMERIK 880 can thus be expanded to comprise 30 measuring cycles for allocation to axes, work spindles and/or auxiliary axes as required. The maximum number of work spindles is restricted to six.

In accordance with the machine configuration, the NC axes of the tool slides, the work spindles and the loader are amalgamated in the form of **axis groups**. Each axis group is allocated an independent interpolator with associated program processing, called a **channel**. The SINUMERIK 880 may have up to 16 autonomous channels (see figure below).
On GA2, software version 1 and higher, you can only select up to eight channels out of 16.



Functional structure SINUMERIK 880

A single-spindle, double-slide lathe with milling unit, NC-controlled tool turrets and integral loader is used in the following to illustrate the application of a channel structure. The following figure is a schematic representation of this configuration.

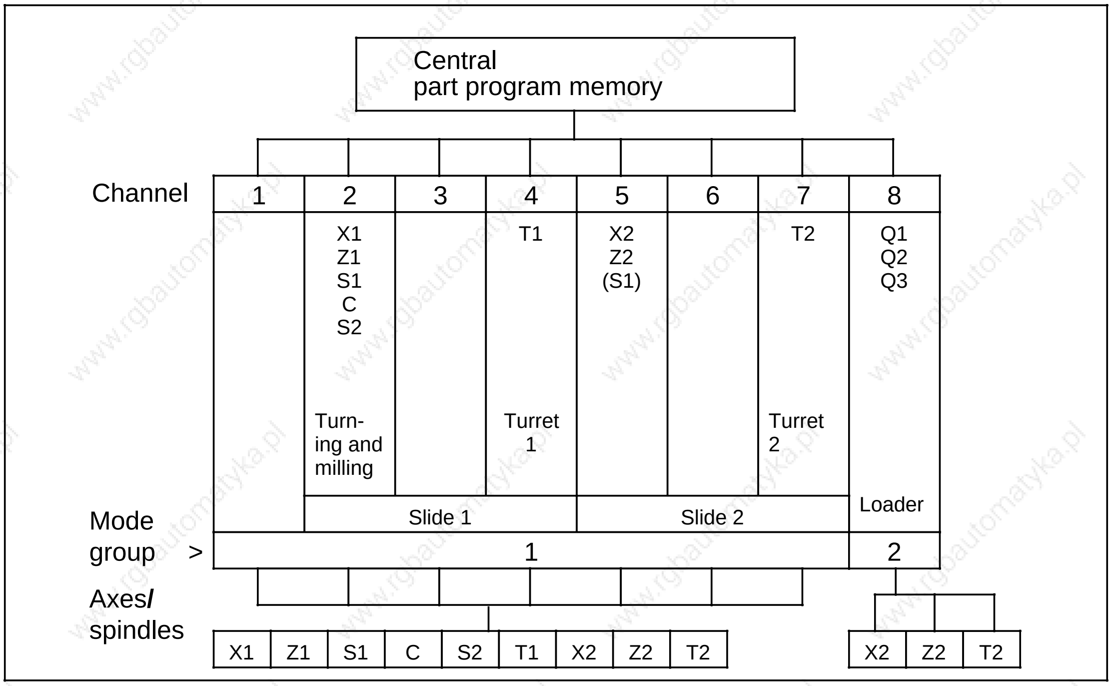


Schematic representation of a single-spindle, double-slide lathe for turning/milling with integral loader

The machine units

- Slide 1, main spindle, auxiliary spindle
- Turret 1
- Slide 2
- Turret 2, and
- Loader

are allocated to the channels of the SINUMERIK 880 as illustrated in the following figure.



Channel structure: programmable allocation of channels

In addition to the processing channels in which the programs controlling the machine units run, additional channels can be allocated special tasks. In this case, channels 3 and 6 control the execution of save programs that can be run by the user after a tool breakage, enabling him to retract and change the tool as well as restart the program. The spare channel 1 is intended for a future coordination program able to control the entire procedure. This program will not necessarily be dedicated to channel 1.

Depending on the workpiece being manufactured, machining programs have to be compiled for reading in the central part program memory.

6.2 Mode groups

The channels are linked in higher-level **mode groups**. A single mode group contains the channels that always have to work simultaneously in the same mode for operational reasons. A maximum of eight mode groups are permitted.

Within the mode group, each axis can be programmed in each channel. In the above example, the loader has been allocated its own mode group. This permits operation of the loader setting-up mode during workpiece production.

The assignment of:

- NC CPU — NC channels
- Servo CPU — Measuring circuit addresses
- NC channels — Mode groups
- NC axes — Mode groups
- Spindles — Mode groups

is effected by way of NC machine data.

6.3 Interface to NC channels

The channel-specific NC/PLC interface is stored in data blocks DB 10 (channel 1) - DB 25 (channel 16).
The PLC machine data bits:

PLC I = MD 6000, 6001
PLC II = MD 6100, 6101

can be set to determine which PLC processes which NC channel.

Note:

On GA2, software version 1 and higher, you can only select up to eight channels out of 16 because no more than two NC CPUs can be used.

When working with two PLCs, the PLC machine data bits:

PLC I = MD 6003, 6004
PLC II = MD 6103, 6104

can be set in addition to determine whether the other PLC can also evaluate to the NC/PLC interface signals.

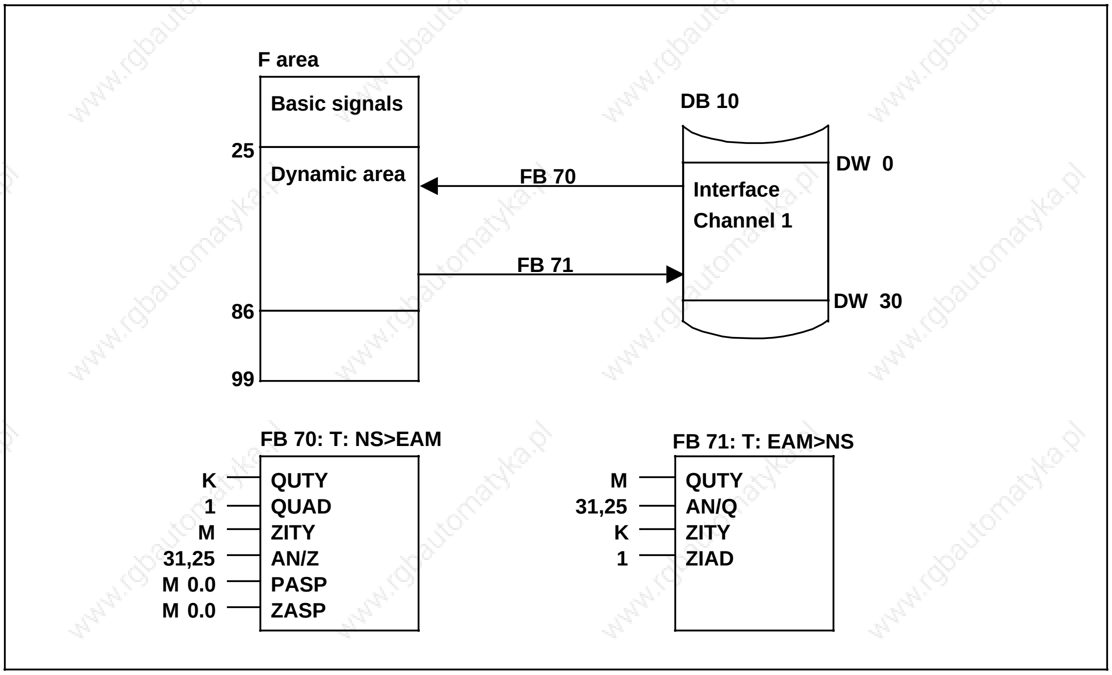
By way of a further PLC machine data:

PLC I = MD 6006, 6007
PLC II = MD 6106, 6107

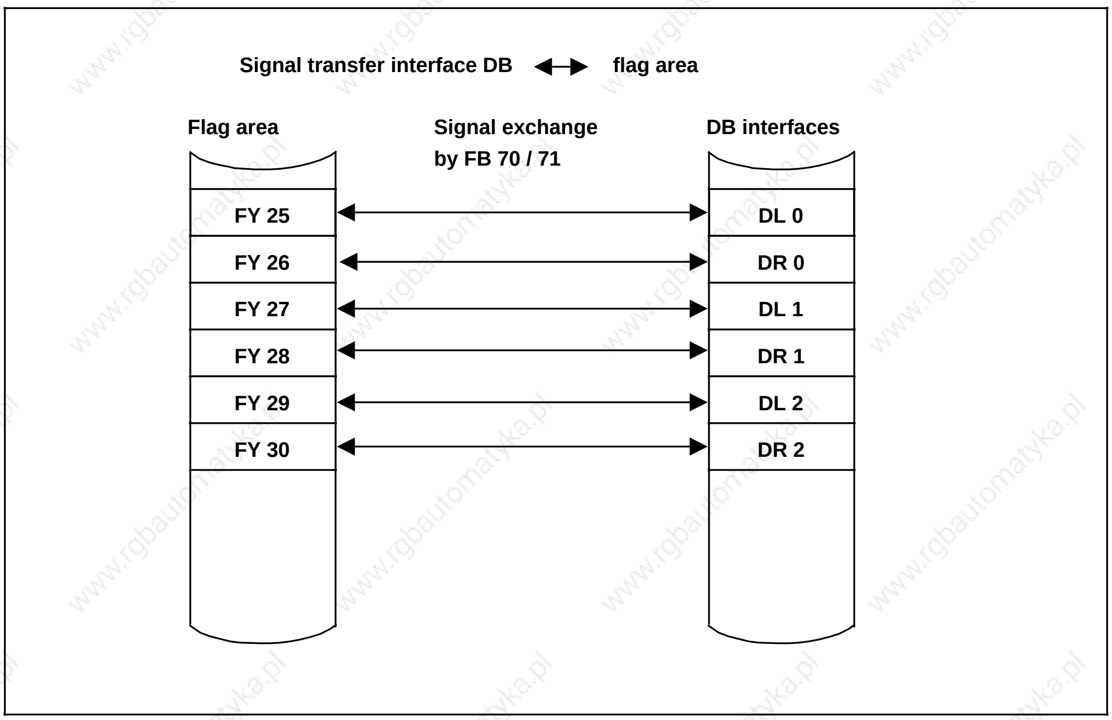
the PLC that can only send the signals on the NC/PLC interface can be set to output the FEED DISABLE and READ-IN DISABLE signals to the NC.

Several bits are available in each case for the signals GENERAL FEED DISABLE, READ-IN DISABLE and NC START DISABLE. If, for example, a different bit is set for each machine function that has to activate feed disable, it is easy to determine which function initiated feed disable in the event of a fault. Each set bit can be allocated a message text so that the operator can be informed of the diagnosis. This function is described in detail in the “Display of messages” Section.

Since signal processing in data blocks is a tedious process, two function blocks (FB 70 and FB 71) are available to permit the exchange of signals between data words and flag words. The following figures show the structural principle of channel allocation and the assignment of data bytes to flag bytes.



Example: Signal exchange between DB 10 and flags



Example: Assignment data bytes flag bytes

The function blocks FB 70 and FB 71 are contained in the PLC operating system.

6.4 Signals to NC channel

6.4.1 Operating modes

DRF ACTIVE	**DW 0, bit 15**

1 signal: Handwheel operation also becomes effective with mode AUT or MDA (differential resolver offset).

0 signal: No handwheel operation possible during AUT or MDA modes.

Notes:

- In the AUT or MDA operating mode, handwheels 1 - 3 (e.g. activated by a keyswitch) can be used to set a permanent path offset. The offset is shown separately and remains effective even with absolute blocks.
- The signal is evaluated by the 1st channel (master channel) of a mode group. The 1st channel of a mode group is defined in NC MD.
- The DRF SELECTED signal (DB 10 - 25, DW 14, bit 9) can be used to make the selection. The signal is transmitted by FB 78.

RESET	**DW 0, bit 14**

1 signal: The mode group is reset; the reset states are set (e.g. with G functions); the alarms of the mode group are cancelled.

0 signal: No effect.

Notes:

- The RESET signal must be given by the PLC (e.g. by the RESET key).
- The signal is interpreted only by the 1st channel (master channel) of a mode group. The 1st channel of a mode group is set by means of NC MD.
- EMERGENCY STOP is not cancelled by RESET. EMERGENCY STOP can be cancelled only by ACKNOWLEDGE EMERGENCY STOP.

MODE SELECTION SWITCH — DW 0, bit 8 to 11

The PLC user program uses this signal to determine the mode in which the channels of a mode group operate.

The mode can be specified, for example, with the selection switch on the machine control panel. The modes are coded as follows:

Mode selection switch 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	INCR 10
7	0	1	0	0	INCR 100
8	1	1	0	0	INCR 1000
9	1	1	0	1	INCR 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)

Notes:

- The modes are interpreted only by the 1st channel (master channel) of the mode group.
- When the operating mode MDA, PRESET or REF is selected, a reset is triggered in the NC.
- The mode change is not effected in the control until all axes of the mode group are at a standstill (exact stop coarse).

6.4.2 Submodes

SKIP BLOCK	**DW 0, bit 7**

1 signal: The blocks marked by an oblique stroke (**/**) in the workpiece program are skipped. If a series of blocks is to be skipped, this signal is effective only if it is present before decoding the first block, preferably before NC Start.

0 signal: No blocks in the part program are skipped. If a series of blocks is to be skipped, they are processed only if the 0 signal is present before decoding the first block.

Note:

The SKIP BLOCK SELECTED signal (DB 10 ... 25, DW 14, bit 15) can be used to make the selection. If applicable the signal is transmitted by FB 78.

SINGLE BLOCK	**DW 0, bit 6**

1 signal: With AUT and MDA operating modes, program execution in single block mode.
0 signal: No effect.

Notes:

- If a train of contour elements is defined in a program block, only one contour element is covered with each start with SINGLE BLOCK selected. If cutter radius compensation is selected, intermediate blocks may be inserted.
- If there is a series of G 33 blocks, SINGLE BLOCK is effective only if DRY RUN FEEDRATE is selected.
- Arithmetic blocks are not processed in the single step mode.
- The individual block function can be allocated an extended function with NC MD 5004 bits 5 and 6 (mode group specific single block). (For further details, refer to Installation Guide.)

DECODING SINGLE BLOCK	**DW 0, bit 5**

1 signal: In operating modes AUT and MDA, execution of **all** program blocks in the single block mode.

0 signal: No effect.

Notes:

- With single block selected, usually only those blocks containing travel movements and/or auxiliary functions are executed block by block. Using the DECODING SINGLE BLOCK signal, pure arithmetic blocks can also be tested in the single block mode.
- The DEC SINGLE BLOCK SELECTED signal (DB 10 ... 25, DW 14, bit 13) can be used to make the selection. If applicable, the signal is transmitted by FB 78.

DRY RUN FEEDRATE **DW 0, bit 4**

1 signal: Traverse is at the dry run feedrate set with a setting data instead of at the programmed feedrate (with G01, G02, G03). The dry run feedrate also applies in place of the revolutional feedrate and the feedrate for thread cutting.

0 signal: Traverse is at the programmed feedrate. If the signal changes to “0” within a G33 block, the programmed feedrate does not become effective until the end of the block.

Note:

The DRY RUN FEEDRATE SELECTED signal (DB 10 ... 25, DW 14, bit 12) can be used to make the selection. If applicable, the signal is transmitted by FB 78.

Example of application:

Testing the workpiece program at increased feedrate.

M01 ACTIVE **DW 1, bit 3**

1 signal: The M01 in the part program leads to programmed stop.
0 signal: The M01 in the part program does not lead to programmed stop.

Note:

The M01 ACTIVE SELECTED (DW 14, bit 11) signal can be used to make the selection. If applicable the signal is transmitted by FB 78.

6.4.3 Feedrate modification

FEEDRATE OVERRIDE ACTIVE **DW 1, bit 13**

1 signal: The selected feedrate override is active channel-specifically.
0 signal: The selected feedrate override is inactive; the 100% override value is stipulated.

Note:

Axis-specific deletion of this signal can be achieved with NC setting data (NC SE 560*.0). This is recommended, for example, if a turret is controlled by an auxiliary axis in the same mode group.

Even if the signal FEEDRATE OVERRIDE = 0 (i.e. the feedrate override is not active), the switch position 1 or the code of position 1 (00001 or 00000) still applies. As soon as this feedrate override code is set again, the feedrate enable is cancelled.

Example of application:

Using the FEEDRATE OVERRIDE ACTIVE signal, the feedrate override switches can be enabled, e.g. with the keyswitch, while setting up a new NC program.

FEEDRATE OVERRIDE **DW 1, bit 8 to 12**

The feedrate override can be preselected with the selector switch on the machine control panel or via the PLC 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	

Note:

The percentage values given in the table are stored as machine data (NC MD 100 ... 130). Only the NC machine data for positions 1 to 23 are entered as standard; the standard machine data can be altered. The other machine data can be entered subsequently if required, thus also permitting evaluation of the codes for positions 24 to 31, supplied by a connected code switch or PLC program.

RAPID TRAVERSE OVERRIDE ACTIVE — DW 1, bit 5

1 signal: The selected rapid traverse override is active channel-specifically.
0 signal: The selected rapid traverse override is inactive; the 100 % override value is stipulated.

Notes:

- **Axis-specific** deletion of this signal can be achieved with NC setting data (NC SE 560*.1). This is recommended, for example, if a turret is controlled by an auxiliary axis in the same mode group.
- The signal FEEDRATE OVERRIDE FOR RAPID TRAVERSE OVERRIDE (DB 10 ... 25, DW 14, bit 10) can be used to make the selection. The signal is transmitted by FB 78.

Example of application:

Using the RAPID TRAVERSE OVERRIDE ACTIVE signal, the rapid traverse override switches can be enabled, e.g. with the keyswitch, while setting up a new NC program.

RAPID TRAVERSE OVERRIDE — DW 1, bit 0 to 2

The rapid traverse override can be preselected with the selector switch on the customer control panel as follows:

Position	Code D	C	B	A	Override value in %
1	0	0	0	1	1
2	0	0	1	1	10
3	0	0	1	0	50
4	0	1	1	0	100
5	0	1	1	1	
6	0	1	0	1	
7	0	1	0	0	
8	1	1	0	0	

Notes:

- The percentage values given in the table stored as machine data (NC MD 147 - 154). Only the machine data for positions 1 to 4 are entered as standard; the other machine data can be entered subsequently if required, thus also permitting evaluation of the codes for positions 5 to 8, supplied by a connected code switch or PLC program.
- The values given in the table are effective only if the RAPID TRAVERSE OVERRIDE SWITCH AVAILABLE NC MD 5000.4 machine data is set. If the bit is not set, the position 100 % of the feedrate override switch applies to rapid traverse override.

6.4.4 Program modification

Notes on block search

There are three ways of reentering an aborted program:

- Block search with calculation
- Block search without calculation
- Block search with calculation from last main block

In part programs a distinction is made between main blocks and subblocks.

Note:

In the case of "External execution", only block search with calculation is permitted.

Block search with calculation

The control starts at the beginning of the program and

- calculates all blocks and
- outputs all auxiliary functions to the PLC.

Once the target block is reached, the control begins processing from there after NC start.

Block search without calculation

The control **jumps** to the specified target block and begins processing the part program from there after NC start. Block search without calculation is of no significance for the PLC.

Block search with calculation from last main block

The control executes a block search (without calculation) to the last main block (:) **before** the target. Starting at this main block, the control performs a block search with calculation up to the specified target block.

EXTERNAL EXECUTION **DW 2, bit 15**

1 signal: The "External execution" function is activated when the signal is set. The part program for the NC channel is read in at an interface during machining.

0 signal: The "External execution" function is not active or is deselected. The part program is executed normally from the part program memory in the COM area.

Notes:

- The "External execution" function can be selected by the user by softkey (see EXTERNAL EXECUTION SELECTED signal) or automatically by the PLC user program.
- The interface to be used is specified in machine data MD 130*. If this interface is already busy when the function is initiated (by NC START), alarm 2044 "Error external execution" is issued.
- If "External execution" is initiated by a host computer, the PLC user program must evaluate errors when the function is started and report to the host.
- If the external part program is executed faster than it is transmitted so that the subsequent block is not available, workpiece machining comes to a standstill. The PLC user program has recourse to the following options in order to prevent this in conjunction with time-critical program sections:
  - General reduction of machining feedrate (feedrate override)
  - Ensure that the buffer for incoming program parts is full before time-critical program sections, e.g. by means of read-in disable. The buffer size and free capacity can be queried from the NC data channel.

  Time-critical program sections can be marked, e.g. by special M functions, so that the PLC user program is able to recognize them.

BLOCK SEARCH WITH CALCULATION **DW 2, bit 14**

1 signal: Start block search with calculation.
0 signal: No block search.

Note:

The signal must remain present until acknowledged.

Example of application:

Activation of block search. Activation is generally effected by pressing the BLOCK SEARCH and START softkeys (DB 10 ... DB 25, DW 14, bit 6). If applicable, the signal is transferred by FB 78.

BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK **DW 2, bit 13**

1 signal: Start block search with calculation from last main block.
0 signal: No block search.

Note:

The signal must remain present until acknowledged.

Example of application:

Activation of block search. Activation is generally effected by the BLOCK SEARCH and START softkeys (DB 10 ... DB 25, DW 14, bit 5) being pressed. The signal is transferred by FB 78.

DELETE DISTANCE TO GO — DW 2, bit 3

0/1 transition: The distance to go (set/actual difference) of all axes is deleted. Following errors are always traversed. Active dwell blocks are interrupted.

1/0 transition: No effect.

Notes:

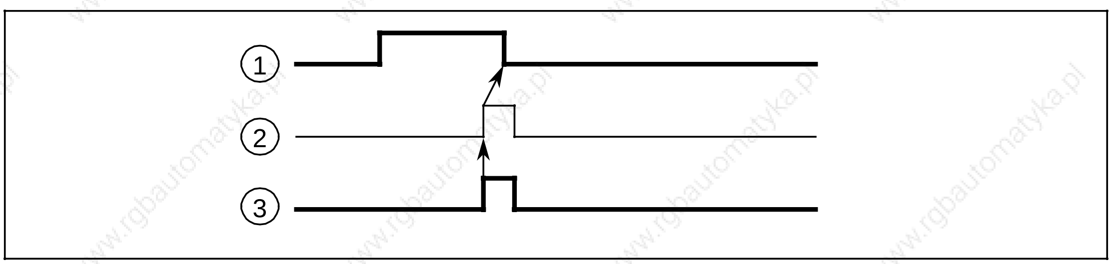
- The DELETE DISTANCE TO GO signal must be active for at least one PLC cycle.
- After DELETE DISTANCE TO GO, a program block with G 90 has to follow for the deleted axis at least.
- DELETE DISTANCE TO GO with rounding axes leads to an alarm with processing stop.
- DELETE DISTANCE TO GO allowed only in G01, G02 and G03 blocks (G02/G03 blocks only in 2D Interpolation)

DELETE NUMBER OF SUBROUTINE PASSES — DW 2, bit 2

1 signal: Deletes the remaining number of subroutine passes.
0 signal: No effect.

Notes:

- By deleting the remaining number of subroutine passes, the NC can be synchronized with an externally reported machine position.
- The subroutine pass that is currently being executed is completed as far as M17.
- The 1 signal must be active until the end of the subroutine and has to be reset with M17.
- To interrupt a specific subroutine, @ 714 (STOP DEC) has to be programmed in the last block before M17.



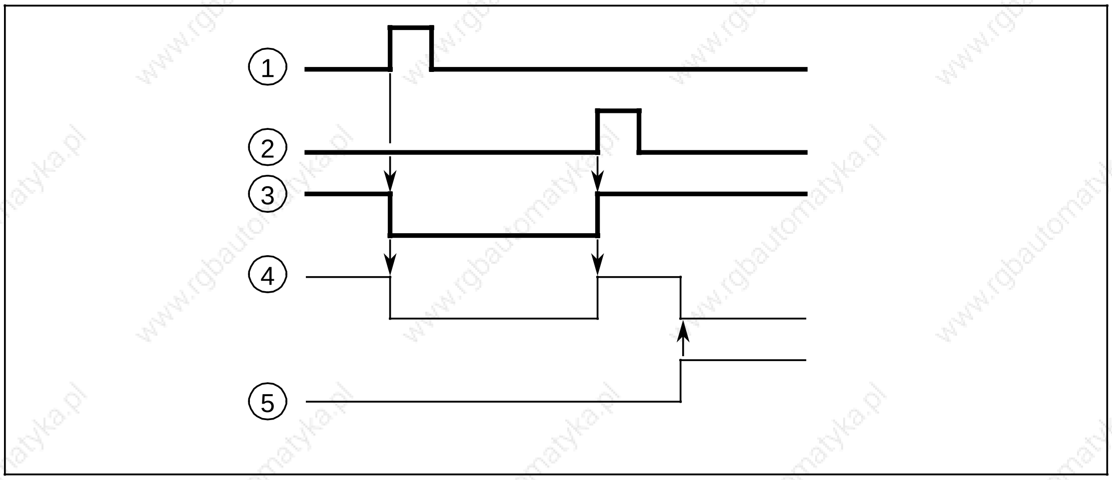
Signal chart

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

NC STOP DW 2, bit 1

0/1 transition: The current NC program is stopped immediately, the current block is not concluded. Residual paths are not traversed until the next start. The axes are brought to a standstill under control.

1/0 transition: No effect.



Signal chart

1: NC STOP signal
2: NC START signal
3: PROGRAM RUNNING signal
4: Axis running
5: Block executed

Notes:

- If the NC program has been interrupted, additional auxiliary functions can be stored, for example. These will be executed after the next NC START.
- When the NC START signal is given, program execution recommences at the breakpoint. If additional auxiliary functions were stored while the program was interrupted, only these will be effective after the first Start. Program execution is then continued with the second NC Start.
- The NC STOP signal must be active for at least one PLC cycle.
- If data were transferred to the NC after NC STOP (e. g. temperature compensation, tool offset), these are taken into account **immediately** after NC START.

NC START — DW 2, bit 0

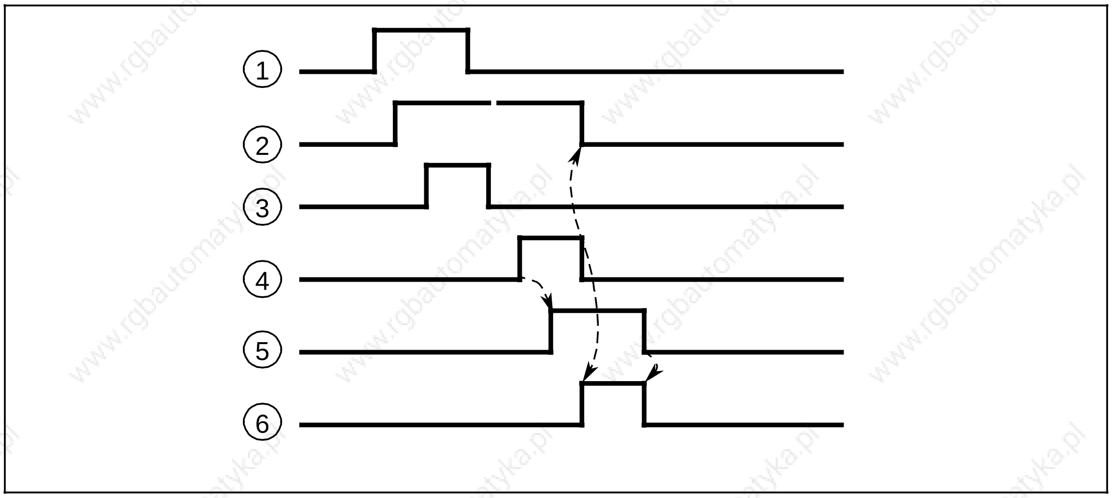
AUT mode:

0/1 transition: The selected NC program is started or continued or the auxiliary functions stored while the program was interrupted are output. If data were transferred from the PLC to the NC after PROGRAM INTERRUPTED (e. g. temperature compensation, tool offset), these are taken into account **immediately** after NC START.

1/0 transition: No effect.

Example of application:

Transfer of new tool offsets with NC START and NC STOP.



Signal chart

1: RAPID TRAVERSE signal
2: READ-IN DISABLE signal
3: Transfer of new tool offsets
4: NC STOP signal
5: PROGRAM INTERRUPTED
6: NC START signal

MDA mode

0/1 transition: The input block data are released for execution.
1/0 transition: No effect.

JOG, INC, REPOS (overstore) modes

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

Notes:

- The NC START signal must be active for at least one PLC cycle.
- Subroutines can also be selected and started directly (without main program).

SPINDLE NUMBER — DW 3, bits 8 to 10

SPINDLE NUMBER informs the NC channel of:

- The number of the spindle from which the NC channel picks off the pulses, e.g. for revolutional feedrate.
- The number of the spindle to which an S word **without** extended address is output.

Spindle	Code C	B	A
1	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0

Note:
SPINDLE NUMBER defines the spindle that can be programmed without extended M and S addresses and is displayed in the basic images of the NC.

SKIP BLOCK 1.../8 — DW 4, bits 8 to 15

1 signal: The marked part program blocks are skipped.
0 signal: The marked part program blocks are **not** skipped.

6.4.5 General feed disable

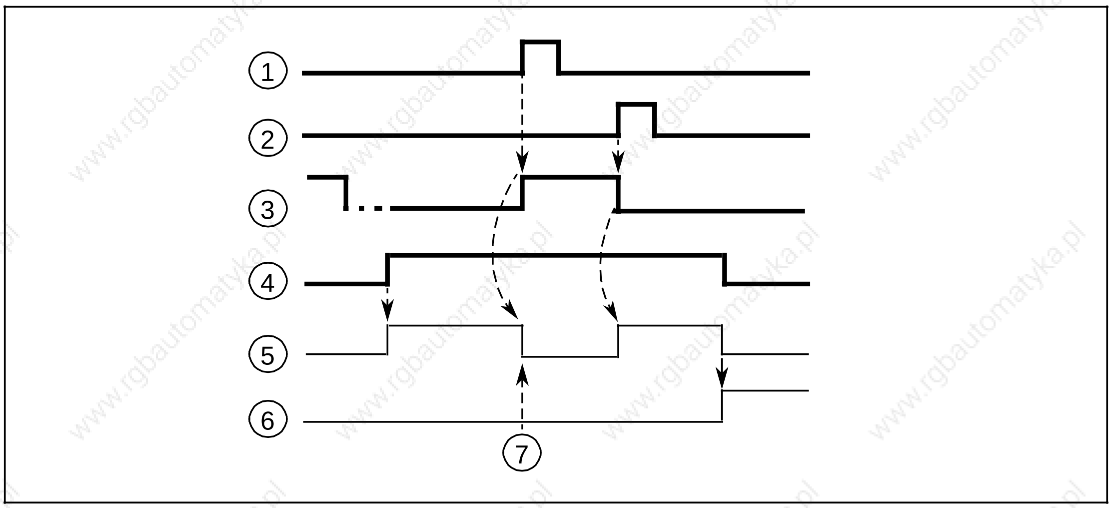
GENERAL FEED DISABLE	DW 6

1 signal: Effects feed hold of all interpolator controlled axes provided that no G 33 (thread cutting) signal is present.

0 signal: Effects feed enable of all axes.

Notes:

- The signal is effective only in the automatic modes.
- When GENERAL FEED DISABLE is selected, all axes in motion are brought to a standstill along the contour. Position control remains operative, i.e. the following error is reduced to zero.
- GENERAL FEED DISABLE is activated if at least one bit in DW 6 is set.
- If an axis must not be traversed in any mode due to interlock conditions, this must be prevented for the specific axis with FEED DISABLE.
- A message can be allocated to any FEED DISABLE bit.



Signal chart

1: FEED OFF signal
2: FEED ON signal
3: FEED DISABLE signal
4: Motion command (e.g. X +)
5: X axis in motion
6: Block executed
7: Controlled positioning

Example of application:

To interrupt machining by selecting FEED OFF on the operator panel.

GENERAL FEED DISABLE AND READ-IN DISABLE	**DW 7, DW 8**

1 signal: Effects FEED HOLD of all interpolator-controlled axes AND READ-IN DISABLE provided that no G 33 (thread cutting) signal is present. The signal is effective only in the automatic modes.

0 signal: Effects feed enable of all axes and read-in enable.

Notes:

- See GENERAL FEED DISABLE and READ-IN DISABLE signal descriptions.
- The signal is activated if at least one bit is set.
- A message can be allocated to any bit.

6.4.6 Read-in disable

READ-IN DISABLE	**DW 9 and DW 10**

AUT/MDA modes:

1 signal : Disables transfer of data for the next block to the main memory.
0 signal : Enables transfer of data for the next block to the main memory.

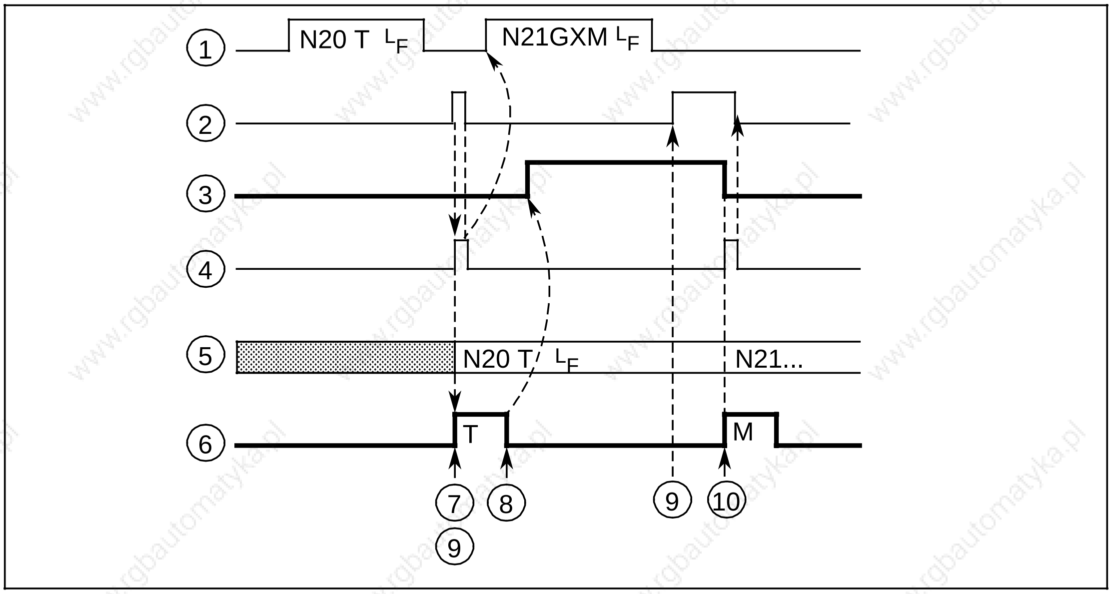
JOG, INC, REPOS or AUT interrupted (OVERSTORE) modes:

1 signal : Activation of input auxiliary functions is disabled.
0 signal : Enables activation of the auxiliary functions input at the NC operator panel via NC START.

Notes:

- If complete execution of an auxiliary function is a precondition for processing the next block (e.g. tool change), the automatic block change has to be prevented with READ-IN DISABLE.
- Read-in disable is activated if at least one READ-IN DISABLE bit is set.
- A message can be allocated to any READ-IN DISABLE bit.
- With rapid output of the auxiliary function to the PLC [d)] it is not possible to stop part program execution in the same block as the READ-IN DISABLE or the signal FEEDRATE DISABLE COMPLETE AND READ-IN DISABLE.

d) with GA2, software version 1 and higher



Signal chart

1: Reading in intermediate memory
2: Block executed
3: READ-IN DISABLE signal
4: Data transfer
5: Content of main memory
6: Output of auxiliary functions
7: Data transfer to main memory
8: Read-in disable for tool change
9: Interrogation point for read-in enable
10: Cancel READ-IN DISABLE

6.4.7 NC start disable

NC START DISABLE	DW 11

1 signal: No NC START signal.
0 signal: NC START signal active.

Notes:

- NC START DISABLE is activated if at least one bit in DW 11 is set.
- A message can be allocated to any NC START DISABLE bit.

Application example:

Suppression of renewed program execution because of lack of lubricant, for example.

6.4.8 Status word

STATUS WORD FOR USER	DW 12

Freely assignable word.

Example of application:

If several NC channels are treated the same from a logic point of view, this can be put into effect by the user with **one** function block. The inevitably different statuses of the FBs for the individual channels can be stored in the channel-specific STATUS WORD.

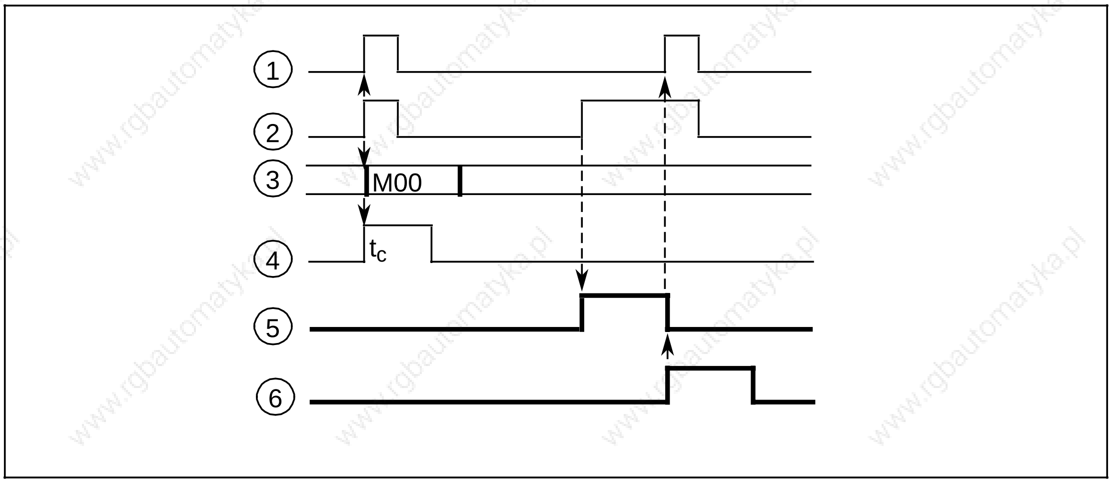
6.5 Signals from NC channel

6.5.1 Program commands

M00/M01; PROGRAMMED STOP	**DW 13, bit 15**

1 signal: Block executed, auxiliary functions output and
a) M00 in main memory or
b) M01 in main memory and M01 ACTIVE selected

0 signal: a) With NC START
b) Program abort with RESET



Signal chart

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

Note:

If a different mode is selected with the M00/M01; PROGRAMMED STOP signal set, this state is maintained until the NC START or RESET signal is given.

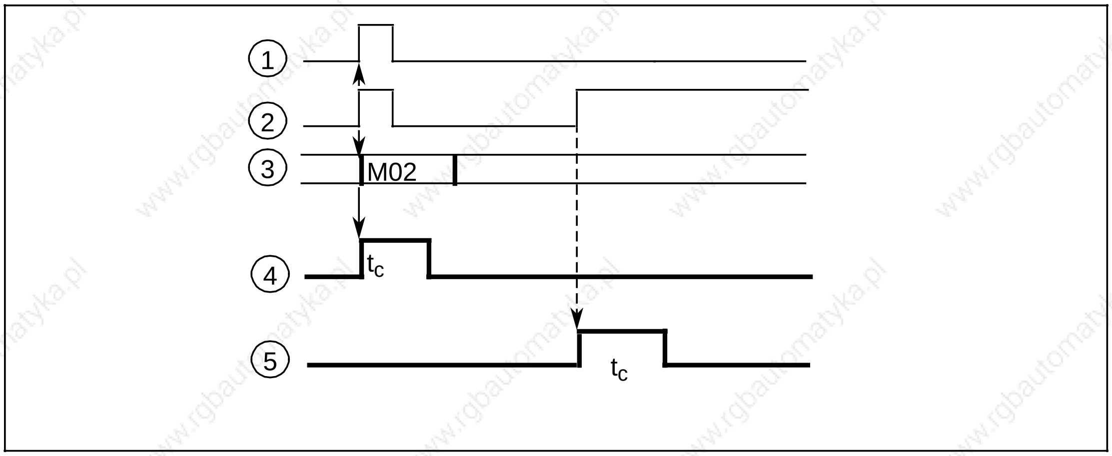
Example of application:

To bring the main spindle to a standstill, e.g. to carry out checks on the workpiece.

M02/M30; END OF PROGRAM, PROGRAM ABORT DW 13, bit 14

1 signal:
a) An NC block with M02/M30 (or M17 if a subroutine, and not a main program, has been started) has been fully executed; if traversing movements are also programmed in this block, the signal is not output until the target position has been reached.
b) Program aborted with RESET.
c) Selection of MDA, PRESET or REF modes.
d) After EMERGENCY STOP ACKNOWLEDGEMENT

0 signal: No end of program or program abort.



Signal chart

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

Notes:

- The functions M02 and M30 are equivalent.
- The M02/M30 signal is active for only one cycle.
- Not suitable for automatic function sequences such as:
  – batch counting
  – bar feed
  – opening protective devices

  For these functions, write M03/M30 in an independent block and use the M02/M30 word or the M02/M30 decoded M signal.
- The following must not be written in the last block of a program:
  – auxiliary functions that lead to read-in disable
  – S values that are to be active beyond M02/M30.

Example of application:

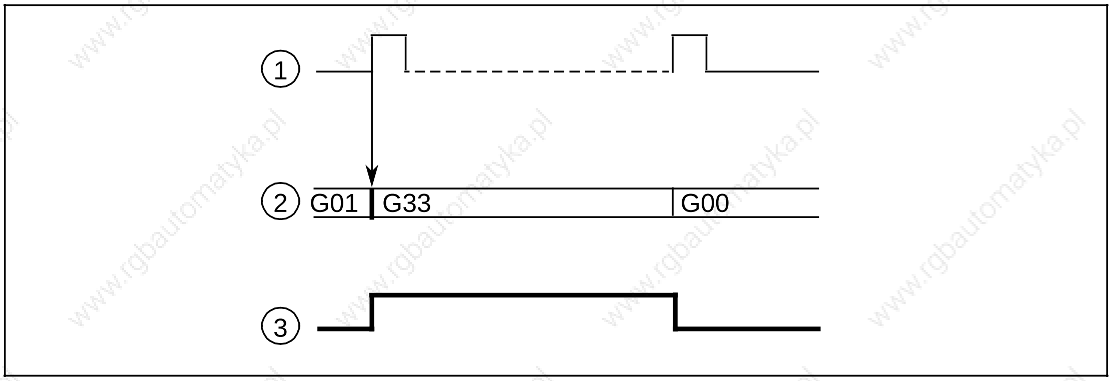
Deleting function activated by M, T and H words.

G33/G63; THREAD CUTTING **DW 13, bit 13**

AUT, MDA modes

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 ended or aborted.



Signal chart

1: Data transfer to main memory
2: Content of main memory
3: G33/G63 signal

Notes:

- The following are inactive:
  with G33: a) Feedrate override
  b) Feed hold (GENERAL FEED DISABLE signal is not interpreted).
  c) Single block (Stop not effected until the end of the next block without G33).
  with G63: Feedrate override
- With G33 (thread cutting), feed hold can be achieved indirectly by linking G33 and GENERAL FEED DISABLE to obtain the SPINDLE DISABLE signal.
- With G63, the NC reacts directly to the FEED DISABLE signal.
- Additional G functions can be decoded using FB 69.

G00; RAPID TRAVERSE	DW 13, bit 12

AUT, MDA modes

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

JOG, REPOS modes

1 signal: Rapid traverse and direction keys pressed at the same time.
0 signal: Rapid traverse and direction key not pressed at the same time.

REF mode

1 signal: Reference point approach speed (DECELERATION signal = 1, i.e. reference point not yet reached).

0 signal: Reference point reached.

Note:

Additional G functions can be decoded using FB 69.

Example of application:

Activation of bed lubrication.

G96; CONSTANT CUTTING SPEED	DW 13, bit 11

1 signal: Constant cutting speed selected with G96.
0 signal: Constant cutting speed not selected.

Note:

Additional G functions can be decoded using FB 69.

BLOCK SEARCH ACTIVE	DW 13, bit 10

1 signal: The BLOCK SEARCH function has been started at the NC and not yet completed.
0 signal: The BLOCK SEARCH function has been completed.

PROGRAM INTERRUPTED	DW 13, bit 9

AUT, MDA modes

1 signal: NC part program interrupted by NC STOP or mode change.

0 signal:
- a) Program not started.
- b) Program ended or aborted.
- c) Program has been restarted following NC STOP or mode change.

Note:

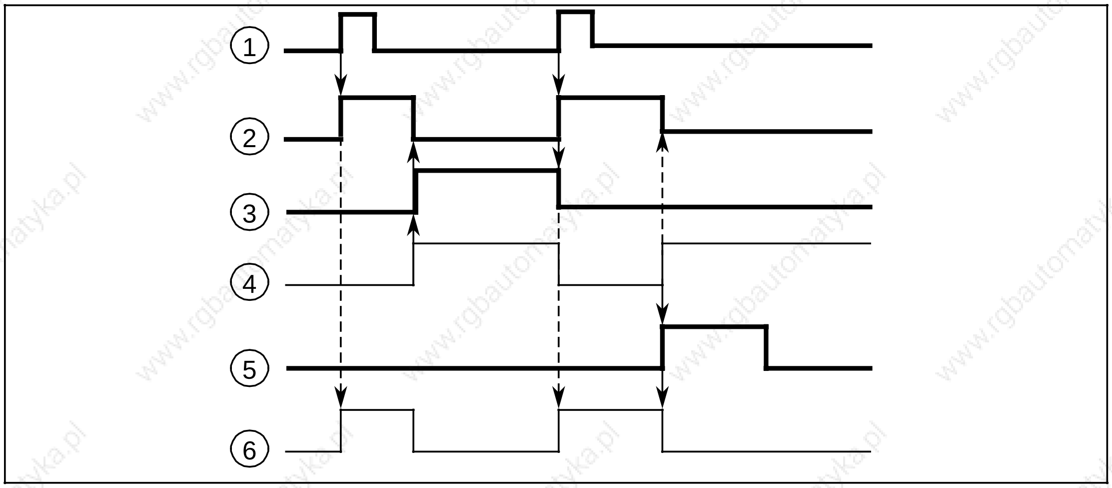
The PROGRAM INTERRUPTED signal indicates that NC part program execution can continue by restarting.

PROGRAM RUNNING	DW 13, bit 8

AUT, MDA modes

1 signal: Program started (NC start).

0 signal:
- a) Program interrupted by
  - – programmed stop (M00/M01)
  - – NC STOP or
  - – mode change.
- b) With single block operation: block executed.
- c) End of program reached (M02/M30).
- d) Program aborted by RESET.
- e) No further blocks in the memory (e.g. with MDA).
- f) Current block cannot be executed.



Signal chart

1: NC START signal
2: PROGRAM RUNNING signal
3: M00/M01 signal
4: Position reached
5: M02/M30 signal
6: “PROGRAM RUNNING” lamp comes on

Note:

The PROGRAM RUNNING signal does **not** change to 0 if workpiece machining is stopped by any of the following conditions:

- Output of GENERAL FEED DISABLE, axis-specific FEED DISABLE or SPINDLE DISABLE
- READ-IN DISABLE
- FEEDRATE OVERRIDE at “0%”
- Software limit switches triggered or working area limitation reached
- Tripping of spindle or axis monitors
- Set displacement values selected in the NC program for axes in FOLLOW-UP OPERATION, for axes without CONTROLLER ENABLE or for PARKING AXES
- EMERGENCY STOP

TRANSFORMATION ACTIVE DW 13, bit 7

1 signal: Transformation active
0 signal: No transformation active

Note:

If transformation is active, the user can determine the transformation concerned by means of FB 69. The FB 69 call can be made conditional on the TRANSFORMATION ACTIVE signal.

TAPPING WITHOUT COMPENSATION CHUCK ACTIVE[d)] DW 13, bit 4

1 signal: The function "tapping without compensation chuck" (G203/G204) was selected.

0 signal:
a) The function G203/G204 has been deselected by the function G205
b) The function G203/G204 has been interrupted by a key reset or by the signal SPINDLE RESET, if bit MD 521*.4 "abort C-axis mode on reset/M02/M03" equals 1.
c) The function G203/G204 is not active after the machine has been switched on.

Note:

- Before you select the function "tapping without compensation chuck" (G203/G204) ensure that the correct gear stage is selected.
- After selecting the function you must switch the spindle to C-axis mode with the signal INITIATE C-AXIS MODE (DB 31, DW K + 3, bit 3). When cycle L84 is called the thread cycle whose number is stored in MD 274 is executed.
- Before the spindle is switched to C-axis mode the PLC user program must make the necessary preparations, such as:
  - stop spindle
  - assign axis-specific interface.
- Because the infeed axis and the C-axis interpolate during tapping it is necessary to set both axes to the same dynamic response.
- For the infeed axis the following machine data apply after the spindle has been switched to C-axis mode:
  - MD 1320* Servo gain factor for tapping without compensation chuck
  - MD 1260* Feedforward factor for threading without compensation chuck
  - MD 1324* Time constant dynamic feedforward control for threading without compensation chuck

Caution:

The functions G203/G204 must not be aborted with the M function "deselection of C-axis mode".

d) with GA2, software version 1 and higher

COUPLED AXES ACTIVE[d)] DW 13, bit 0

1 signal: The COUPLED AXES function (coupled-motion combinations G151 and G159) has been selected by the PLC via the command channel or by the NC part program.

0 signal:
a) The "coupled axes" function is not active.
b) The signal has been reset by deselection of the coupled-motion combination by G150, by reset, by emergency off, by end of program (M02/M03) or by M17, if the subroutine containing it was called as a main program.
c) The signal is reset in REFPOINT mode.

Note:

- The COUPLED AXES function is not active during simulation.
- If the function was set by the NC part program, the signal remains set when the NC part program is interrupted by NC STOP.
- If the function was set via the command channel, there is a difference between the AUTOMATIC and JOG/INC FEED ... modes.
  In AUTOMATIC mode, the COUPLED-AXIS function can be selected in all channels. The signal is set in the channel DB associated with this channel.
  In JOG and INC FEED ..., it is only possible to select the function in the first channel of a mode group (the master channel).
- If the function was selected via the command channel, the signal is not reset on a RESET but only when it is deselected via the command channel.

6.5.2 Softkey select functions

SKIP BLOCK SELECTED DW 14, bit 15

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

Note:

The SKIP BLOCK SELECTED signal must be transferred to the SKIP BLOCK interface signal by the PLC user program. FB 78 can be used for this purpose.

DECODING SINGLE BLOCK SELECTED DW 14, bit 13

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

Note:

The DECODING SINGLE BLOCK SELECTED signal must be transferred to the DECODING SINGLE BLOCK interface signal by the PLC user program. FB 78 can be used for this purpose.

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d) with GA2, software version 1 and higher

DRY RUN FEEDRATE SELECTED	DW 14, bit 12

1 signal: DRY RUN FEEDRATE submode selected.
0 signal: DRY RUN FEEDRATE submode not selected.

Note:

The DRY RUN FEEDRATE SELECTED signal must be transferred to the DRY RUN FEEDRATE interface signal by the PLC user program. FB 78 can be used for this purpose.

M01 SELECTED	DW 14, bit 11

1 signal: M01 ACTIVE submode selected.
0 signal: M01 ACTIVE submode not selected.

Note:

The M01 SELECTED signal must be transferred to the M01 ACTIVE interface signal by the PLC user program. FB 78 can be used for this purpose.

FEEDRATE OVERRIDE FOR RAPID TRAVERSE SELECTED	DW 14, bit 10

1 signal: The feedrate override switch is also to act as the rapid traverse override switch. Feedrate overrides above 100 % are restricted to 100 % rapid traverse override.

0 signal: The feedrate override switch is not to act as the rapid traverse override switch (rapid traverse 100%).

Notes:

- The FEEDRATE OVERRIDE FOR RAPID TRAVERSE SELECTED signal must be transferred to the RAPID TRAVERSE OVERRIDE ACTIVE interface signal by the PLC user program. FB 78 can be used for this purpose.
- This signal is useful only if no separate rapid traverse override switch is provided.

DRF SELECTED	DW 14, bit 9

1 signal: "Differential resolver offset" selected by softkey in the relevant select display.

0 signal: "Differential resolver offset" not selected.

Note:

The DRF SELECTED signal must be transferred to the DRF ACTIVE interface signal by the PLC user program. FB 78 can be used for this purpose.

TEACH IN, PLAYBACK SELECTED	DW 14, bit 8

1 signal: TEACH IN/PLAYBACK submodes selected by the operator.

0 signal: Otherwise

Example of application:

Branches in the PLC user program with TEACH IN/PLAYBACK.

EXTERNAL EXECUTION SELECTED	DW 14, bit 7

1 signal: The softkey for the "External execution" function is active,; i. e. the function has been selected by the operator.

0 signal: The softkey for the "External execution" function is not active; i. e. the function has not been selected or has been deselected.

Note:

The PLC user program must transfer the EXTERNAL EXECUTION SELECTED signal to the EXTERNAL EXECUTION signal (see signal description).

BLOCK SEARCH WITH CALCULATION SELECTED	DW 14, bit 6

1 signal: "Block search with calculation" function selected.

0 signal:
a) "Block search with calculation" function not selected.
b) After 1 signal triggered by BLOCK SEARCH WITH CALCULATION WITHOUT ERROR or ERROR ON BLOCK SEARCH WITH CALCULATION.

Note:

The PLC user program must transfer the BLOCK SEARCH WITH CALCULATION SELECTED signal to the BLOCK SEARCH WITH CALCULATION interface signal. FB 78 can be used for this purpose.

BLOCK SEARCH WITH CALC. FROM LAST MAIN BLOCK SELECTED DW 14, bit 5

1 signal: "Block search with calculation from last main block" function selected.

0 signal:
a) "Block search with calculation from last main block" function not selected.
b) After 1 signal triggered by BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK or ERROR ON BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK.

Note:

The program must transfer the BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK SELECTED signal to the BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK interface signal. FB 78 can be used for this purpose.

6.5.3 Acknowledgements

BLOCK SEARCH WITH CALCULATION WITHOUT ERROR DW 15, bit 14

1 signal: Block search with calculation completed without errors.

0 signal:
a) Errors during "Block search with calculation" function.
b) "Block search with calculation without error" carries 0 signal.

BLOCK SEARCH WITH CALC. FROM LAST MAIN BLOCK WITHOUT ERROR DW 15, bit 13

1 signal: "Block search with calculation from last main block" function completed without errors.

0 signal:
a) Errors during "Block search with calculation from last main block" function.
b) "Block search with calculation from last main block" inactive.

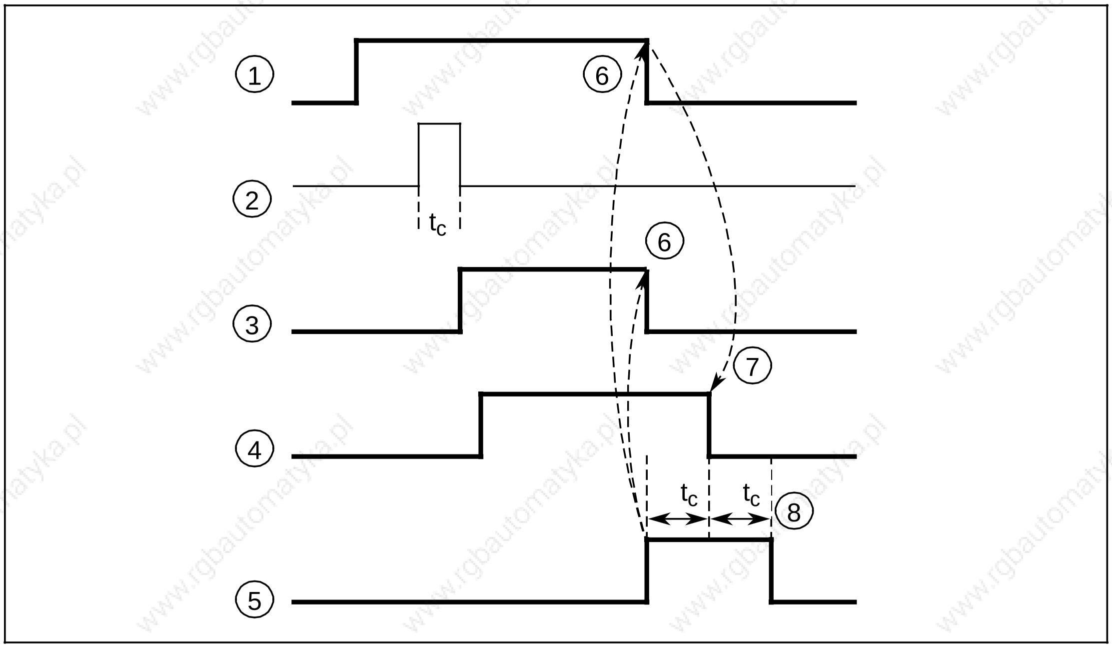
ERROR ON BLOCK SEARCH WITH CALCULATION DW 15, bit 6

1 signal: Error on "Block search with calculation" function.

0 signal: Block search completed without errors.

ERROR ON BLOCK SEARCH WITH CALC. FROM LAST MAIN BLOCK **DW 15, bit 5**

1 signal: Error on "Block search with calculation from last main block" function.
0 signal: Block search completed without errors.



1: BLOCK SEARCH signal via softkey
2: NC START signal
3: BLOCK SEARCH ACTIVE signal
4: BLOCK SEARCH signal to NC channel
5: BLOCK SEARCH WITHOUT ERROR or ERROR ON BLOCK SEARCH signal
6: BLOCK SEARCH signal cancelled **internally**
7: User cancels BLOCK SEARCH
8: BLOCK SEARCH WITHOUT ERROR or ERROR ON BLOCK SEARCH signal cancelled **internally**
t_c: PLC cycle time

6.5.4 Ready signals

NC START DISABLE	**DW 16, bit 15**

1 signal: NC START cannot be triggered.
0 signal: NC START can be triggered.

Notes:

- The signal must be transferred by the PLC user program to one bit of the NC START DISABLE signals if the PLC machine data DESELECT AUTOMATIC NC START DISABLE is set (PLC I = MD 6026.5; PLC II = MD 6126.5).
- The signal is set in the MDA mode and in the overstore image for all the channels of the selected mode group except for the channel that has just been selected. NC START can then be effective only in the selected channel.

NC ALARM WITH PROCESSING STOP	**DW 16, bit 13**

1 signal: At least one channel-specific NC alarm (block-related) is present which causes a channel processing stop

0 signal: No NC alarm with the effect of causing a processing stop is currently active.

Note:

No sequence-related alarms are reported to the PLC.

NC START POSSIBLE	**DW 16, bit 12**

1 signal: The NC sets the signal to "1" as soon as an NC start request is accepted by the NC channel.

0 signal: No acceptance of NC start request by NC channel.

Notes:

- The NC START POSSIBLE signal is valid only in the automatic modes.
- NC start requests are generally required for program modification purposes, e.g. for starting an NC part program, resuming a part program after NC stop or in single block mode, for starting block search and for starting after TEACH IN/PLAYBACK or overstore. NC start can also be effective, therefore, if the NC channel is not in the reset state.
- NC start is not permitted while a program or single block is being executed, during a block search, or if an NC alarm with processing disable has been issued. NC start requests are also ignored if the mode group is not ready.
- From software version 6 onwards, the entire mode group is no longer disabled in the case of alarms with channel-specific processing disable.

NC CHANNEL IN RESET STATE **DW 16, bit 11**

1 signal: The signal is set to "1" as soon as the NC channel is in the reset state, that is when processing is inactive.

0 signal: The signal is reset to "0" as soon as processing takes place in the NC channel, e.g.

- Execution of a program
- Block search
- TEACH IN or PLAYBACK active
- Overstore active
- etc.

Note:

The NC CHANNEL IN RESET STATE signal is valid only in the automatic modes of the NC.

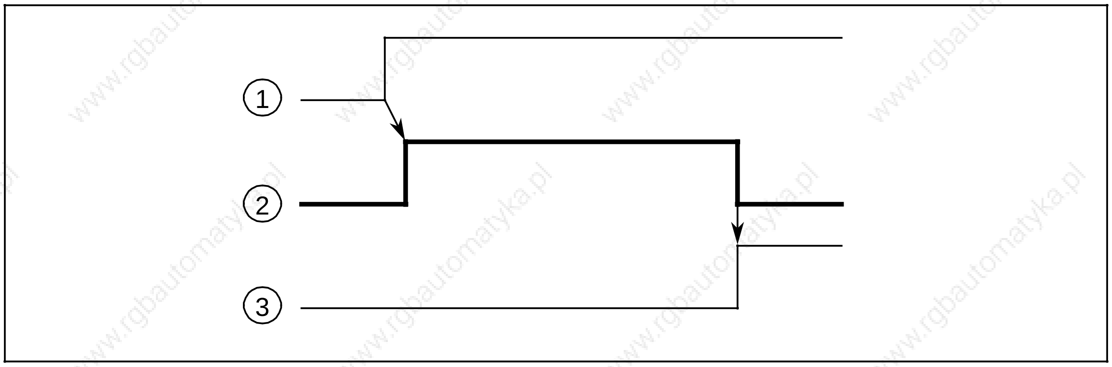
Example of application:

The "Program selection" function with FB 62 can be activated by the PLC only if the relevant NC channel is in the reset state. In the PLC user program, therefore, the function is triggered exclusively depending on the NC CHANNEL IN RESET STATE signal.

MODE GROUP READY **DW 16, bit 9**

1 signal: After Power On and build-up of all voltages

0 signal: Mode group not ready. Reasons:
a) Measuring circuit error or major axis/spindle alarm triggered
b) Hardware fault
c) Incorrect machine data



1: Mains voltage
2: MODE GROUP READY
3: Fault message

Notes:

- If MODE GROUP READY changes to 0:
  - the feed drives and spindle drive are brought to a standstill with a quick stop (i.e. with max. braking current), and
  - all signals transferred from the NC to the PLC are changed to the inactive state (reset state).
- All commands given to the NC must be cancelled if MODE GROUP READY carries the 0 signal.
- MODE GROUP READY does not change to "1" after the cause of the fault has been remedied until the 1st channel of the MODE GROUP has been reset with RESET or until the NC is switched back on after disconnecting the power supply.
- All functions stored in the intermediate and main memories of the NC are deleted.
- The signal is output only in the 1st channel (master channel) of a mode group.

NC ALARM **DW 16, bit 8**

1 signal: At least one channel-specific NC alarm (block-related) is present.
0 signal: No NC alarm is present.

6.6 Output of auxiliary functions and block information

6.6.1 General

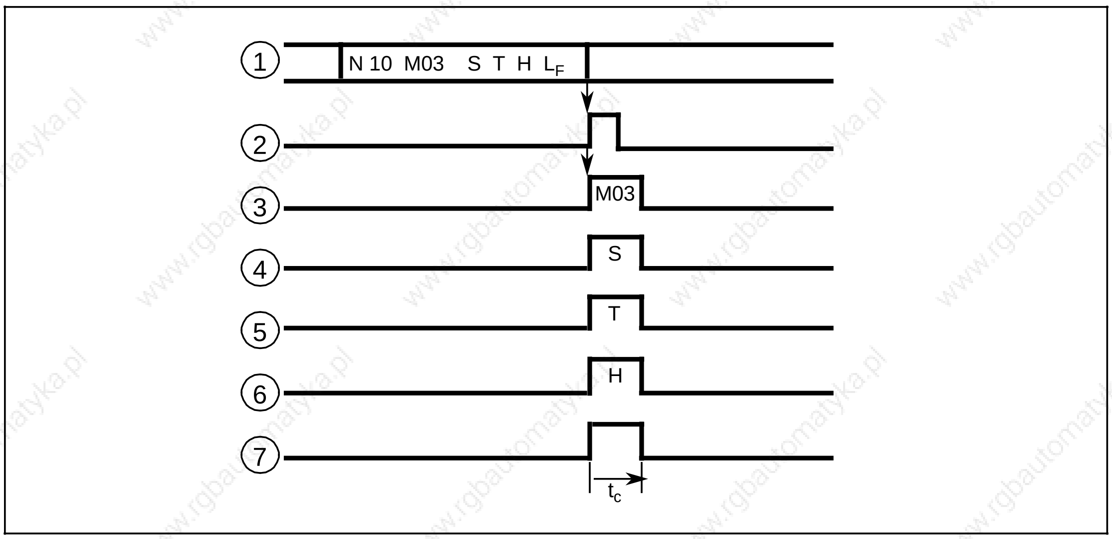
The M, S, T and H auxiliary functions and D and F block information are output to the interface together with the respective modification signals. The modification signals indicate that the value in the relevant word is valid.

The M, S, T and H auxiliary functions can be written with an extended address. If an auxiliary function has been programmed with an extended address, this is output as well.
The output sequence is:
M WORD 1, M WORD 2, M WORD 3, S, T, H, D, F.

Example:

M1=5 Stop for spindle 1
M2=5 Stop for spindle 2

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



Signal chart

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

You can declare the auxiliary functions and block information to rapid [d)] or slow with respect to their output to the PLC.

After a slow auxiliary function or block information has been entered in the NC PLC program and the change signal has been set, the control waits for an acknowledgement before initiating a block change. The change signal remains set for one PLC cycle.
With rapid output to the PLC the control does not wait for acknowledgement from the PLC program but initates the change immediately. The PLC program resets the change signal immediately after transfer of the auxiliary function or the block information.

The auxiliary functions S and T and the block information D and F are declared to be rapid if the appropriate bit in MD 542* is 1.

Declarations of the auxiliary functions H and M are non-modal. A minus sign in front of the value makes the function rapid.

Example:

M = 03	slow auxiliary function
M = -03	rapid auxiliary function

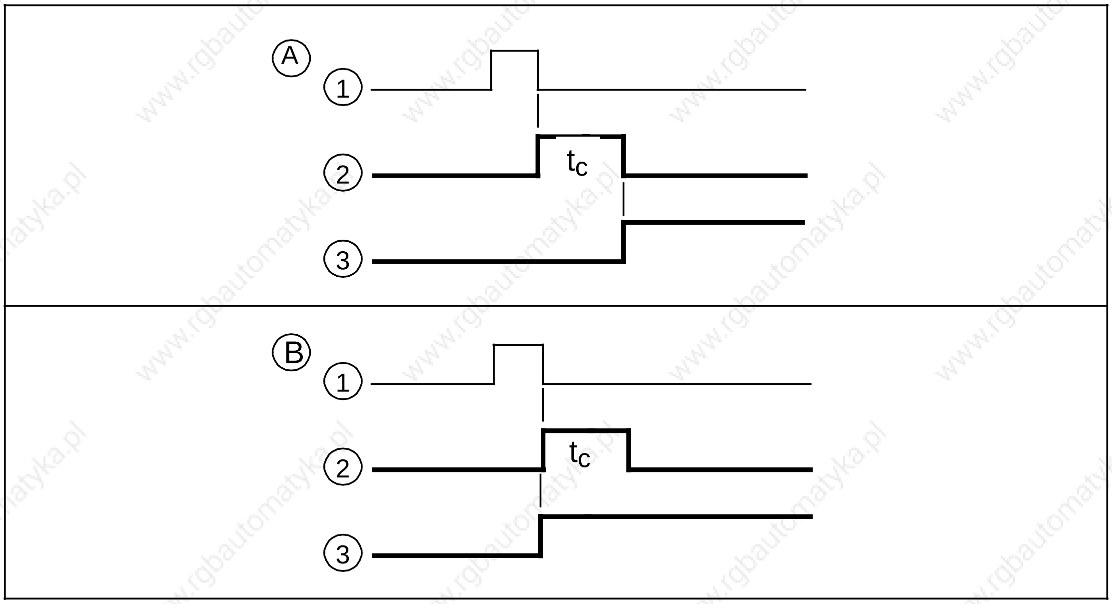
Notes:

- If a block contains several auxiliary functions, the rapid output to PLC is only activated when all the auxiliary functions of a block are declared as rapid. The same goes for block information.
- If rapid output to PLC is used, it is not possible to stop part program execution in the same block with the signal READ-IN DISABLE (DB 10...DB 25, DW 7...DW 10).

The following can still be determined via machine data:

- Output of information before or at the beginning of the NC axis movement (NC MD 5003, bit 2)
- Which information is output with block search (NC MD 544*)
- Output to PLC I, PLC II
- Binary or BCD information output (NC MD 546*)

d) with GA2, software version 1 and higher



A: Information output before axis movement
B: Information output with axis movement
1: Reading NC block into main memory
2: Information at interface (word and modification signal; t_c= PLC cycle time)
3: TRAVEL COMMAND signal

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

The following M functions are decoded:

Without extended address: M00 - M99 in channel-specific DB (DB 10 ... 25)
With extended address: according to decoding list for all channels in DB 30

If an M function is not in the M00 - M99 range and not contained in the decoding list, the signals M WORD MODIFICATION and M WORD NOT DECODED are output. For M00 - M99 the extended address is = 0.

6.6.2 Behaviour in different modes

BLOCK SEARCH mode

Three types of output can be selected via NC machine data:

- During block search, the auxiliary functions are neither stored nor output; (NC MD 546*.0)
- During block search, the programmed auxiliary functions are output immediately with the modification signal; (NC MD 546*.2 - NC MD 546*.7)
- During block search, the NC stores the last auxiliary function of an address in each case; after the NC START these stored information items are output together with the relevant modification signals. Up to three M functions are stored and output provided that they were programmed **in one block** and that there were **no further M functions after this block** as far as the selected block.

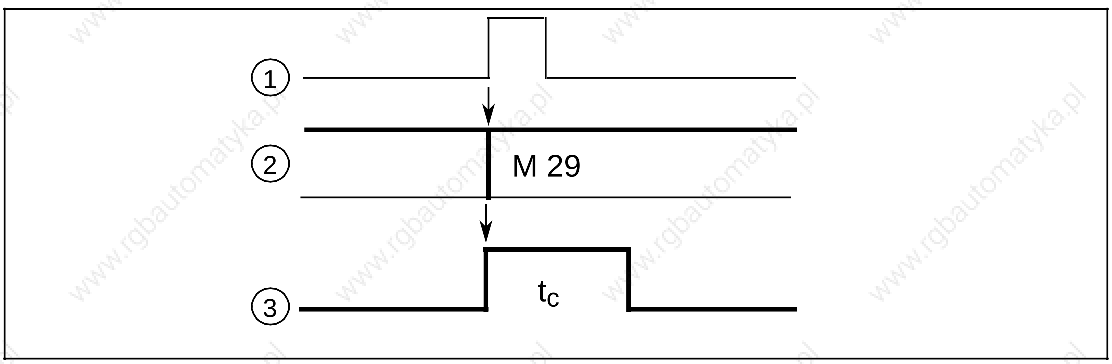
After reaching the preselected block, information can be stored manually.

AUTOMATIC mode

After decoding of the information items in the NC, these are output to the interface together with the relevant modification signal. The modification signal lasts for one PLC cycle. The information words are retained until a new block programmed with M, S, T, H, D and/or F functions has been decoded by the NC.

JOG, INC, MDA, AUT mode interrupted

Additional M, S, T, H and D functions can be stored manually. The auxiliary function with relevant modification signal is not output to the interface until NC START is issued.



Signal chart

1: NC START
2: Auxiliary function, e.g. M 29
3: M modification signal (t_c = PLC cycle time)

6.6.3 Description of information signals

M WORD 1, M WORD 2, M WORD 3, S, T, H, D, F MODIFICATION	**DW 17, bits 8 to 15**

1 signal: The M, S, T, H, D, or F information is output to the interface with a new value.

0 signal: The value of the relevant information is invalid.

Note:

The modification signals are valid for only one PLC cycle in each case.

LAST INFORMATION	**DW 17, bit 7**

1 signal: The last information programmed in the NC block (M, S, T, D, H or F function) is available at the interface as a valid word with the relevant modification signal.

0 signal: The last information of the NC block is not yet available.

Note:

This signal, together with the output modification signals, is valid for one PLC cycle.

M WORD 1, M WORD 2, M WORD 3 NOT DECODED	**DW 17, bits 0 to 2**

This signal, together with the relevant M modification signal, is valid for one PLC cycle.

1 signal: M WORD greater than 99 (extended address = 0) and, with extended address > 0, not contained in decoding list.

0 signal: M WORD less than 99 (extended address = 0) and/or contained in decoding list.

STATIC M SIGNALS	**DR 18 to DR 30**

The static signals are set by decoded M functions. They remain at "1" until reset by a command in the PLC user program.

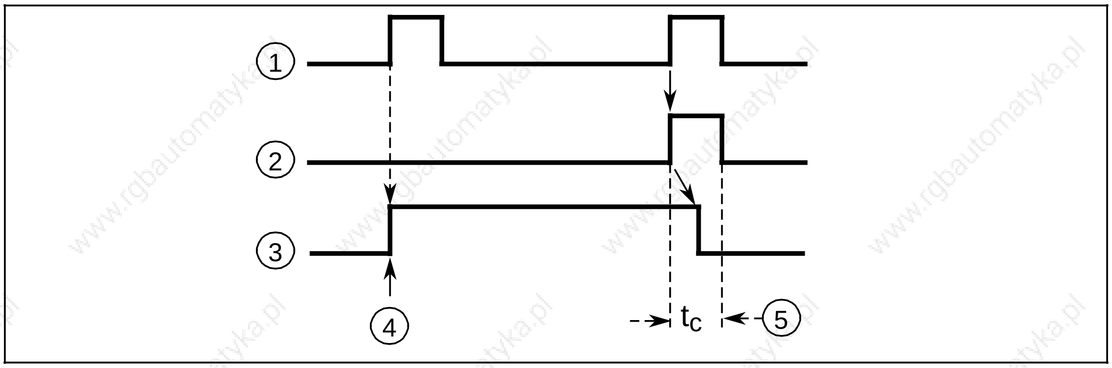
Up to three M signals can be set per PLC cycle and channel.

DYNAMIC M SIGNALS	**DL 18 to DL 30**

Like the static signal bits, the dynamic M signal bits are set by decoded M functions, but they remain at “1” for only one PLC cycle and are then reset by the PLC operating system. Up to three dynamic signals can be output per PLC cycle and channel.

Example of application:

To switch on coolant by statically scanning a static M signal.
To switch off coolant by resetting the static M signal with a dynamic M signal.



Signal chart

1: M modification signal
2: Dynamic M signal
3: Static M signal (coolant ON)
4: Static M signal set
5: Static M signal reset by dynamic M signal by the user program within one PLC cycle (t_c= PLC cycle time)

M WORD 1, M WORD 2, M WORD 3	**DW 32, 34, 36**
EXTENDED ADDRESS M WORD 1 TO 3	**DW 31, 33, 35**

Up to three M functions programmed in one NC block are made available at the same time as soon as the M modification signals are available.

Format: Fixed-point number, value range 0 to 9999
Extended address: Fixed-point number, value range 0 to 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. Otherwise it is generally recommended to relate the M function to a specific channel by means of the extended address.

Example of application:

Decoding or evaluation of M functions that are not decoded as standard or according to the list.

S WORD, EXTENDED S ADDRESS DW 37 to 39

The S value programmed in the NC is made available as soon as an S modification signal is available.

Format: Fixed-point or BCD number, value range 0.1 to 999999
Extended address: Fixed-point or BCD number, value range 0 to 99

Note:

- If an S value is programmed that exceeds the selected value range, only the maximum value is output in each case. This also applies to the analog value output. The analog output can process values from 0.1 - 1600 / 1 - 16000 only (NC MD 520*.3).
- The spindle for which the S word is valid is programmed by means of the extended S address.

Example of application:

Gear stage selection from the PLC.

T WORD, EXTENDED T ADDRESS DW 40 to 42

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

Format: Fixed-point or BCD number, value range 0 to 99999999
Extended address: Fixed-point or BCD number, value range 0 to 99

Notes:

- The **magazine** from which the tool is to be taken is programmed by means of the extended T address.
- For the “tool management” function blocks (FB package 1), the T word has to be output as a fixed-point number.

Example of application:

Control of automatic tool selection.

H WORD, EXTENDED H ADDRESS — DW 43 to 45

The block information programmed in the NC is made available as soon as an H modification signal is available.

Format: Fixed-point or BCD number, value range 0 to 99999999
Extended address: Fixed-point or BCD number, value range 0 to 99

Note:

The H word is divided into groups by means of the extended H address.

Extended address (H group key)	Function
0	Unassigned
1	Activation of tool wear / break monitor
2	Reserved
3	Set values for wear / break monitor
4	Compensation values for wear / break monitor
5...	Unassigned

Example of application:

Switching functions on the machine.

D WORD — DW 46

The programmed D address is made available as soon as a D modification signal is available.

Format: Fixed-point or BCD number, value range 0 to 255

F WORD, EXTENDED F ADDRESS — DW 47 to 49

The F word programmed in the NC is made available as soon as an F modification signal is available.

Format: Fixed-point or BCD number, value range 0 to 99999
Extended address: not in use at present

Example of application:

Amending the programmed F word with tool wear monitoring (adaptive control).

SKIP BLOCK SELECTED /1.../8	DW 51, bits 8 to 15

1 signal: "Skip block" function selected.
0 signal: "Skip block" function not selected.

Note:

The SKIP BLOCK SELECTED /1.../8 signal must be transferred by the PLC user program to the SKIP BLOCK /1.../8 interface signal. FB 78 can be used for this purpose.

6.6.4 T/H word routing

The previously implemented output of the T/H words to the STORED BLOCK INFORMATION in the source channel is also effected when the routing function is activated. The routing is executed additionally when the function is activated. The output of the T/H words to the STORED BLOCK INFORMATION in the source channel takes place, however, only if the target DB is not already assigned by a routing operation or the routing is not suppressed by the signal SUPPRESS ROUTING[d)].

An H word programmed in the same NC block is routed together with the T word in the same way. (An H word on its own in an NC block is not routed, but only output to the STORED BLOCK INFORMATION in the source channel.) For routing purposes the number is stated as an extended T address in the part program. The channel numbering ranges from 1 to 16.

SUPPRESS ROUTING[d)]	DW 63, bit 15

1 signal: The signal is set by the user. Any T/H word routing programmed in the program is suppressed.

0 signal: The signal is reset by the user.

Note:

- The signal is set in the target channel DB. When the signal is set, routing programmed in the source channel is suppressed. If the source channel and the target channel are identical, the routing in this source/target channel is suppressed.
- Suppression of the T/H word routing is signalled by the PLC operating system with the signal ROUTING SUPPRESSED.
- Normal output of T and H words in the source channel (DW 40 to DW 45) is not affected by this signal.

d) with GA2, software version 1 and higher

ROUTING SUPPRESSED [d)]	**DW 63, bit 16**

1 signal: The signal is set by the PLC operating system if a T/H word routing programmed in the program is suppressed with the signal SUPPRESS ROUTING.

0 signal: The signal is reset by the user.

Note:

- If the bit "signal in the source/target channel" (PLC MD 6029.3) is set, the signal is output in the target channel DB. Otherwise, it is output in the source channel DB.
- If the source and target channel is identical, the signal is output in this channel.
- The signal ROUTING SUPPRESSED must be reset by the user.

COORDINATION ERROR	**DW 63, bit 7**

The COORDINATION ERROR bit is always set in the envisaged target channel DB, not in the source channel DB.

1 signal:
- Set by PLC operating system in the event of a conflict
- If a T word is to be entered in the STORED BLOCK INFORMATION but the T WORD VALID and/or H WORD VALID bit is still set.
- If a T word is to be routed to DW 65 to 66 but the T WORD VALID and/or H WORD VALID bit is still set.

0 signal:
- After Power On Reset.
- Reset by user.

Note:

The channel DB is disabled for further routing operations as long as the COORDINATION ERROR bit is set.

H WORD VALID	**DW 63, bit 1**

1 signal: Set by the PLC operating system if a routed H word and the extended H address have been entered in DW 67 to 69.

0 signal:
- After Power On Reset (cold restart).
- Reset by user.

Note:

The channel DB is disabled for further routing operations as long as the H WORD VALID bit is set.

d) *with GA2, software version 1 and higher*

T WORD VALID	**DW 63, bit 0**

1 signal: Set by the PLC operating system if a routed T word and the number of the source DB have been entered in DW 64 to 66.

0 signal:
- After Power On Reset (cold restart).
- Reset by user.

Note:

The channel DB is disabled for further routing operations as long as the T WORD VALID bit is set.

NUMBER OF SOURCE CHANNEL	**DW 64**

The PLC operating system enters the number of the channel in which the T word was transferred by the NC. The number is valid only as long as the T WORD VALID and/or H WORD VALID bits are set.

Value range: 1-16
Format: 16-bit binary

Note:

Data word DW 64 is cleared only with COLD RESTART, not with Power On Reset.

ROUTED T WORD	**DW 65, DW 66**

The PLC operating system enters the T word supplied by the NC. The T word is valid only as long as the T WORD VALID bit = 1.

Format: As supplied by NC.

Note:

Data words DW 65 and DW 66 are cleared only with COLD RESTART, not with Power On Reset.

ROUTED H WORD	**DW 67 to DW 69**

The PLC operating system enters the extended H address and the H word supplied by the NC. This interface is operated only if a T word is routed in the same NC block. The information is valid only as long as the H WORD VALID bit = 1.

Format: As supplied by NC.

Note:

Data words DW 67 to DW 69 are cleared only with COLD RESTART, not with Power On Reset.

7 ELG-Specific Signals (DB 29)

7.1 Switching ELG functions

The electronic gearbox (ELG) can be controlled by the PLC user program by means of DB 29. The ELG can also be controlled by setting data bits. The setting data can be modified at the control panel or via the NC part program (@ code).

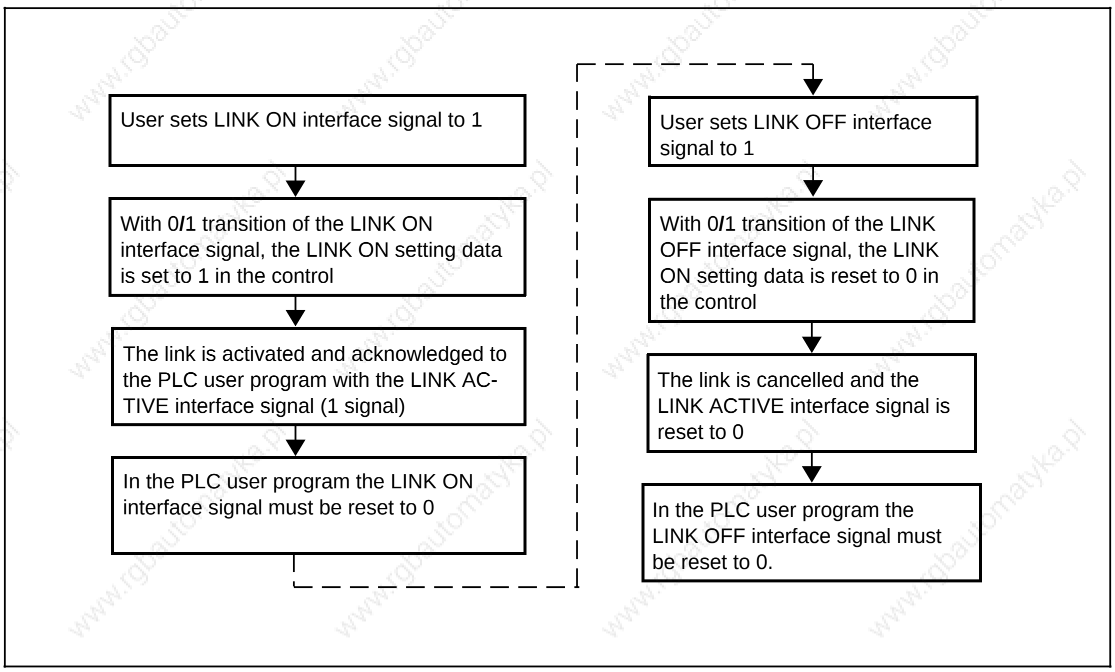
The NC ensures that the setting data bits and interface signals for the ELG do not contain any contradictions. When the PLC user program switches an ELG function the setting data bits are accordingly altered by the NC. For its part, the PLC user program recognizes changes made to ELG functions by setting data bits with reference to the ELG status signals.

In order to avoid contradictions between the control signal settings in DB 29 and setting data bit statuses, all the control signals in DB 29 are edge-sensitive. More precisely: the function change is triggered by the **change** from the 0 to the 1 signal, not the status of the signal (0 or 1). The PLC user program must therefore reset the control signals to 0 in DB 29 when the desired function change is indicated in the status signals.

The following example shows a typical signal sequence when switching an ELG function.

Example:

Selecting and deselecting the gearbox link



Note:

- The signals from DB 29 are transferred to the NC only if PLC MD 6029.2 (MD 6129.2 with PLC II) is set. The bit can be set only for one PLC.
- With the bit "keyswitch for ELG NS" (NC MD 5051, bit 0), you can disable the signals in DB 29. If the bit is set, operation from the PLC is not possible.
- You can also use DB 29 for the EXTENDED SPINDLE function. See the Function Manual "Extended Spindle Functions".

A detailed description of the electronic gearbox is contained in the Electronic Gearbox (ELG) Function Manual.

7.2 Signals from ELG (DB 29)

NEW $K_{\text{Ü}}$ CALCULATED	**DW m, bit 15**

1 signal: The new speed ratios $K_{\text{Ü}}$ have been calculated without error and can be made effective with ACTIVATE NEW $K_{\text{Ü}}$.

0 signal: a) When the new speed ratios are activated, the NC resets the signal to 0.
b) The speed ratios could not be calculated. NEW $K_{\text{Ü}}$ DEFECTIVE is set in this case (see signal description).

ACCELERATION LIMITATION SYNCHRONOUS ACTIVE	**DW m, bit 14**

1 signal: The following axis again follows the movements of the leading axes with positional synchronism, also after acceleration phases. If the maximum permissible acceleration of the following axis is reached so that it is unable to follow the leading axes, the travel increments by which the following axis is retarded are added up and output after the acceleration phase. The axes then run with positional synchronism again.

0 signal: If the maximum acceleration of the following axis is reached, it is unable to follow the leading axes. The resulting positional deviation is not travelled and has no effect on the signals SYNCHRONISM FINE/COARSE. After the acceleration phase, the following axis follows the leading axes with speed synchronism only.

FA 1: m=0	FA 2: m=4	FA 3: m=8

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The maximum permissible acceleration of the following axis is stated in MD 276*.
- Also see ACCELERATION LIMITATION SYNCHRONOUS.
- The meaning of this signal has changed in GA2, software version 1 from what it was in software version 6. See the description of the signal ACCELERATION LIMITATION SYNCHRONOUS.

EMERGENCY RETRACTION ENABLED — DW m, bit 13

1 signal: The emergency retraction monitor is operating. In the event of a fault occurrence that requires emergency retraction of the axes, the NC activates a hardware signal and sets the EMERGENCY RETRACTION ACTIVE interface signal.

0 signal: The emergency retraction monitor is switched off.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The **hardware signal** for displaying an emergency retraction can be output by the servo CPU only via the mixed I/O module (6FX1138-4BA00).

COMPENSATORY CONTROLLER ACTIVE — DW m, bit 12

1 signal: Compensatory control active. The current partial actual values of the following and leading axes are checked, taking the speed ratios into account. Additive set speeds are calculated from the partial actual value deviations and output to the following axis.

0 signal: Compensatory control inactive.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The signal determines the effect of COMPENSATORY CONTROLLER ON/OFF. If the compensatory controller is active it is switched off with COMPENSATORY CONTROLLER ON/OFF, otherwise it is switched on.

FA 1: m=0	FA 2: m=4	FA 3: m=8

FA OVERLAY ACTIVE	DW m, bit 10

1 signal: An additional movement can be superimposed on the movement of the following axis derived from the leading axes. This superimposed movement (positional shift) can be specified in the following ways:
a) AUT mode:
In the NC part program (Incremental dimensioning G 91)
b) JOG or INC mode:
With the travel keys or handwheel
c) By the PLC:
With the "Path dimension" and "Division increment" command channel functions.

0 signal: The following axis follows only the movements of the leading axes; no additional movements can be superimposed (exception: handwheel, see FA OVERLAY OFF).

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The following axis overlay can be switched with FA OVERLAY ON and FA OVERLAY OFF.
- The following axis overlay must be active for the "Semi-automatic centering" and "On-the-fly synchronization" functions.

SYNCHRONIZATION ENABLED	DW m, bit 9

1 signal: Synchronization of the following axis with the leading axis specified in the setting data is enabled. The synchronization can now be initiated by the following means:
a) LINK ON:
With synchronization enabled, the following axis is synchronized with the corresponding leading axis.
b) ACTIVATE NEW $K_{ü}$:
With synchronization enabled, the following axis is synchronized with the corresponding leading axis when the gearbox link is switched to a new speed ratio.
c) SYNCHRONIZATION START:
With synchronization enabled, synchronization of the following axis with the corresponding leading axis can be requested explicitly with the SYNCHRONIZATION START signal. When the gearbox link is switched off (LINK OFF) the following axis is moved to the position specified in the setting data.

0 signal: Synchronization is not enabled. The NC resets the signal to 0 when synchronization is reached.

Note:

Synchronization enable is requested with the SYNCHRONIZATION ON signal.

FA 1: m=0	FA 2: m=4	FA 3: m=8

LINK ACTIVE	**DW m, bit 8**

1 signal: The gearbox link has been switched on with LINK ON and is active. The following axis follows the movement of the leading axes taking the current speed ratios into account.

0 signal: The gearbox link is inactive; the following axis can be operated like a normal NC axis.

Note:

Certain monitoring operations are performed on the following axis with LINK ACTIVE, e.g. for synchronism coarse/fine or emergency retraction monitoring. A compensatory controller may also act on the following axis.

NEW $K_{Ü}$ DEFECTIVE	**DW m, bit 7**

1 signal: An error has occurred when calculating the speed ratios $K_{Ü}$ between the leading axes and the following axis. The NC issues alarm 3170 "FA 1 $K_{Ü}$ defective" (for FA 1); the ACTIVATE NEW $K_{Ü}$ command is disabled.

0 signal: No error occurrence during calculation of the speed ratios by the NC.

Notes:

- The signal is of significance only if calculation of new speed ratios for the following axis has been requested with CALCULATE NEW $K_{Ü}$.
- Also see NEW $K_{Ü}$ CALCULATED.

FA 1: m=0	FA 2: m=4	FA 3: m=8

AUTOMATICALLY CONTROLLED CORRECTION OF FA — DW m, bit 6

1 signal: Automatically controlled correction of FA owing to a malfunction. The setpoints for the following axis are derived from the partial actual values of the leading axes.

0 signal: The type of link between the following axis and the leading axes specified in the machine data is effective.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The machine data specify **how long** automatically controlled correction of the following axis is to be effective.
  FA1: MD 956
  FA2: MD 976
  FA3: MD 996

Example of application:

Recognition of link malfunctions.

MAXIMUM ACCELERATION — DW m, bit 5

1 signal: The setpoint for acceleration of the following axis is greater than the maximum acceleration stated in the machine data. The positional deviation of the following axis from the leading axes increases. Alarm 2419 "FA 1 acceleration limit" (for FA 1) is issued.

0 signal: The acceleration of the following axis is less than its maximum acceleration.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The acceleration limitation for the gearbox link can be deselected with the "Suppression of acceleration limitation" machine data bits; this also suppresses the corresponding alarm.

  Suppression of acceleration limitation:

  FA1: MD 5021.3
  FA2: MD 5022.3
  FA3: MD 5023.3
- The possible or permissible maximum acceleration of the following axis is stated in machine data MD 276*.

FA 1: m=0	FA 2: m=4	FA 3: m=8

MAXIMUM VELOCITY	**DW m, bit 4**

1 signal: The set velocity of the following axis is greater than the maximum velocity stated in the machine data. The positional deviation of the following axis from the leading axes increases; synchronism is endangered. Alarm 2416 "FA 1 velocity limit" is issued (for FA 1).

0 signal: The velocity of the following axis is less than its maximum velocity.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The maximum velocity is stated in NC MD 280*.

ACCELERATION WARNING THRESHOLD REACHED	**DW m, bit 3**

1 signal: The momentary acceleration of the following axis is greater than the value specified as the acceleration warning threshold. There is a danger of the synchronism of the leading axes and the following axis being disturbed in the event of further acceleration.

0 signal: The momentary acceleration of the following axis does not reach the acceleration warning threshold.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The acceleration warning threshold is intended to help prevent exceeding the maximum acceleration. It is stated in machine data as a percentage of the maximum acceleration value; the same percentage value is valid for the velocity warning threshold.

  Warning threshold for acceleration and velocity:

  FA 1: MD 955
  FA 2: MD 975
  FA 3: MD 995
- The NC automatically resets the signal when the current acceleration falls below 7/8 of the warning threshold (hysteresis behaviour).
- Also see SYNCHRONISM COARSE/FINE and MAXIMUM ACCELERATION.

FA 1: m=0	FA 2: m=4	FA 3: m=8

VELOCITY WARNING THRESHOLD REACHED — DW m, bit 2

1 signal: The velocity of the following axis has exceeded the warning threshold. There is a danger of the following axis being unable to follow the leading axes and of disturbed synchronism between the leading axes and the following axis as a result.

0 signal: The velocity of the following axis is lower than the velocity warning threshold.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The velocity warning threshold is intended to help prevent exceeding the maximum velocity. It is stated in machine data as a percentage of the maximum velocity of the following axis; the same percentage value is valid for the acceleration warning threshold.

  Warning threshold for acceleration and velocity:

  FA 1: NC MD 955
  FA 2: NC MD 975
  FA 3: NC MD 995
- The NC automatically resets the signal when the current velocity falls below 7/8 of the warning threshold (hysteresis behaviour).
- Also see SYNCHRONISM COARSE/FINE and MAXIMUM VELOCITY.

SYNCHRONISM FINE — DW m, bit 1

1 signal: The following axis and the leading axes are in synchronism and the actual position of the axis is inside the synchronism fine window.

0 signal: The synchronous deviation of the following axis exceeds the synchronism fine window.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The synchronism fine window defines a tolerance band for the following axis about the setpoint defined by the leading axes. The synchronism fine window is specified by machine data:

  FA 1: NC MD 952
  FA 2: NC MD 972
  FA 3: NC MD 992
- If the bit "block change with synchronism fine" (MD 5021 to MD 5023, bit 2) equals one, the block change after an overlaying movement is not initiated in the NC until the following axis has reached "synchronism fine" and all partial setpoints of the block have been output.

FA 1: m=0	FA 2: m=4	FA 3: m=8

Example of application:

Enable feed movement for the head of a hobbing cutter.

SYNCHRONISM COARSE	**DW m, bit 0**

1 signal: The following axis and leading axes are in synchronism and the actual position of the axis is inside the synchronism coarse window.

0 signal: The synchronous deviation of the following axis from the leading axes exceeds the synchronism coarse window.

Notes:

- The signal does not have any significance if the gearbox link is not selected (LINK ACTIVE = 0).
- The synchronism coarse window defines a tolerance band for the following axis about the setpoint defined by the leading axes. The synchronism coarse window is specified by machine data:

  FA 1: NC MD 953
  FA 2: NC MD 973
  FA 3: NC MD 993

Example of application:

Enable feed movement for the head of a hobbing cutter.

SYNCHRONIZATION REACHED	**DW m + 1, bit 14**

1 signal: The following axis has reached the relative synchronized position. The synchronization enable is cancelled when the synchronized position is reached.

0 signal: The SYNCHRONIZATION REACHED signal is cancelled when synchronization is reactivated (SYNCHRONIZATION ON signal = 1).

FA 1: m=0	FA 2: m=4	FA 3: m=8

Notes:

- If the following axis moves away from the relative synchronized position after reaching it, e.g. with a superimposed movement, the SYNCHRONIZATION REACHED signal neverthe less remains active, i.e. set to 1.
- The relative synchronized position is determined by:
  - the synchronized positions of the following axis and the corresponding leading axis
  - the distance of the leading and the following axis from their synchronized positions when switching the link on/over.
  - the path traversed since switching the link on/over, taking the speed ratio into account.

  The relationship between these variables is described in the ELG Function Manual.
- When approaching the relative synchronized position, only the following axis moves (with the leading axis stationary) or carries out a superimposed movement ("On-the-fly syn-chronization" with traversing leading axis).
- When synchronization has been reached the synchronization enable is cancelled again.

EMERGENCY RETRACTION ACTIVE	DW m + 1, bit 13

1 signal: Synchronism between the following axis and the leading axes is disturbed and the positional deviation is greater than the emergency retraction threshold specified in the machine data.

0 signal: With the gearbox link selected, the following axis is in synchronism with the lead-ing axes and its positional deviation from its setpoint is below the emergency retraction threshold.

Notes:

- The signal is effective only if the gearbox link is selected and the emergency retraction monitor is enabled (EMERGENCY RETRACTION ENABLED = 1).
- A delay of 2 IPO cycle times plus 1 PLC cycle time must be anticipated between exceed-ing the emergency retraction threshold and the EMERGENCY RETRACTION ACTIVE signal being set.
- EMERGENCY RETRACTION ACTIVE can also be output as a hardware signal by the ser-vo CPU provide a mixed I/O module is available in the servo area. This hardware signal permits a very fast reaction to the positional deviation because it is generated in time with the position control pulse.

FA 1: m=0	FA 2: m=4	FA 3: m=8

CENTRE POSITION REACHED	**DW m + 1, bit 11**

1 signal: The centre position between the two flanks of the workpiece has been approached by the following axis.

0 signal: Centre position not reached yet.

Note:

The signal does not have any significance with the "semi-automatic centering" (SAC) function deselected.

Example of application:

The centre of the tooth gap is approached for further the machining of prefabricated gears. The machining feed is initiated when the centre of the tooth gap is reached.

2ND FLANK STORED	**DW m + 1, bit 10**

1 signal: The second flank of the workpiece has been approached with the direction keys or handwheel. The PLC user program has reported this to the NC with 2ND FLANK APPROACHED. The NC has accepted and stored the flank position. The NC prevents the axis traversing beyond this flank position; any attempt to overrun the flank position triggers a cancel alarm. The NC now automatically approaches the centre position between the 1st and 2nd flanks.

0 signal:
a) The "semi-automatic centering" (SAC) function is deselected (with SAC ON/OFF).
b) After Reset.
c) If 2ND FLANK APPROACHED is set again.

Notes:

- The signal does not have any significance if the SAC function is switched off.
- Also see 2ND FLANK APPROACHED.

FA 1: m=0	FA 2: m=4	FA 3: m=8

1ST FLANK STORED	**DW m + 1, bit 9**

1 signal: The first flank of the workpiece has been approached with the direction keys or handwheel. The PLC user program has reported this to the NC with 1ST FLANK APPROACHED. The NC has accepted and stored the flank position. The NC prevents the axis traversing beyond this flank position; any attempt to overrun the flank position triggers a cancel alarm.

0 signal:
a) The "semi-automatic centering" (SAC) function is deselected (with SAC ON/OFF).
b) After Reset.
c) If 1ST FLANK APPROACHED is set again.

Notes:

- The signal does not have any significance if the SAC function is switched off.
- Also see 1ST FLANK APPROACHED.

SAC ACTIVE	**DW m + 1, bit 8**

1 signal: The "Semi-automatic centering" function is selected.

0 signal: The "Semi-automatic centering" function is not selected. The following signals are, therefore, of no significance:
1ST FLANK STORED
2ND FLANK STORED
CENTRE POSITION REACHED.

Notes:

- The signal does not have any significance if the gearbox link is not selected.
- The function is switched with the SAC ON/OFF signal.

Example of application:

Prefabricated workpieces can be centered with the tool with the aid of the "Semi-automatic centering" function.

FA 1: m=0	FA 2: m=4	FA 3: m=8

7.3 Signals to ELG (DB 29)

CALCULATE NEW $K_Ü$	**DW m + 2, bit 15**

0/1 transition: The speed ratios between the following axis and its leading axes are recalculated with the signal change from 0 to 1. The speed ratio parameters must be entered in the setting data first. The NC sets the NEW $K_Ü$ CALCULATED signal if it was possible to calculate the speed ratios without error. If an error occurs during the calculation, the NC sets the NEW $K_Ü$ DEFECTIVE signal and issues an alarm.

1/0 transition: The PLC user program must reset the signal to 0 once the NC has calculated the new speed ratios
(NEW $K_Ü$ CALCULATED = 1 or NEW $K_Ü$ DEFECTIVE = 1).

Notes:

- The speed ratio parameters are specified in setting data words SD 10 to SD 39.
- The calculation of speed ratios can also be initiated by the CALCULATE NEW $K_Ü$ setting data bit. With each 0/1 transition of the CALCULATE NEW $K_Ü$ interface signal the NC program sets the setting data bit of the same name.
- The new speed ratios are put into effect by ACTIVATE NEW $K_Ü$.

ACCELERATION LIMITATION SYNCHRONOUS ACTIVE	**DW m + 2, bit 14**

0/1 transition: On a positive edge of the signal, the signal ACCELERATION LIMITATION SYNCHRONOUS is switched active. If the ACCELERATION LIMITATION SYNCHRONOUS ACTIVE signal is a 0 signal, the acceleration limitation is switched on, otherwise it is switched off.

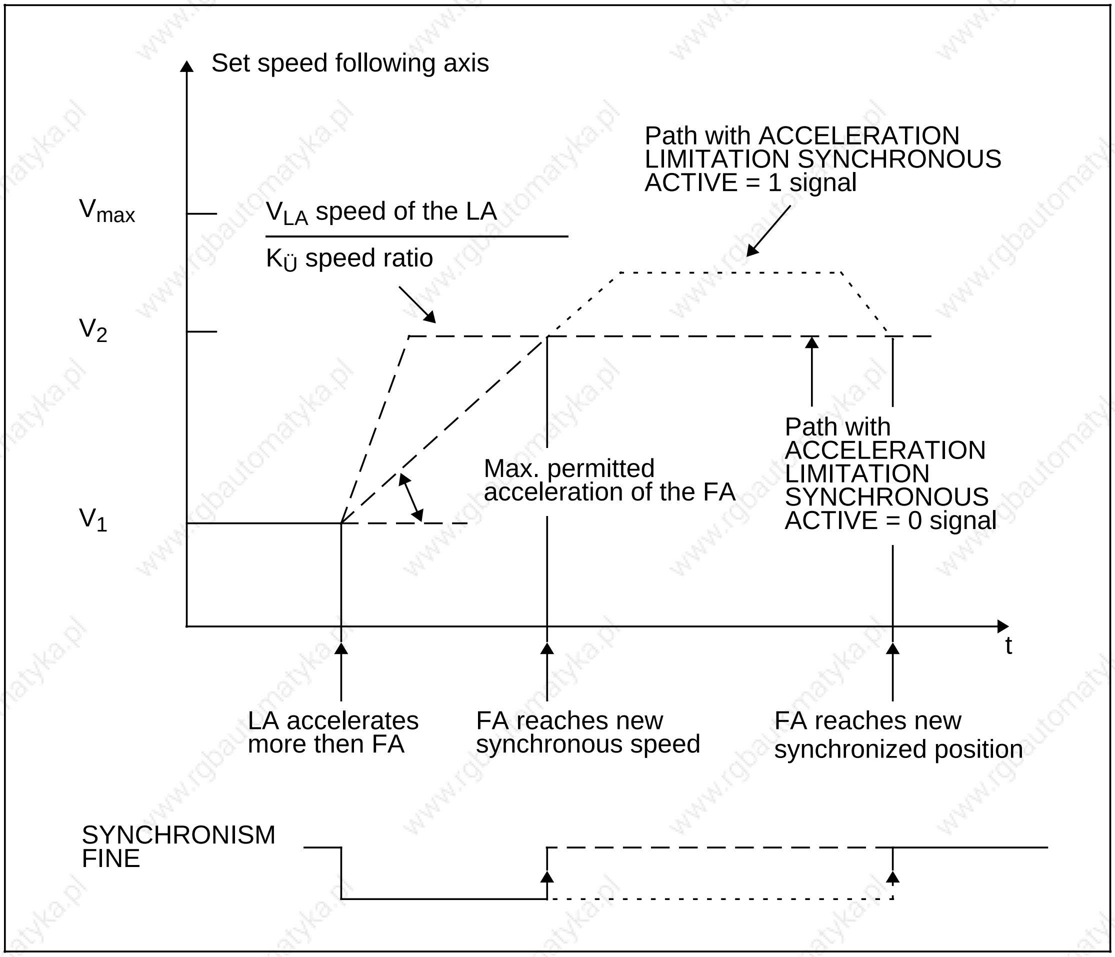
1/0 transition: The PLC user program must reset the signal to 0 if the status of ACCELERATION LIMITATION SYNCHRONOUS ACTIVE has changed.

Notes:

- The acceleration limitation for the following axis can also be switched with the ACCELERATION LIMITATION SYNCHRONOUS setting data bit. The NC transfers every change effected by the interface signal to the setting data bit.
- The acceleration limitation for the following axis ensures, if the gear link is active, that the following axis runs in positional synchronism with the leading axes again even after acceleration processes. Positional deviations that occur during the acceleration are added up and corrected after the acceleration process; that is to say the following axis accelerates for a slightly longer time than the leading axes and thus catches them up (see figure).

FA 1: m=0	FA 2: m=4	FA 3: m=8

Example of how velocity changes with high acceleration of the leading axis:



The acceleration of the following axis is limited by MD 276*.

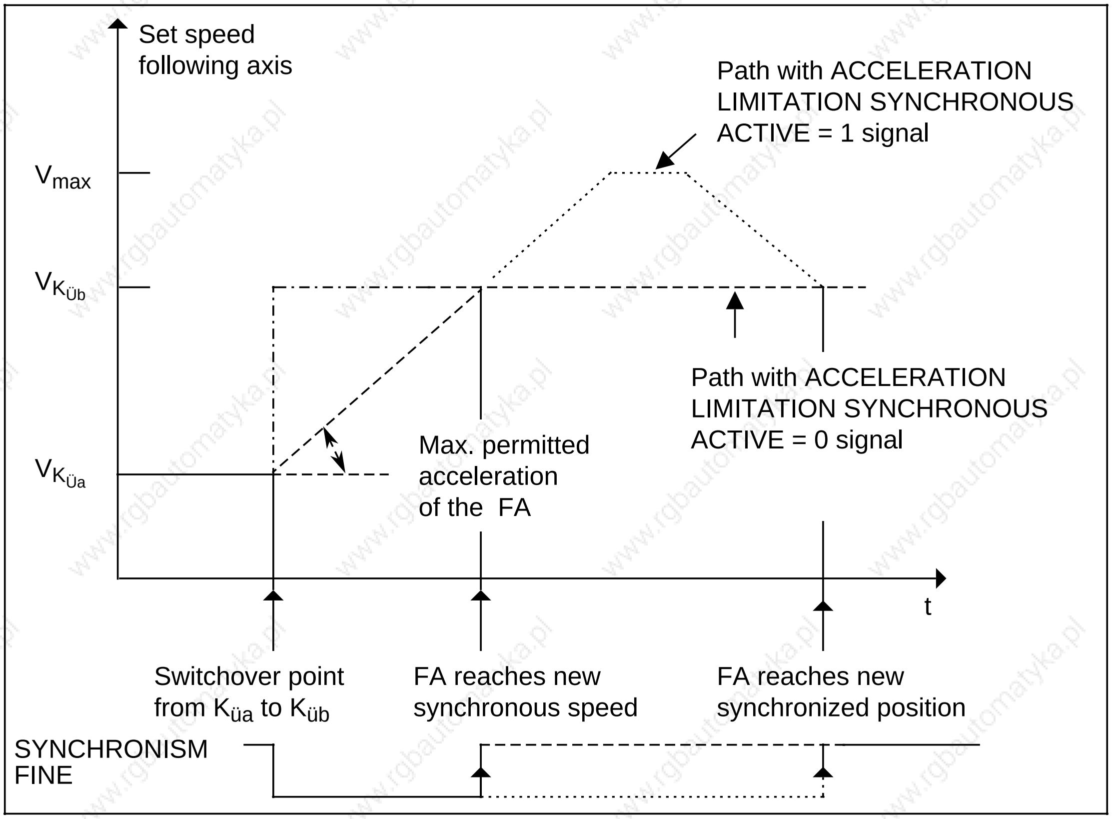
Note:

The meaning of the signal in GA2, software version 1 from what it was in software version 6. The following notes apply to software version 6.

- If acceleration limitation is deselected, the leading axes and following axis run only with synchronous speed and no longer with positional synchronismafter acceleration processes. The positional differences added up during the acceleration are incorporated in the synchronism error. If the synchronism error becomes greater than the relevant tolerance bands, the SYNCHRONISM FINE/COARSE signals are no longer set.
- The acceleration limitation for the following axis ensures that the following axis runs in positional synchronism with the leading axes again even after acceleration processes. Positional deviations that occur during the acceleration are added up and corrected after the acceleration process; that is to say the following axis accelerates for a slightly longer time than the leading axes and thus catches them up (see figure).

FA 1: m=0	FA 2: m=4	FA 3: m=8

Example of how velocity changes when the link is switched: c)



Note:

The following notes apply to GA2, software version 1.

- During the acceleration phase the following axis follows the leading axis with maximum acceleration until the two axes are running with synchronous speed for the first time. The increments that cannot be output are lost.
- If acceleration limitation is deselected, the leading axes and following axis run only with synchronous speed and no longer with positional synchronism after acceleration processes. The positional differences added up during the acceleration are incorporated in the synchronism error.
- If the alarm "FA x velocity limitation" is output, the resulting position difference is stored and travelled when the speed of the leading axis allows it. This position difference is deleted on an emergency off but not on a key reset. This means that on a key reset the leading axis is stopped but the following axis continues to move until the position difference has been eliminated.

c) *up to and including software version 6*

ENABLE EMERGENCY RETRACTION	DW m + 2, bit 13

0/1 transition: Each 0/1 transition switches over the state of emergency retraction monitoring. If the EMERGENCY RETRACTION ENABLED signal is a 0 signal, emergency retraction monitoring is switched on. If it is set, monitoring is switched off.

1/0 transition: The PLC user program must reset the ENABLE EMERGENCY RETRACTION signal if the status of EMERGENCY RETRACTION ENABLED has changed.

Notes:

- Emergency retraction monitoring checks whether the actual position of the following axis is within a tolerance band about the setpoint. The tolerance band is determined by an emergency retraction threshold (MD). In the event of excessive deviation of the actual position from the setpoint, synchronization of the leading and following axes is impaired. If emergency retraction monitoring is switched on, it indicates the malfunction by issuing an alarm, an interface signal (EMERGENCY RETRACTION ACTIVE) and, if applicable, a hardware signal (this requires a mixed I/O module for the servo CPU). The PLC user program can then implement appropriate counter-measures designed to protect the machine and workpiece (emergency retraction).

  Emergency retraction threshold: FA 1: NC MD 954
  FA 2: NC MD 974
  FA 3: NC MD 994

- Emergency retraction monitoring can also be switched with the ENABLE EMERGENCY RETRACTION setting data bit. The NC program transfers every change in the function state of emergency retraction monitoring to the setting data bit.

  ENABLE EMERGENCY RETRACTION: FA 1: SD 5004.5
  FA 2: SD 5006.5
  FA 3: SD 5008.5

- When switching the gearbox link, emergency retraction should be deselected briefly: see note for ACTIVATE NEW $K_Ü$.

FA 1: m=0	FA 2: m=4	FA 3: m=8

COMPENSATORY CONTROLLER ON/OFF	DW m + 2, bit 12

0/1 transition: Each 0/1 transition of the COMPENSATORY CONTROLLER ON/OFF signal changes the state of the compensatory controller. If the COMPENSATORY CONTROLLER ACTIVE signal is on 0, the compensatory controller is switched on. If it is on 1, the compensatory controller is switched off.

1/0 transition: The PLC user program must reset the COMPENSATORY CONTROLLER ON/OFF signal if the status of the COMPENSATORY CONTROLLER ACTIVE signal has changed.

Notes:

- The compensatory controller can also be switched with the COMPENSATORY CONTROLLER ON setting data bit; the NC program modifies this setting data bit accordingly if the PLC user program switches the compensatory controller.
- The purpose of the compensatory controller is to equalize load disturbances and to assist in maintaining the link in the event of partial system failures. It increases the rigidity of the link.
- The compensatory controller should generally be switched on in conjunction with LINK ACTIVE. In exceptional cases (e.g. reference point approach with LINK ACTIVE), however, the compensatory controller must be switched off.

FA OVERLAY ON	DW m + 2, bit 10

0/1 transition: The setpoint overlay for the following axis is activated. In the FA OVERLAY ACTIVE signal the NC indicates that it has switched on the setpoint overlay.

1/0 transition: The PLC user program must reset the FA OVERLAY ON signal if FA OVERLAY ACTIVE has changed to the 1 signal.

Notes:

- The setpoint overlay can also be switched with the FA OVERLAY ON setting data bit. If the PLC user program switches the FA OVERLAY ON interface signal (0/1 transition), the NC program sets the setting data bit of the same name.
- The setpoint overlay can be switched off again with the FA OVERLAY OFF signal or by cancelling the FA OVERLAY ON setting data bit.
- Setpoint overlays can be specified by the NC part program, travel keys, handwheels or the PLC user program (path dimension, division increment).
- If the following axis overlay is specified by the NC part program, it must take place only in G 91 incremental dimension.
- Setpoint overlay must be switched on for the "Semi-automatic centering" and "On-the-fly synchronization" functions.

FA 1: m=0	FA 2: m=4	FA 3: m=8

SYNCHRONIZATION ON	**DW m + 2, bit 9**

0/1 transition: Synchronization between the following axis and the leading axis specified in the setting data is enabled. The NC acknowledges this in the SYNCHRONIZATION ENABLED signal.
The leading and following axes are synchronized with the following signals, ACTIVATE NEW $K_{Ü}$ or SYNCHRONIZATION START or when the link is activated with LINK ON. On LINK ON the following axis moves to the position given in the setting data.

1/0 transition: The PLC user program must reset the signal if synchronization is enabled (SYNCHRONIZATION ENABLED = 1).

Notes:

- Synchronization can also be enabled with the SYNCHRONIZATION ON setting data bit. If the PLC user program sets the SYNCHRONIZATION ON interface signal (0/1 transition), the NC program also sets the setting data bit of the same name.
- The leading axis with which the following axis is synchronized is specified in the setting data.

  Synchronization-compatible leading axis: FA 1: SD 58
  FA 2: SD 61
  FA 3: SD 64
- The synchronized positions are specified in the setting data:

  Synchronized position of the leading axis to: FA 1: SD 57
  FA 2: SD 60
  FA 3: SD 63

  Synchronized position of the following axis: FA 1: SD 56
  FA 2: SD 59
  FA 3: SD 62

  Also see note on SYNCHRONIZATION REACHED.

FA 1: m=0	FA 2: m=4	FA 3: m=8

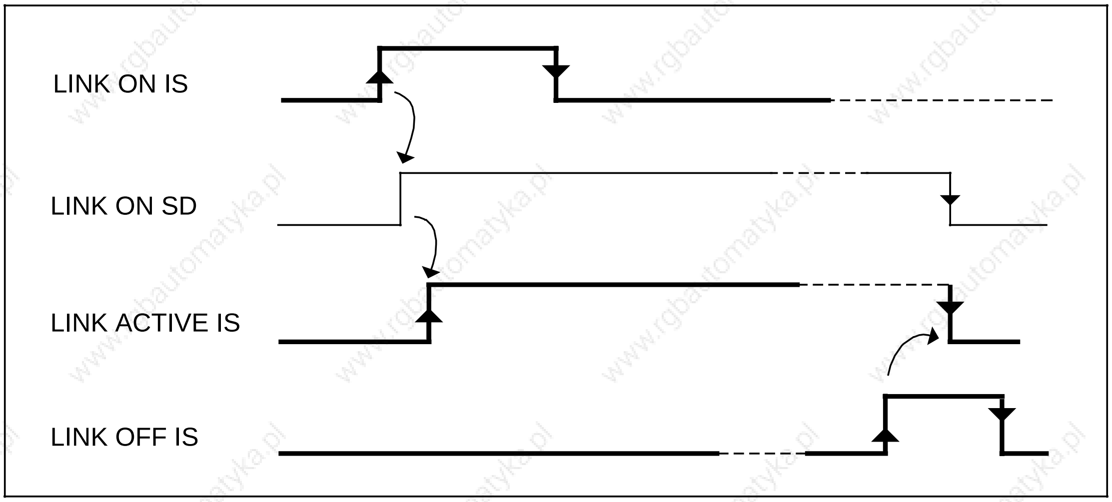
LINK ON	DW m + 2, bit 8

0/1 transition: The gearbox link between the following axis and its leading axes is switched on. By way of acknowledgement the NC sets the LINK ACTIVE signal to 1. The following axis then follows the movements of the leading axes according to the specified speed ratios.

1/0 transition: The PLC user program must reset LINK ON to 0 when the gearbox link is switched on (LINK ACTIVE = 1).

Notes:

- The gearbox link can also be switched with the LINK ON setting data bit. If the PLC user program sets the LINK ON interface signal, the NC program also sets the LINK ON setting data bit.



IS: interface signal, SD: setting data bit

- If synchronization is enabled when the gearbox link is enabled, the PLC user program should cancel the read-in enable until the following axis has reached synchronization (SYNCHRONIZATION REACHED = 1). Also see note on SYNCHRONIZATION START.

FA 1: m=0	FA 2: m=4	FA 3: m=8

ACTIVATE NEW $K_Ü$ — DW m + 2, bit 7

0/1 transition: The newly calculated speed ratios are activated, that is to say they are taken into account when calculating the set speed for the following axis. The NC resets the NEW $K_Ü$ CALCULATED signal when the new speed ratios are effective.

1/0 transition: The PLC user program must reset ACTIVATE NEW $K_Ü$ to 0 when NEW $K_Ü$ CALCULATED has changed to 0.

Notes:

- New speed ratios can also be activated while axes are traversing.
- With synchronization enabled, the following axis is synchronized with the leading axis specified in the setting data when the new speed ratios are activated. In this event, the PLC user program should cancel the read-in enable until synchronization has been reached (SYNCHRONIZATION REACHED = 1). Also see note on SYNCHRONIZATION START.
- If the speed ratios are changed while axes are traversing, emergency retraction monitoring should be disabled. The following axis cannot accelerate suddenly to the velocity determined by the new speed ratios. For this reason the synchronous deviation that occurs will very probably exceed the emergency retraction threshold. Once the following axis has reached the new velocity (see SYNCHRONISM COARSE/FINE) emergency retraction monitoring can be enabled again.
- The ACTIVATE NEW $K_Ü$ signal is also available as a setting data bit.

FA 1: m=0	FA 2: m=4	FA 3: m=8

SYNCHRONIZATION START	DW m + 2, bit 5

0/1 transition: Synchronization between the following axis and the leading axis specified in the setting data is initiated at any time with the 0/1 transition.

1/0 transition: The PLC user program must reset the signal once synchronization is reached (SYNCHRONIZATION REACHED = 1).

Preconditions for synchronization:

- The gearbox link must be switched on (LINK ON = 1).
- Synchronization must be enabled (SYNCHRONIZATION ENABLED = 1).
- When synchronization is started, the read-in enable should be cancelled until synchronization has been reached.
- A free NC channel is needed for the synchronization and the following and leading axes must have the same position control cycle time. The setpoint overlay for the following axis must be switched on.
- When synchronization is started the following axis must not execute a further superimposed movement, otherwise the NC will abort it with "Delete distance to go". Since "Delete distance to go" has a channel-specific effect, all the interpolator-controlled axes associated with the following axis are affected.

FA OVERLAY OFF	DW m + 2, bit 2

0/1 transition: The setpoint overlay for the following axis is switched off. The NC acknowledges this with FA OVERLAY ACTIVE = 0. The FA OVERLAY ON setting data bit is also reset. The movement of the following axis is subsequently determined exclusively by the movements of its leading axes, taking the speed ratios into account (exception: see notes).

1/0 transition: The PLC user program must reset the signal if FA OVERLAY ACTIVE has changed to the 0 signal.

Notes:

- The movements of the following axis can still be influenced by the handwheel with setpoint overlay switched off. This can be prevented by the standard interlocks.
- With setpoint overlay switched off, the "Semi-automatic centering" and "On-the-fly synchronization" functions cannot be performed.

FA 1: m=0	FA 2: m=4	FA 3: m=8

SYNCHRONIZATION OFF	DW m + 2, bit 1

0/1 transition: The enable for synchronization between the following and leading axes is cancelled. The SYNCHRONIZATION ENABLED interface signal and SYNCHRONIZATION ON setting data bit are reset when the NC has disabled synchronization.

1/0 transition: The PLC user program must reset the SYNCHRONIZATION OFF signal if SYNCHRONIZATION ENABLED has been cancelled by the NC.

Note:

Synchronization between the following and leading axes can also be switched with the SYNCHRONIZATION ON setting data bit.

LINK OFF	DW m + 2, bit 0

0/1 transition: The link between the following axis and its leading axes is switched off. The NC cancels the LINK ACTIVE signal and the LINK ON setting data bit as soon as the link is switched off. The following axis then behaves like a normal NC axis again and can be operated as such.

1/0 transition: The PLC user program resets the signal to 0 when the link is cancelled (LINK ACTIVE = 0).

Notes:

- The gearbox link can also be switched with the LINK ON setting data bit.
- If the signal SYNCHRONIZATION ENABLED is set, the following axis moves to the position given in the setting data.

FA 1: m=0	FA 2: m=4	FA 3: m=8

2ND FLANK APPROACHED	**DW m + 3, bit 10**

0/1 transition: The effect of a signal change depends on the 2ND FLANK STORED signal.

a) 2ND FLANK STORED = 0:
The actual position of the axis is stored and overrunning of the workpiece flank is prevented with the 0/1 transition of 2ND FLANK APPROACHED (see 1ST FLANK APPROACHED). The NC sets the 2ND FLANK STORED signal and automatically approaches the centre position between the two flanks (see CENTRE POSITION REACHED).

b) 2ND FLANK STORED = 1:
The stored position of the 2nd workpiece flank is deleted and the associated traversing limit for the axis is cancelled. The 2ND FLANK STORED signal is cancelled. This allows the information on the 2nd workpiece flank to be corrected.

1/0 transition: The PLC user program must reset the 2ND FLANK APPROACHED signal if the status of the 2ND FLANK STORED signal has changed.

Notes:

- The signal is effective only with SAC ACTIVE = 1.
- The 1st flank must be specified before defining the 2nd flank position with 2ND FLANK APPROACHED.

1ST FLANK APPROACHED — DW m + 3, bit 9

0/1 transition: The effect of a signal change depends on the 1ST FLANK STORED signal.

a) 1ST FLANK STORED = 0:
The actual position of the axis is stored with the 0/1 transition of 1ST FLANK APPROACHED. The axis cannot traverse any further in the direction of the workpiece flank; any attempt to overrun the flank position triggers an alarm.

b) 1ST FLANK STORED = 1:
The stored position of the 1st workpiece flank is deleted and the 1ST FLANK STORED signal is reset accordingly. The axis can again be traversed freely; this allows the preset flank position to be corrected.

1/0 transition: The PLC user program must reset the 1ST FLANK APPROACHED signal if the status of 1ST FLANK STORED has changed.

Notes:

- The signal is effective only with SAC ACTIVE = 1.
- After switching on the SAC function the axis must be traversed by at least one path increment before 1ST FLANK APPROACHED is set, otherwise an alarm is triggered.
- The 1st workpiece flank must be specified with 1ST FLANK APPROACHED before defining the 2nd flank position.

FA 1: m=0	FA 2: m=4	FA 3: m=8

SAC ON/OFF	**DW m + 3, bit 8**

0/1 transition: The "semi-automatic centering" (SAC) function is switched over, i.e. switched on or off, each time the signal changes from 0 to 1. The current switching status is indicated by the SAC ACTIVE signal.

1/0 transition: The PLC user program must reset the SAC ON/OFF signal if the status of SAC ACTIVE has changed.

Preconditions:

- The SAC function requires a free NC channel. This channel is automatically determined by the NC.
- The setpoint overlay for the following axis must be switched on (FA OVERLAY ACTIVE =1).
- The gearbox link must be switched on (LINK ACTIVE =1).

Notes:

- The velocity of the axis movement can be influenced by means of the feedrate override.
- After switching on the SAC function the axis must be traversed by at least one path increment before 1ST FLANK APPROACHED is set.

FA 1: m=0	FA 2: m=4	FA 3: m=8

8 Spindle/PLC Interface (DB 31)

8.1 Introduction

Maximum spindle speed and data structure

The SINUMERIK 880 can control a maximum of 6 spindles. The interfaces of **all** spindles are stored in data block 31.

DB 31 also contains the status and control signals of the spindles for synchronous mode. Here again, data areas are provided for six spindles. Only the signals from/to the **following spindles** are relevant in each case.

Data block 31 has the following structure:

DW 0 … DW 23	Status and control signals from/to spindle 1 ... 6
DW 24 … DW 35	Status and control signals for synchronous mode from/to spindle 1 ... 6

When operating with two PLCs the spindle PLC signals can be output to both PLCs. The PLC spindle interface can be operated only from one PLC. This setting is made spindle-specifically, by means of PLC machine data:

- PLC I: MD 6012 and MD 6014
- PLC II: MD 6112 and MD 6114

Assignment with extended spindle address

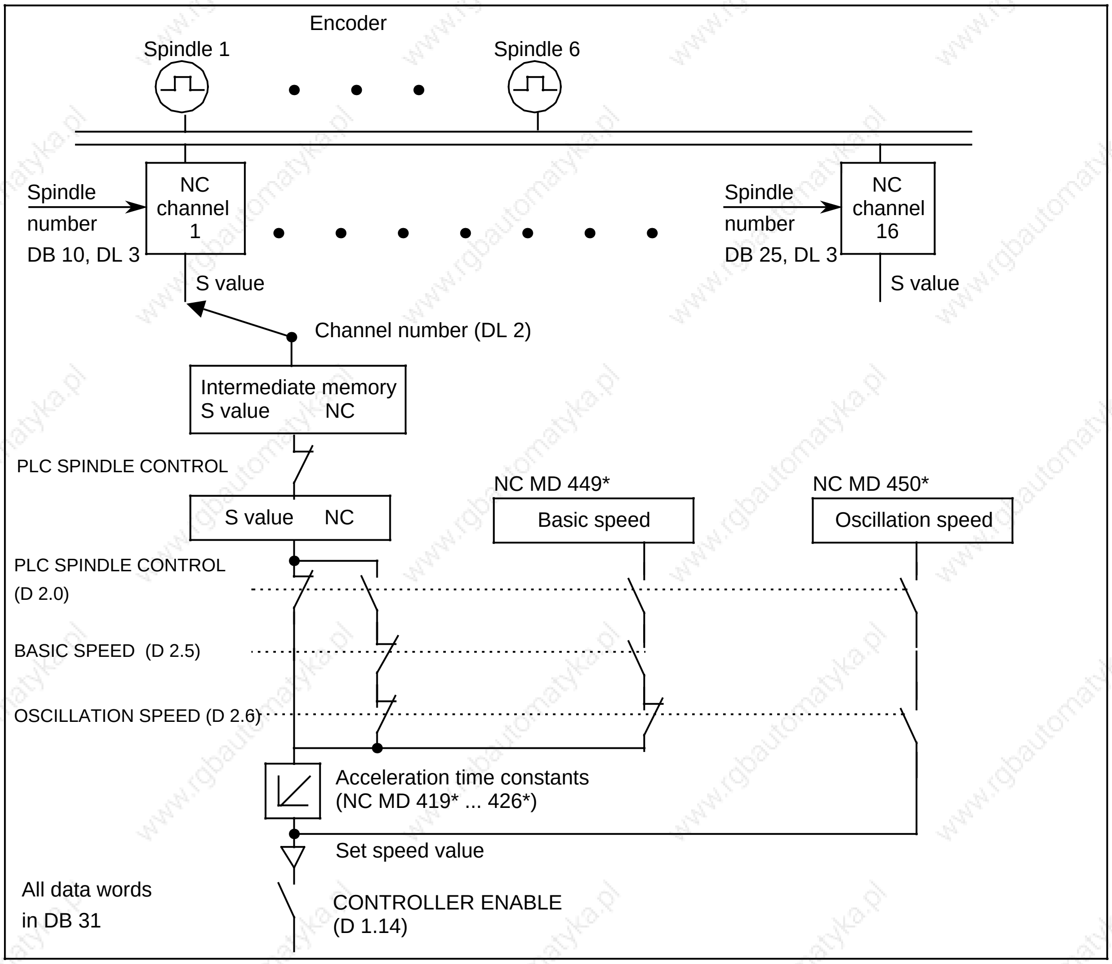
The programmed speed/cutting speed and the spindle M commands M03, M04, M05 and M19 are evaluated in the NC. The extended NC address is used to determin which spindle the programmed values refer to.

Example:

S2=1000	Spindle 2 to run at 1000 rpm
M2=5	Spindle 2 spindle stop (without orientation)

If no extended S address has been written, the S word is output to the spindle stated under SPINDLE NUMBER at the channel-specific interface (DB 10 ... DB 25, DL 3).

Structure of spindle control



Spindle control structure

The above figure shows the basic structure of the spindle control on the SINUMERIK 880.

The pulses of all the spindles can be read by each NC channel. Which channel interprets which spindle pulses is determined by means of the channel-specific SPINDLE NUMBER signal. It is permissible for several channels to access the same spindle pulses **at the same time.** This means, for instance, that on double slide lathes control can pass from channel 1 to, say, channel 2 at v = const. without switching over hardware (also see following figure).

The spindle-specific CHANNEL NUMBER signal is used to determine from which channel the spindle obtains set speed values (S word). If, for example, control passes from channel 1 to channel 2 (at v = const.) on a double slide lathe, the spindle-specific CHANNEL NUMBER interface signal must change from 1 to 2.

The set speed for a spindle can be specified in three ways: in the S value from the NC, as the basic speed, or as the oscillation speed from the PLC. If the PLC SPINDLE CONTROL signal is set, **no more** new S words can be transferred to the spindle by the NC program; the PLC user program can switch the direction of rotation of the spindle in this mode or it can specify the basic or oscillation speed as required.

The hardware assignment spindle number <-> measuring circuit module is made by means of NC machine data 400*. The spindle declared spindle 1 in the MD is also the 1st spindle at the NC/PLC interface, that is to say it is assigned data words 0 ... 3, 24 and 25 in DB 31.

Generally speaking, the spindle control can operate in different spindle modes:

- Control mode — Controlled operation with preset spindle speed and direction of rotation
- Oscillation mode — Controlled operation with preset motor speed and direction of rotation
- Positioning mode — "Oriented spindle stop"; the spindle is incorporated in position control

Two additional modes are available for spindles that are controlled by 32-bit servo CPUs:

- C axis mode — Spindle operated as closed-loop position-controlled rotary axis
- Synchronous mode — "Synchronous spindle" function; two spindles (leading and following spindle) run at synchronous speed with preset speed ratio and defined angular offset (optional)

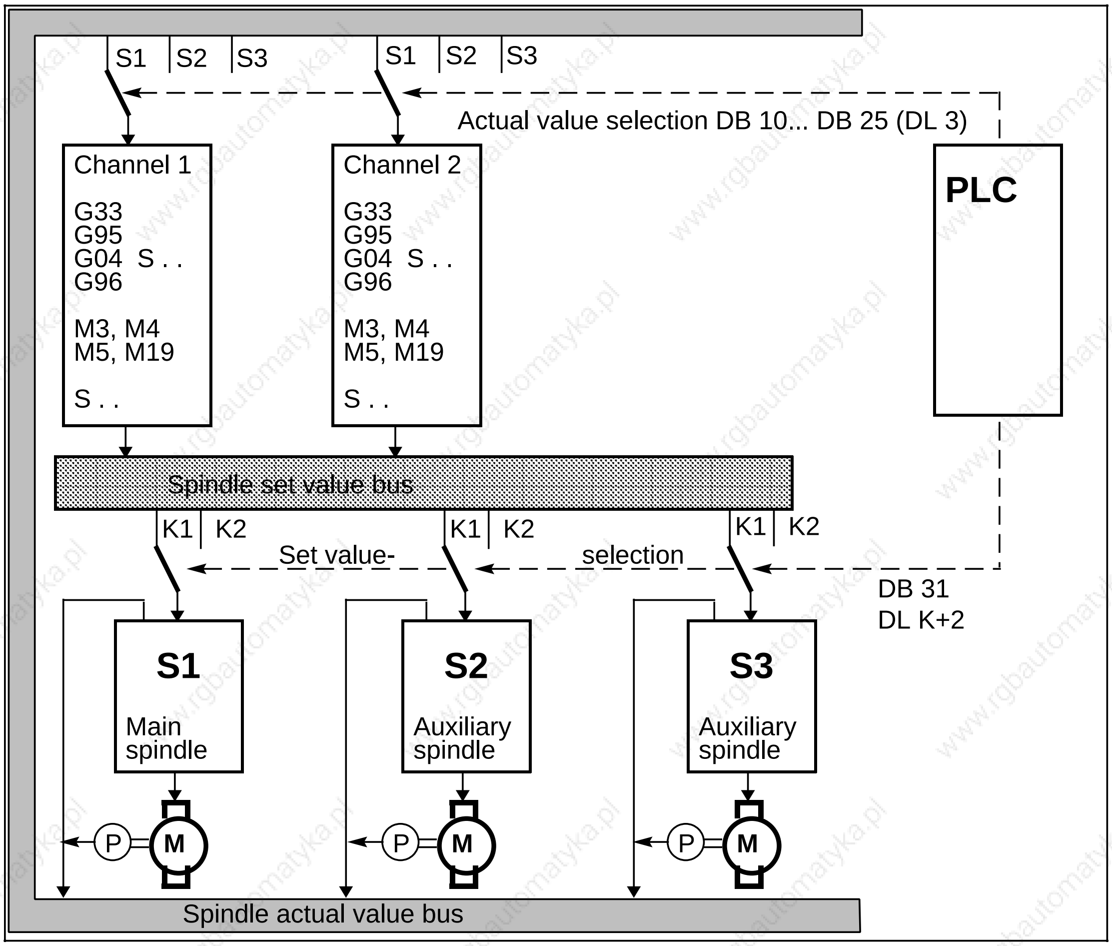
Notes:

- For C axis operation, the spindle is assigned an axis by means of machine data (MD 461*). If a C axis is assigned to the spindle by MD 461* the axis-specific signals are also evaluated.

  Note in particular that the measuring circuit monitors for the axis can be switched off with the PARKING AXIS signal so that the axis-specific measuring circuit monitors can be suppressed.
- See the "Extended Spindle Functions" Function Manual for further notes.

Messages:

The SPINDLE DISABLE signals can be allocated error/operational messages with selection made via PLC machine data.



Spindle assignment, example with three spindles and two channels

8.2 Signals from spindle

ACTUAL DIRECTION OF SPINDLE ROTATION CW	DW K, bit 15

1 signal: Actual direction of rotation cw.
0 signal: Actual direction of rotation ccw.

Notes:

- The signal is derived from the rotational direction of the encoder, taking MD 520*, bit 1 "Sign change actual value" into account.
- When the spindle is at a standstill, the signal corresponds to actual direction of spindle rotation cw.
- Up to and including software version 6, the signal is undefined because no pulse encoder is available for the spindle.
- On GA2, software version 1 and higher, the signal is derived from the set speed and therefore also has a meaning for spindles without an encoder or if the encoder limit frequency is exceeded.

PROGRAMMED SPEED TOO HIGH	DW K, bit 14

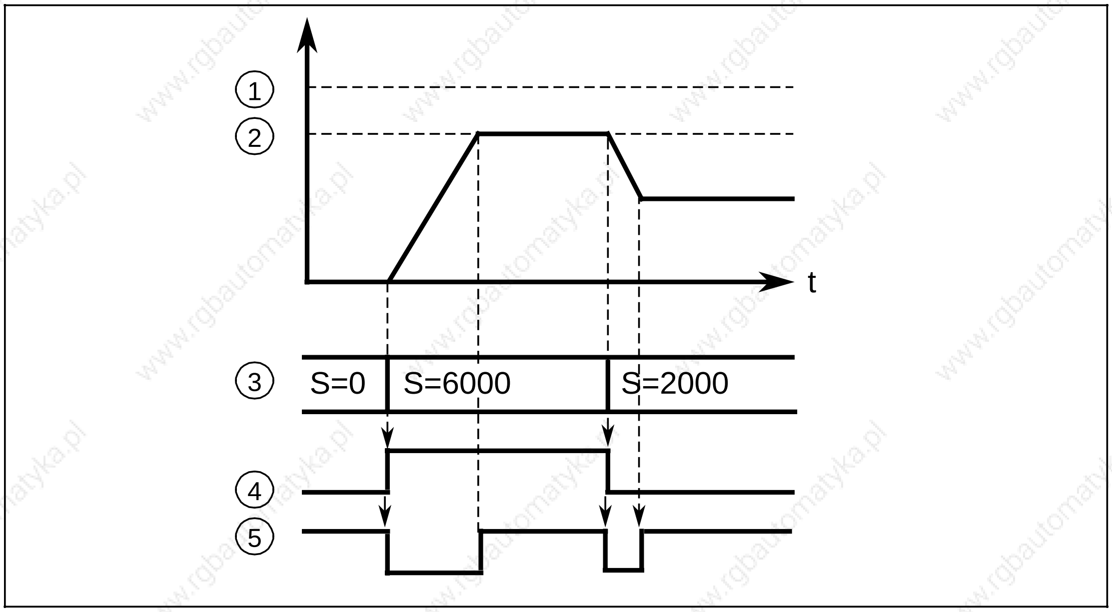
1 signal: The programmed speed or speed calculated with constant cutting speed (G96) is too high.
0 signal: The programmed speed or speed calculated with constant cutting speed (G96) lies below the maximum speed.

Notes:

- The speed override is taken into account when checking the limiting values.
- The maximum speed is the lowest of the following limit values:

  – MD 403* to 410* "Maximum speed" for each gear stage
  – MD 451* "Maximum chuck speed"
  – SD 401* "Programmable spindle speed limitation with G96"; programmed with G92 (taken into account if the NC function G96 is active)
  – SD 403* "Programmable spindle speed limitation"; programmed with G26

The data cells can be overwritten by the PLC using FB 62 if required.



Signal chart

1: Speed limit of selected gear stage, e.g. 5000
2: Maximum chuck speed, e.g. 4000
3: Programmed S values in main memory
4: PROGRAMMED SPEED TOO HIGH signal
5: SPINDLE IN SET RANGE signal

Example of application:

The PROGRAMMED SPEED TOO HIGH interface signal can be used to interrupt further execution of the NC program and output a corresponding message.

SPINDLE IN SET RANGE	**DW K, bit 13**

1 signal: Actual speed in defined range about set speed (set range).

0 signal: Actual speed outside set range.

Notes:

- The set speed is derived from the programmed speed or, in the case of constant cutting speed (G96), from the calculated speed, taking the speed override and speed limiting values into account (see PROGRAMMED SPEED TOO HIGH interface signal).
- The set range is determined by the set speed and the "Spindle speed tolerance" (MD 444*).

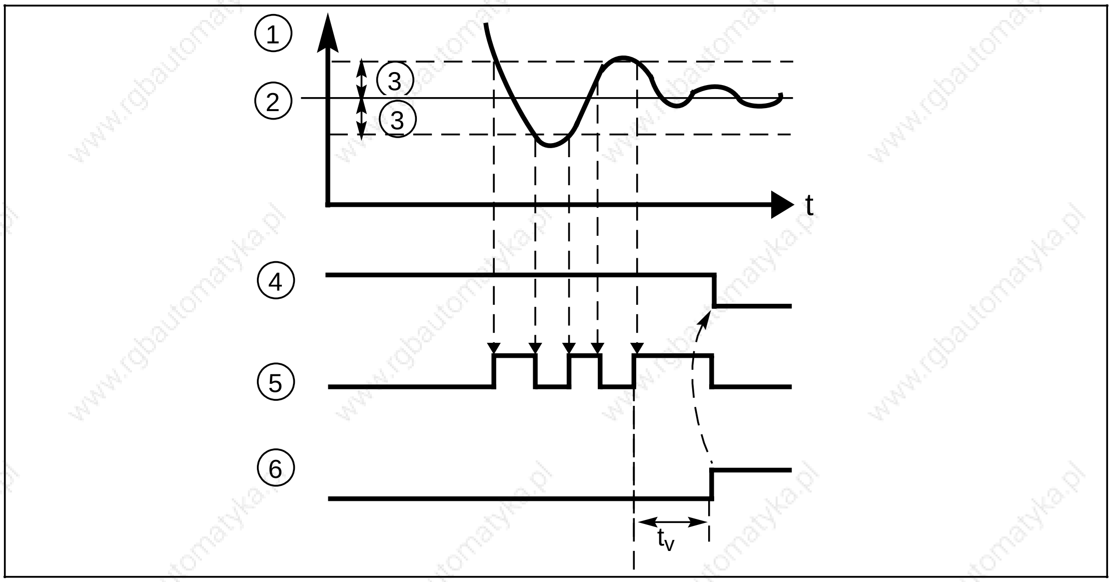
Example of application:

Enabling of axis movements (e.g. by cancelling GENERAL FEED DISABLE interface signal) after a speed change by setting a new S value or after changing gear.

SPINDLE POSITION REACHED — DW K, bit 12

1 signal: Actual spindle in defined range (set range) about the programmed setpoint.

0 signal: Actual spindle position outside defined range.



Signal chart

1: Actual spindle position
2: Setpoint
3: Positional tolerance
4: Position control switched on
5: SPINDLE POSITION REACHED signal
6: ACKNOWLEDGE M 19 signal (from PLC, t_v= delay time)

Notes:

- The signal is relevant only if the spindle is operating in positioning mode (e.g. M19).
- The set range is determined by the following data:
  - The setpoint
  - MD 443* "positional tolerance" with spindle positioning by NC or PLC
  - The position limit in the user data DB with "M19 over several revolutions" from the command channel
- The signal is reset in the event of overshooting beyond the set range (e.g. owing to poor optimization of the position controller).
- The ACKNOWLEDGE M19 signal must not be given by the PLC user program until the spindle has settled in position (e.g. after delay time t_v during which SPINDLE POSITION REACHED was continuously set).

Example of application:

Tool change enable on milling machines.

SPINDLE STOP DW K, bit 11

1 signal: Actual speed in zero-speed range (machine data).
0 signal: Actual speed greater than zero-speed range.

Note:

The zero-speed range is determined by MD 446* "Zero speed tolerance".

Example of application:

Enable for opening guard.

SPINDLE SYNCHRONIZED DW K, bit 10

1 signal: The spindle is synchronized with the encoder, i.e. the encoder zero mark has been recognized.

0 signal: The spindle is not synchronized with the encoder.

Notes:

- The position can be recorded only if the spindle is synchronized with the encoder.
- If the spindle is not synchronized with the encoder, it may be for one of the following reasons:
  - The spindle does not have an encoder.
  - The zero mark has not yet been overrun following POWER ON.
  - A synchronization routine triggered by RESYNCHRONIZE SPINDLE has not been completed yet.
  - Synchronism with the encoder lost owing to excessive speeds; resynchronization is executed automatically when lower speeds are reached.

SPINDLE POSITIONING ACTIVE DW K, bit 9

1 signal: Spindle control operating in positioning mode.
0 signal: Spindle control not operating in positioning mode.

Notes:

- The positioning mode is selected by the NC command M19, the POSITION SPINDLE signal or the "M19 over several revolutions" command channel function.
- The positioning mode is generally aborted by the ACKNOWLEDGE M19 signal.

Example of application:

Suppression of axis movements during positioning.

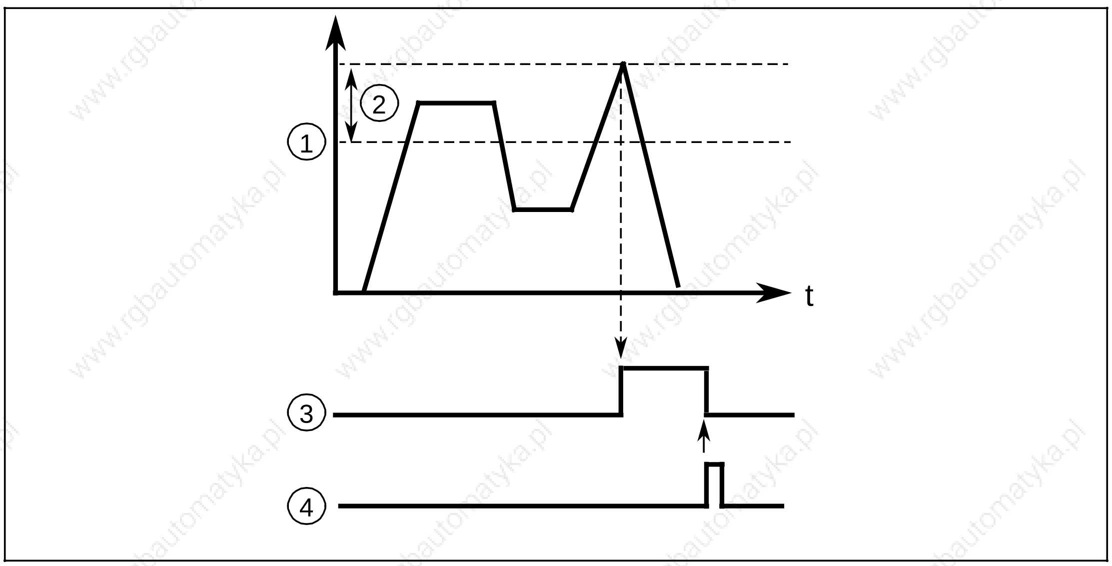
SPEED LIMIT EXCEEDED	**DW K, bit 8**

1 signal: The actual spindle speed has exceeded the maximum speed by more than the permitted tolerance.

0 signal: The actual spindle speed is below the maximum speed.

Notes:

- The maximum speed is the lowest of the following limit values:
  - MD 403* to 410* "Maximum speed" for each gear stage
  - MD 451* "Maximum chuck speed"
  - SD 401* "Programmable spindle speed limitation with G96"; programmed with G92 (taken into account if the NC function G96 is active)
  - SD 403* "Programmable spindle speed limitation"; programmed with G26
- The permissible tolerance is determined by:
  - MD 445* "Maximum spindle speed tolerance"
- If the spindle exceeds one of the maximum speed by more than the permissible tolerance, all the spindles and axes of the relevant mode group are brought to a standstill and an alarm is issued.
- The SPEED LIMIT EXCEEDED signal is modal and has to be reset with RESET.



Signal chart

1: Maximum speed
2: Permissible spindle speed tolerance
3: SPEED LIMIT EXCEEDED signal
4: RESET signal

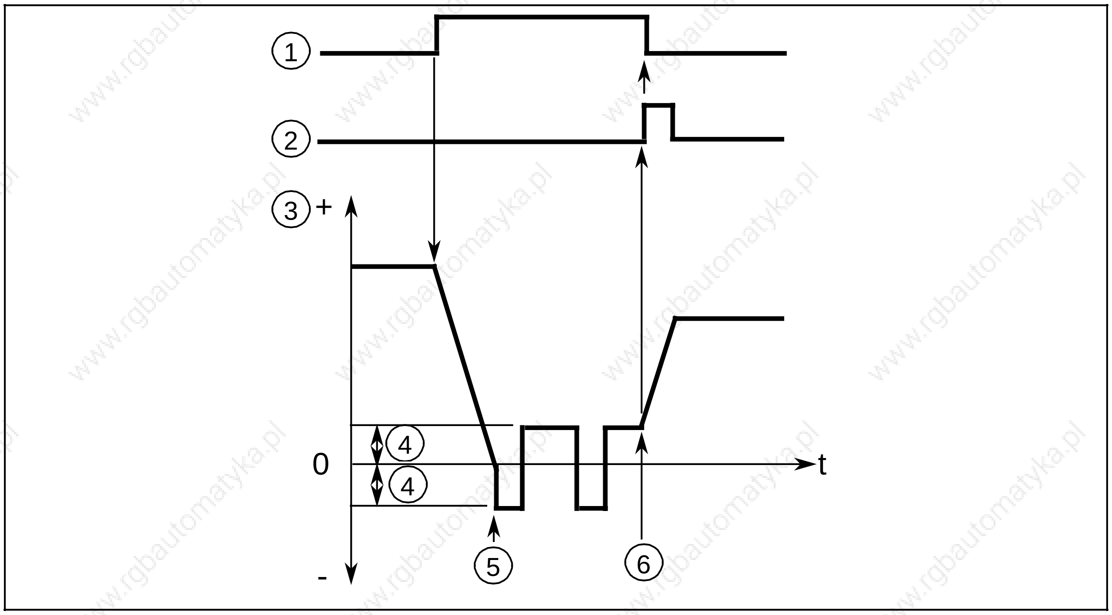
CHANGE GEAR — DW K, bit 7

1 signal: Request to PLC to change to new set gear stage.
0 signal: No gear stage change requested.

Notes:

- The signal is output if the programmed S value is outside the speed range of the current actual gear stage and a new set gear stage could be determined.

  The speed ranges are determined by:
  – MD 403* to MD 410* "Maximum speed" for each gear stage
  – MD 411* to MD 418* "Minimum speed" for each gear stage
- Once the gear change has been made the signal has to be reset by the PLC user program and the new actual gear stage has to be entered in the interface.
- The speed ranges are checked only if a new S value has been specified. The PLC user program can therefore also acknowledge the gear stage change (reset CHANGE GEAR interface signal) without having changed the gear stage if required.
- MD 521*, bit 5 "New S value after PLC acknowledgement" determines whether the spindle is to assume the set speed until the gear stage change has been acknowledged.
- If the gear stage change is triggered directly by the NC part program (M 41 ... M 48, decoding by PLC user program), the CHANGE GEAR interface signal cannot be evaluated until the LAST INFORMATION interface signal is also present.
- The signal also has to be reset and the new actual gear stage entered in the interface if the gear stage is selected by M 41 ... M 48.
- The change limits are allowed to overlap.
- CHANGE GEAR is output only if the "Signals from/to spindle" PLC MD (PLC I: MD 6012, PLC II: MD 6112) is set and the relevant PLC is declared in NC MD 5038.
- If dual PLCs are used and the "trace spindle signals" function is activated (PLC I MD 6014, PLC II MD 6114), the PLC user program must reset the signal "CHANGE GEAR" in both PLCs.

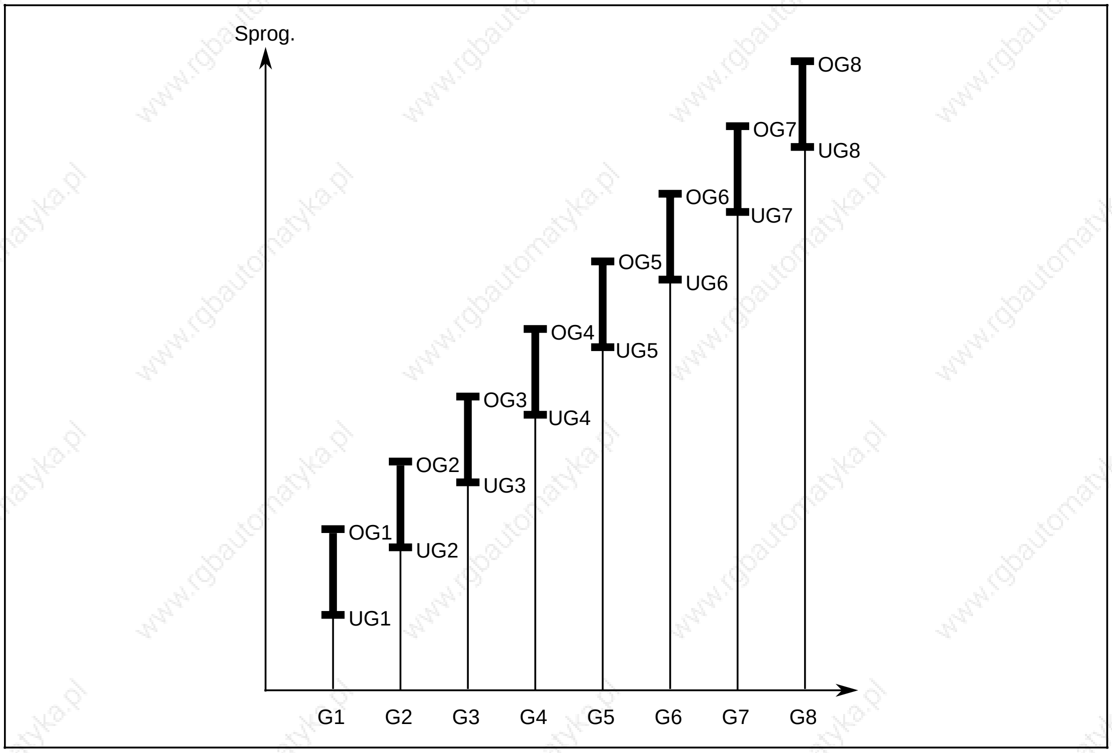


Signal chart

1: CHANGE GEAR signal
2: Feedback signal from gear to PLC: "Gear engaged"
3: Actual spindle motor speed
4: Set value for oscillation speed
5: Oscillation, change gear
6: Gear engaged, accelerate spindle motor

Sequence:

- Controlled by NC:
  - New set gear stage determined and output to interface.
  - CHANGE GEAR interface signal changes from 0 to 1.
- Controlled by PLC user program:
  - Spindle decelerated to zero speed.
  - Spindle motor accelerated to oscillation speed (OSCILLATION SPEED and SET ROTATION CW interface signals).
  - The direction of rotation of the motor is reversed in order to facilitate gear engagement (SET ROTATION CW interface signal).
  - The user program recognizes that the gear has engaged (e.g. by the "Gear engaged" signal from the gearbox). The new actual gear stage **must** then be entered in the interface (DW K + 1, bit 0 to 2) and the CHANGE GEAR interface signal has to be reset.
- Controlled by NC:
  - The spindle is enabled again and accelerated to the new speed.



Example of assignment of speed ranges to gear stages

OG :	Upper limit speed of gear stage
UG :	Lower limit speed of gear stage
G1...G8:	Gear stages 1 ... 8
S-prog:	Programmed S value

SET GEAR STAGE — DW K, bit 0 to 2

In the case of automatic gear stage selection by the NC, the SET GEAR STAGE is output in coded form to the PLC at the same time as CHANGE GEAR:

Gear stage	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

8.3 Signals to spindle

CHANGE GAIN FACTOR	**DW K + 1, bit 15**

1 signal: For position control of the spindle in the positioning mode, the gain of the position controller is calculated from the gear stage-dependent gain factor multiplied by the factor for the gain change (MD 469*).

0 signal: For position control of the spindle in the positioning mode, the gain of the position controller is determined directly by the gear stage-dependent gain factor.

Notes:

- This signal is valid only for spindles that are controlled by 32-bit servo CPUs.
- The individual factors are determined by machine data:
  - MD 435* to 442* "Gain factor" for the position controller (for 8 gear stages)
  - MD 469* "Factor for gain change"
- With some drive actuators a change in the standardization of the analog set speeds in the actuator can achieve steadier zero speed behaviour of the spindle in conjunction with position control. This change must be taken into account in the control by changing the gain factor.
- The standardization change in the drive actuator is made by a terminal signal. This signal must always be set at the **same time** as the CHANGE GAIN FACTOR interface signal. It is sensible to set the signals conditional on the SPINDLE STOP interface signal.
- The gain factor change **must not** be activated at higher speeds. The magnitude of the transmitted set speeds must always be less than 10 V.

SERVO ENABLE DW K + 1, bit 14

1 signal: Speed controller enable for spindle.

0 signal: Effects rapid deceleration of spindle at maximum braking current. The interface to the drive is interrupted after the time delay set by machine data (MD 447*) has run down. Only the actual values are held (follow-up mode).

Notes:

- The following applies if positioning is selected by the NC or PLC:
  - If the signal is not set when the selection is made, the positioning operation is not initiated until it is set.
  - If the signal is cancelled during spindle positioning, the positioning operation is only interrupted. It is resumed when the signal is set again.
- The following applies if positioning is selected by the command channel:
  - If the signal is not set when the selection is made, the function is not executed. A negative acknowledgement is entered in the user interface of the command channel.
  - If the signal is cancelled during spindle positioning, the positioning operation is interrupted. A negative acknowledgement is entered in the user interface of the command channel.
- The following applies to synchronous mode:
  - If the signal is not set when the selection is made, the spindle mode is not changed. No alarm is output; the block change is nevertheless performed immediately.
  - If the signal is cancelled during synchronous mode, the operation is only interrupted. The spindle position can be changed (e.g. manually) as long as the signal is not set.
  - Synchronous mode is reactivated when the signal is set again. Any change in the spindle position during the interruption is not compensated. The angular offset between the leading and following spindles no longer corresponds to that before the interruption.

INPUT SET VALUE ZERO **DW K + 1, bit 13**

1 signal: The current set speed is overwritten with 0 thus braking the spindle according to the acceleration ramp.

0 signal: No effect.

Notes:

- The acceleration ramp is determined by machine data. The selection of the currently valid machine data is made with reference to the actual gear stages and the mode:
  - In control mode, MD 419* to 426* ACCELERATION TIME CONSTANT WITHOUT POSITION CONTROL are used.
  - In synchronous mode, MD 478* to 485* ACCELERATION TIME CONSTANT WITH POSITION CONTROL are used.
- The set speed 0 is normally selected automatically at the end of the program or if the program is aborted. If this is suppressed by machine data (MD 520*, bit 6), the spindle can be brought to a standstill by the PLC user program with this signal or the SPINDLE RESET signal.
- The programmed S value is lost when the INPUT SET VALUE ZERO signal is set.
- The positioning mode can still be selected (by NC, PLC or command channel) with the signal set if the 16-bit servo CPU is used. The positioning routine is executed nevertheless.

If the 32-bit servo CPU is used, positioning is not performed.

SPINDLE OVERRIDE ACTIVE — DW K + 1, bit 12

1 signal: The set spindle (speed) override is taken into account when determining the set speeds.

0 signal: The set spindle override values are not taken into account. A value of 100 % is always set.

Note:

The override value is generally set with the switch on the machine control panel.

Example of application:

This signal can be used to enable the speed override switch on the machine control panel during the test phase of a new NC part program (e.g. with the keyswitch).

SPINDLE OVERRIDE — DW K + 1, bit 8 to 11

The spindle (speed) override is taken into account when determining the set speeds for the spindle if the SPINDLE OVERRIDE ACTIVE signal is set. The override value determines the percentage of the programmed set speed output to the spindle.

The override value is generally set with the switch on the machine control panel. Refer to the following table for the assignment of switch positions to the percentage values and their codes.

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

Note:

The percentage values given in the table are standard values which are stored as machine data. They can be changed if required.

RESYNCHRONIZE SPINDLE — DW K + 1, bit 7

Caution:

This signal exists twice, once each for operation with 16-bit and 32-bit servo CPUs. This signal description is valid only for 32-bit servo CPUs (also see DW K + 2, Bit 3).

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

Notes:

- This signal is also effective without the PLC SPINDLE CONTROL interface signal (unlike DW K + 2, bit 3).
- Spindles in synchronous mode cannot be resynchronized with their pulse encoders.

Example of application:

Resynchronization of encoder and spindle control if, e.g. with drill heads, the encoder has been changed with the drill head.

ACKNOWLEDGE M19 — DW K + 1, bit 6

Caution:

This signal exists twice, once each for operation with 16-bit and 32-bit servo CPUs. This signal description is valid only for 32-bit servo CPUs (also see DW K + 2, bit 2).

1 signal: Spindle positioning is aborted.
0 signal: No effect.

Notes:

- This signal is also effective without the PLC SPINDLE CONTROL interface signal (unlike DW K + 2, bit 2).
- The signal is effective only with positioning mode active.
- The signal must not be set when positioning mode is selected.

SPINDLE RESET	**DW K + 1, bit 5**

1 signal: The spindle is brought to a standstill.
0 signal: No effect.

Notes:

- With MD 521*, bit 6 = 1 ("No abort with reset or M02/M03") the spindle does not react to reset requests by the NC but, subject to the following precondition, to the SPINDLE RESET signal:
  – The channel to which the spindle is currently assigned by the PLC (DW K + 2, bit 8 to 12) is in the reset state (e.g. following key reset).
- The spindle is brought to a standstill according to the acceleration ramp. The selection of the currently valid machine data is made with reference to the actual gear stage and the mode:
  – In control or oscillation mode, MD 419* to 426* "Acceleration time constant without position control" are used.
  – In synchronous or positioning mode when selected by NC or PLC, MD 478* to 485* "Acceleration time constant with position control" are used.
  – In positioning mode when selected by command channel the acceleration time constant from the user DB is used.
- The synchronous and C axis modes are not deselected by Reset (or SPINDLE RESET).
- C-axis mode (M or G function) is aborted by a reset (also a SPINDLE RESET), if the bit "abort C-axis mode on reset/M02M03" (MD 521*.4) equals 1. [d)]
- Output of the oscillation or basic speed is not aborted by Reset (or SPINDLE RESET).

Exceptions:

Alarms that lead to cancellation of the MODE GROUP READY signal always bring the spindle to a standstill.

d) with GA2, software version 1 and higher

INVERT M03/M04	DW K+1, bit 4

1 signal: The sign of the set voltage stipulated for M03 and M04 is inverted.

0 signal: No effect.

Note:

A positive voltage is specified for M03 as standard. Adaptation to the machine can be effected with MD 521*, bit 1 "Setpoint sign change".

Example of application:

With mechanical transmissions (e.g. drill heads), the direction of rotation is reversed mechanically by a gear mechanism. The correct direction of rotation can be obtained with INVERT M03/M04.

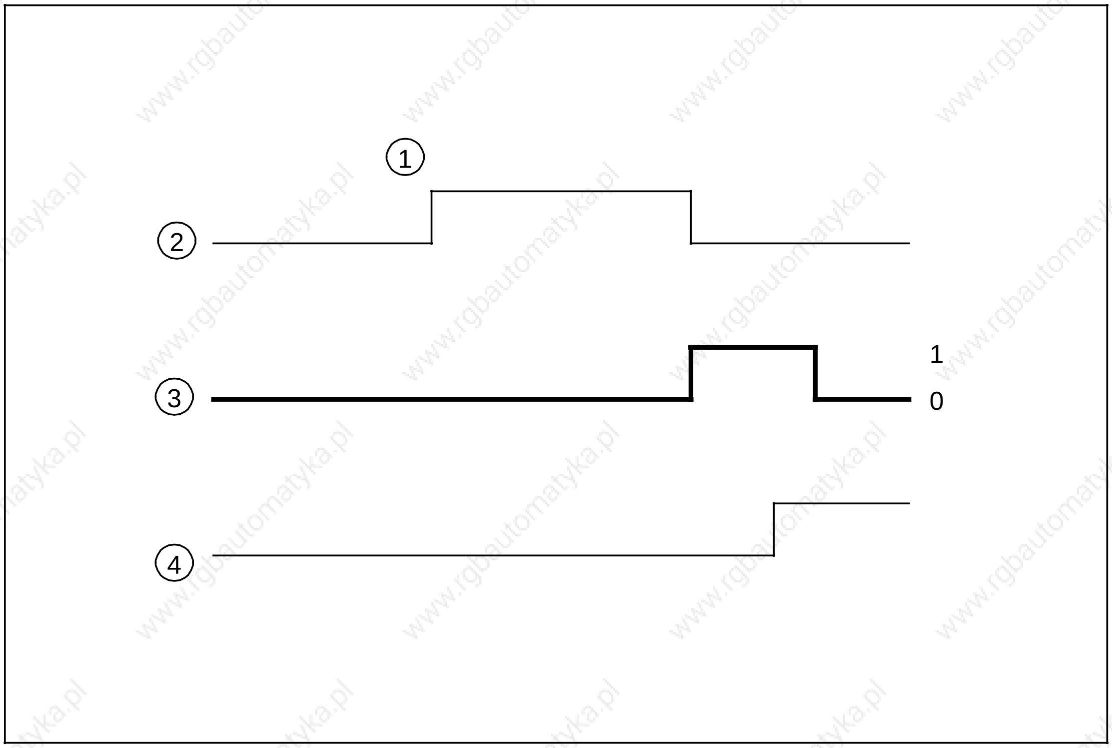
ACTUATE C AXIS OPERATION	DW K + 1, bit 3

1 signal: The PLC user program has concluded the preparations to initiate C axis operation. The spindle control can now switch to C axis operation.

0 signal: Switch to C axis operation disabled.

Notes:

- This signal is valid only for spindles that are controlled by 32-bit servo CPUs.
- With recourse to this signal the PLC user program can delay the switch to C axis operation until the required preconditions have been satisfied. No block change takes place as long as the signal is not set.
- Examples of measures required to satisfy the preconditions for the switch:
  - Bring spindle to standstill
  - Engage correct gear stage
  - Preset axis-specific interface
- Cancelling the signal does **not** abort C axis operation.



Signal chart for 'Actuate C axis operation"

1: Instant of decoding G or M function for selecting C axis operation
2: Measures taken by the PLC user program to prepare for C axis operation
3: ACTUATE C AXIS OPERATION
4: Block change

ACTUAL GEAR STAGE — DW K + 1, bit 0 to 2

A variable-speed gearbox connected to the output side of the DC motor provides a large speed range at the spindle. The set speed determined by the NC program with the S value always refers to the speed of the main spindle, not to that of the DC motor. Therefore, the current gear stage has to be taken into account when calculating the set speed for the motor.

The PLC user program must thus always report the valid actual gear stage to the NC. The following codes are used:

Gear stage	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:

- Gear stage 1 is assigned to the lowest spindle speed range.
- If fewer than 8 gear stages are available, codes for unavailable gear stages must not be transferred to the NC.

CHANNEL NUMBER — DW K + 2, bit 8 to 12

The channel mandatorily assigned to each spindle by the PLC user program is the one from which it obtains its setpoints. The channel numbers are encoded as follows:

Channel number	Code E	D	C	B	A	Channel number	Code E	D	C	B	A
1	0	0	0	0	0	9	0	1	0	0	1
1	0	0	0	0	1	10	0	1	0	1	0
2	0	0	0	1	0	11	0	1	0	1	1
3	0	0	0	1	1	12	0	1	1	0	0
4	0	0	1	0	0	13	0	1	1	0	1
5	0	0	1	0	1	14	0	1	1	1	0
6	0	0	1	1	0	15	0	1	1	1	1
7	0	0	1	1	1	16	1	0	0	0	0
8	0	1	0	0	0						

Notes:

- The channel-specific DB 10 ... DB 25 determine the spindle from which the channel obtains the actual values for displaying in the basic image.
- The leading and following spindles in synchronous mode must be assigned to the same channel here.

SET ROTATION CW — DW K + 2, bit 7

1 signal: The set voltage that corresponds to clockwise rotation according to the parameterization is stated.

0 signal: The set voltage that corresponds to counter-clockwise rotation according to the parameterization is stated.

Notes:

- The signal is effective **only** if the PLC SPINDLE CONTROL signal is also set.
- The sign of the set voltage is parameterized by:
  - INVERT M03/M04 interface signal
  - MD 521*, bit 1 "Setpoint sign change"
- The signal determines the direction of rotation in oscillation mode or with control mode at basic speed (BASIC SPEED signal).

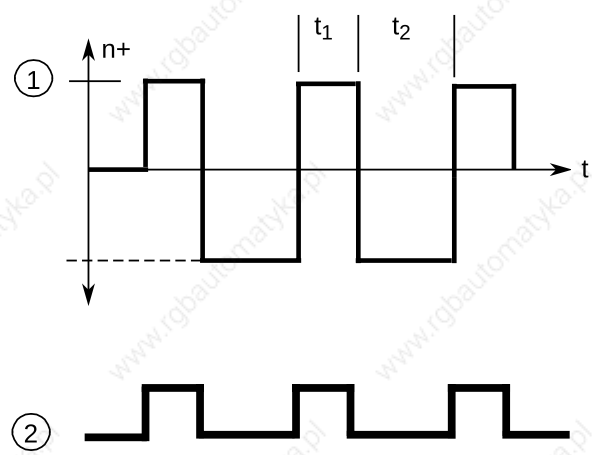
OSCILLATION SPEED — DW K + 2, bit 6

1 signal: Request for oscillation mode.

0 signal: Oscillation mode is deselected on the 1   0 transition.

Notes:

- The signal is effective **only** if the PLC SPINDLE CONTROL signal is also set.
- The oscillation speed is determined by MD 450*. It refers not to the spindle speed but to the motor speed (unit: VELO).
- The direction of rotation is determined by the SET ROTATION CW and INVERT M03/M04 signals. MD 521*, bit 1 ("Setpoint sign change") is also taken into account.
- The speed override is disregarded.
- The programmed values (S value, direction of rotation) are reactivated when the OSCILLATION SPEED or PLC SPINDLE CONTROL signal is cancelled as long as the NC function M3/M4 has not been cancelled by the signal POSITION SPINDLE.
- The oscillation mode is not aborted by Reset.
- The acceleration time constants do not have any significance in oscillation mode.



Oscillation mode

1: Motor oscillation speed
2: SET ROTATION CW signal (t_1 not equal to t_2)

Example of application:

Gear change with drive motor oscillation in order to facilitate gear engagement (also see description of CHANGE GEAR signal).

BASIC SPEED DW K + 2, bit 5

1 signal: A fixed basic speed is specified for the spindle.

0 signal: The basic speed is deselected on the 1 0 transition.

Notes:

- The signal is effective only if the PLC SPINDLE CONTROL signal is also set.
- The basic speed is determined by MD 449*. It refers to the spindle speed. A very low speed is recommended.
- The speed override is taken into account.
- If the basic speed is not in the speed range of the current gear stage, a gear speed change is requested.
- The direction of rotation is determined by the SET ROTATION CW and INVERT M03/M04 interface signals. MD 521*, bit 1 ("Setpoint sign change") is also taken into account.
- The programmed values (S value, direction of rotation) are reactivated when the BASIC SPEED or PLC SPINDLE CONTROL interface signal is cancelled as long as the NC function M03/M04 has not been cancelled by the signal POSITION SPINDLE.
- The basic speed setting is not aborted by Reset.
- The acceleration time constants are taken into account. The selection of the currently valid machine data is made with reference to the actual gear stage and the mode:
  - If synchronous mode is not selected, MD 419* to 426* "Acceleration time constant without position control" are used.
  - If synchronous mode is selected, MD 478* to 485* "Acceleration time constant with position control" are used.

Example of application:

The spindle can be positioned manually with the slow basic speed.

POSITION SPINDLE	**DW K + 2, bit 4**

1 signal: Request for positioning mode.
0 signal: No effect.

Notes:

- The signal is effective **only** if the PLC SPINDLE CONTROL signal is also set.
- The setpoint is determined by MD 452*.
- If the spindle is stationary, the position is approached by the shortest path. The spindle rotates at the shutdown speed entered in MD 427* to 434*.
- If the spindle is not stationary when the request is made, the position is approached without changing the direction of rotation.
- In the positioning mode MD 478* to 485* "Acceleration time constant with position control" are used to deselect or to abort positioning mode.
- To deselect or abort positioning mode, you have to use the ACKNOWLEDGE M19 signal.
- The POSITION SPINDLE interface signal has the effect of deleting the M03 or M04 functions stored on the NC. The stored S value is, however, retained and is reactivated when the ACKNOWLEDGE M19 interface signal is issued and M03 or M04 is subsequently programmed.

Example of application:

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

RESYNCHRONIZE SPINDLE	**DW K + 2, bit 3**

Caution:

This signal exists twice, once each for operation with 16-bit and 32-bit servo CPUs. This signal description is valid only for 16-bit servo CPUs[c)] (also see DW K + 1, bit 7).

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

Note:

RESYNCHRONIZE SPINDLE (for 16-bit servo CPUs) is effective only in conjunction with PLC SPINDLE CONTROL.

Example of application:

Resynchronization of encoder and spindle control if, e.g. with drill heads, the encoder has been changed **with** the drill head.

c) up to and including software version 6

ACKNOWLEDGE M19 DW K + 2, bit 2

Caution:

This signal exists twice, once each for operation with 16-bit and 32-bit servo CPUs. This signal description is valid only for 16-bit servo CPUs[c)] (also see DW K + 1, bit 6).

1 signal: Spindle positioning is aborted.
0 signal: No effect.

Notes:

- This signal is effective **only** if the PLC SPINDLE CONTROL signal is also set.
- The signal is effective only with positioning mode active.
- The signal must not be set when positioning mode is selected.

PLC SPINDLE CONTROL DW K + 2, bit 0

1 signal: Enable the following interface signals:
- SET ROTATION CW
- OSCILLATION SPEED
- BASIC SPEED
- POSITION SPINDLE
- RESYNCHRONIZE SPINDLE (for 16-bit servo CPUs[c)])
- ACKNOWLEDGE M19 (for 16-bit servo CPUs[c)])

0 signal: Spindle control by NC or command channel.

Notes:

- The RESYNCHRONIZE SPINDLE and ACKNOWLEDGE M19 interface signals for spindles controlled by 16-bit servo CPUs[c)] must also be enabled by this signal.
- If the NC part program issues a new request to the spindle it does not become effective until the PLC SPINDLE CONTROL interface signal is cancelled again.
- If several of the signals stated above are present at the same time, the following priorities apply (in descending order):
  - POSITION SPINDLE
  - OSCILLATION SPEED
  - BASIC SPEED

c) up to and including software version 6

SPINDLE DISABLE	**DW K + 3**

1 signal: The spindle is brought to a standstill according to the acceleration ramp.
0 signal: Spindle drive enable.

Notes:

- A message text can be allocated to any bit in DW K + 3.
- The previous set speed becomes effective when the spindle is enabled again. The positioning operation is resumed if the positioning mode is active.
- Spindle disable is activated if at least one bit in DW K + 3 is set.
- The selection of the currently valid acceleration time constant is made with reference to the actual gear stage and the mode:
  - In control or oscillation mode MD 419* to 426* "Acceleration time constant without position control" are used.
  - In synchronous or positioning mode when selected by NC or PLC, MD 478* to 485* "Acceleration time constant with position control" are used.
  - In positioning mode when selected by command channel the acceleration time constant from the user DB is used.

8.4 Signals for synchronous mode from spindle

NEW $K_Ü$ CALCULATED	**DW L + 24, bit 15**

1 signal: The new speed ratio $K_Ü$ between the following spindle and its leading spindle has been calculated without error.

0 signal: New speed ratio not calculated.

Notes:

- The new $K_Ü$ must be activated by setting the ACTIVATE NEW $K_Ü$ signal or the corresponding setting data bit.
- The NEW $K_Ü$ CALCULATED signal is automatically reset when the new $K_Ü$ is activated.

DEFINED ANGULAR OFFSET REACHED	**DW L + 24, bit 14**

1 signal: The programmed angular offset between the following spindle and its leading spindle has been reached.

0 signal: No defined angular offset between the leading and following spindles.

Notes:

- The angular offset is specified by the G201 command.
- Programming an angular offset is optional.
- The signal is reset when the G201 command is activated.
- The signal is of significance only to the following spindle in synchronous mode.

EMERGENCY RETRACTION ACTIVE DW L + 24, bit 13

1 signal: Synchronism between the following spindle and its leading spindle is disturbed and the positional deviation is greater than the specified emergency retraction threshold.

0 signal: The following spindle is in synchronism with the leading spindle.

Notes:

- The emergency retraction threshold is specified in MD 9x4 (x = 5, 7, 9 for following spindle 1, 2, 3).
- The emergency retraction threshold is monitored only if synchronous mode is selected and the "Enable emergency retraction" setting data bit for the following spindle is set.
- A delay of 2 IPO cycle times plus 1 PLC cycle time must be anticipated between exceeding the threshold and the signal being set.
- The EMERGENCY RETRACTION message can also be output directly as a hardware signal subject to the availability of a mixed I/O module in the servo area. This is effected much quicker (in time with the position control pulse) than output of the interface signal.
- With this signal, the alarm EMERGENCY RETRACTION is output and the servo enable is cancelled.
- The signal is of significance only to the following spindle in synchronous mode.

Example of application:

This signal can be used in conjunction with parting monitoring. The workpiece is clamped in following and leading spindles. After the parting operation a defined angular offset between the leading and following spindles is programmed.

If the parting operation was unsuccessful the angle cannot be accepted. The positional deviation becomes too great and the signal is set; an alarm is issued at the same time.

FOLLOWING SPINDLE IN SYNCHRONOUS MODE — **DW L + 24, bit 8**

1 signal: Spindle operates as following spindle in synchronous mode.

0 signal: Spindle does not operate as following spindle in synchronous mode.

Notes:

- In the synchronous mode the spindle follows the movements of the leading spindle.
- Special monitoring operations are executed only in the synchronous mode (e.g. synchronism coarse/fine, emergency retraction).
- Commands to the following spindle are ignored in the synchronous mode. (except: G201 and G202).
- The signal is also indicated in the relevant setting data bit.

NEW $K_Ü$ DEFECTIVE — **DW L + 24, bit 7**

1 signal: An error has occurred when calculating the new speed ratio $K_Ü$ between the following spindle and its leading spindle.

0 signal: No error during calculation.

Notes:

- The signal is of significance only if the calculation of a new speed ratio $K_Ü$ has been triggered first.
- An alarm is issued at the same time as the signal is set.
- The new speed ratio cannot be activated while this signal is set.
- An error during the calculation indicates that impermissible speed ratio parameters have been entered in the setting data (e.g. denominator equal to 0, numerator too great, denominator too small).

AUTOMATICALLY CONTROLLED CORRECTION DW L + 24, bit 6

1 signal: Automatically controlled correction of following spindle.
0 signal: Leading and following spindle operate normally.

Notes:

- Automatically controlled correction is generally caused by a malfunction of the leading spindle.
- In the case of automatically controlled correction, the following spindle only follows the actual values of the leading spindle.
- The following spindle follows the movements of the leading spindle for a programmable period (MD 9x6, x = 5, 7, 9 for following spindle 1, 2, 3).
- The signal is of significance only to the following spindle in synchronous mode.

Example of application:

With this signal the PLC user program can recognize a malfunction before the link is disengaged.

MAXIMUM ACCELERATION DW L + 24, bit 5

1 signal: Maximum acceleration of the following spindle.
0 signal: The acceleration of the following spindle is less than its limiting value.

Notes:

- The maximum acceleration of the following spindle is determined by the "Acceleration time constant with position control" (MD 478* to 485*).
- The "FA x acceleration limit" alarm (x = 1, 2, 3 for following spindle 1, 2, 3) is issued at the same time as the signal is set.
- Monitoring can be deselected with the MD 502x, bit 3 "suppression of acceleration limitation" (x = 1, 2, 3 for following spindle 1, 2, 3).
- Synchronism between the leading and following spindles is endangered when the signal is set.
- The signal is of significance only to the following spindle in synchronous mode.

MAXIMUM SPEED	DW L + 24, bit 4

1 signal: The following spindle has reached its maximum speed.

0 signal: The following spindle rotates slower than its maximum speed.

Notes:

- The maximum speed of the following spindle is determined by the minimum value from the following values:
  - MD 403* to 410* "Maximum speed" for each gear stage
  - MD 451* "Maximum chuck speed"
  - SD 403* "Programmable spindle speed limitation"; programmed with G26
- The "FA x speed limit" alarm (x = 1, 2, 3 for following spindle 1, 2, 3) is issued at the same time as the signal is set.
- Synchronism between the leading and following spindles is endangered when the signal is set.
- The signal is of significance only to the following spindle in synchronous mode.

ACCELERATION WARNING THRESHOLD REACHED	DW L + 24, bit 3

1 signal: The momentary acceleration of the following spindle is greater than the acceleration warning threshold.

0 signal: The momentary acceleration of the following spindle is less than the acceleration warning threshold.

Notes:

- The warning threshold is determined by MD 9x5 (x = 5, 7, 9 for following spindle 1, 2, 3).
- Monitoring can be deselected with the MD 502x, bit 3 "Suppression of acceleration limitation" (x = 1, 2, 3 for following spindle 1, 2, 3).
- Synchronism between the leading and following spindles is endangered when the signal is set.
- The signal is of significance only to the following spindle in synchronous mode.
- The signal is automatically reset when the acceleration falls below 7/8 of the warning threshold (hysteresis behaviour).

SPEED WARNING THRESHOLD REACHED DW L + 24, bit 2

1 signal: The momentary speed of the following spindle is higher than the speed warning threshold.

0 signal: The momentary speed of the following spindle is lower than the speed warning threshold.

Notes:

- The warning threshold is determined by MD 9x5 (x = 5, 7, 9 for following spindle 1, 2, 3).
- Synchronism between the leading and following spindles is endangered when the signal is set.
- The signal is of significance only to the following spindle in synchronous mode.
- The signal is automatically reset when the speed falls below 7/8 of the warning threshold (hysteresis behaviour).

Example of application:

The PLC user program can reduce the speed of the leading spindle (and therefore that of the following spindle) by means of the speed override when the signal is set.

SYNCHRONISM FINE DW L + 24, bit 1

1 signal: The positional deviation between the following spindle and its leading spindle is within the "Synchronism fine" tolerance band.

0 signal: The positional deviation between the following spindle and its leading spindle is outside the "Synchronism fine" tolerance band.

Notes:

- The tolerance band is determined by the offset angle between the leading and following spindles and by the "Synchronism fine" tolerance MD 9x2 (x = 5, 7, 9 for following spindle 1, 2, 3).
- If no defined angular offset has been programmed with G201, the offset angle that was valid when the synchronous mode was selected is used to check synchronism.
- The signal is of significance only to the following spindle in synchronous mode.
- If, with G201 without offset angle, bit "block change with synchronism fine" (MD 5021 to MD 5023, bit 2) equals 1, the block change in the NC is not initiated after an overlaying motion until the following spindle reaches "synchronism fine" and all partial setpoints of the block have been output.

Examples of application:

- Clamping of the workpiece in the following spindle when transferring from the leading spindle. Clamping is not effected until the spindles are sufficiently in synchronism.
- This signal can be used in conjunction with parting monitoring. The workpiece is clamped in following and leading spindles. After the parting operation a defined angular offset between the leading and following spindles is programmed.

  If the parting operation was unsuccessful the angle cannot be accepted. The positional deviation becomes too great and the signal is not set.

SYNCHRONISM COARSE	DW L + 24, Bit 0

1 signal: The positional deviation between the following spindle and its leading spindle is within the "Synchronism coarse" tolerance band.

0 signal: The positional deviation between the following spindle and its leading spindle is outside the "Synchronism coarse" tolerance band.

Notes:

- The tolerance band is determined by the offset angle between the leading and following spindles and by the "Synchronism coarse" tolerance MD 9x3 (x = 5, 7, 9 for following spindle 1, 2, 3).
- If no defined angular offset has been programmed with G201, the offset angle that was valid when the synchronous mode was selected is used to check synchronism.
- The signal is of significance only to the following spindle in synchronous mode.

Examples of application:

- Clamping of the workpiece in the following spindle when transferring from the leading spindle. Clamping is not effected until the spindles are sufficiently in synchronism.
- This signal can be used in conjunction with parting monitoring. The workpiece is clamped in following and leading spindles. After the parting operation a defined angular offset between the leading and following spindles is programmed.

  If the parting operation was unsuccessful the angle cannot be accepted. The positional deviation becomes too great and the signal is not set.

8.5 Signals for synchronous mode to spindle

CALCULATE NEW $K_Ü$	DW L + 25, bit 15

0/1 transition: The speed ratio $K_Ü$ between the following spindle and its leading spindle is recalculated.

1/0 transition: No effect.

Notes:

- The speed ratio $K_Ü$ is calculated from the speed ratio parameters; these must be entered as setting data (SD x4, x5, x = 1, 2, 3 for following spindle 1, 2, 3).
- The NC sets the NEW $K_Ü$ CALCULATED signal if it was possible to calculate the speed ratio without error. Otherwise, the NC sets the NEW $K_Ü$ DEFECTIVE signal and issues an alarm.
- The PLC user program must reset the signal to 0 once the NC has calculated the new speed ratio.
- The NEW $K_Ü$ CALCULATED signal is reset when the calculation is initiated. This is generally performed, however, by the "Activate new $K_Ü$" command.
- The speed ratio calculation can also be initiated by setting the relevant setting data bit.
- The new speed ratio is put into effect by setting the ACTIVATE NEW $K_Ü$ signal.

INTERLOCK SYNCHRONOUS MODE	DW L + 25, bit 11

1 signal: Synchronous mode cannot be selected for this following spindle.
0 signal: No effect.

Notes:

- If the spindle is operating as a following spindle in synchronous mode when the signal is set, the synchronous mode is aborted.
- The following spindle continues to rotate with the current actual speed and direction. The link between the leading and following spindles is cancelled.

ACTIVATE NEW $K_Ü$	DW L + 25, bit 7

0/1 transition: The newly calculated speed ratio $K_Ü$ between the following and leading spindles is activated, i.e. it is taken into account when calculating the set values for the following spindle.

1/0 transition: No effect.

Notes:

- The new speed ratio can also be activated in the synchronous mode. Furthermore, a new $K_Ü$ can be activated while the leading and following spindles are rotating.
- The new $K_Ü$ can be activated only if the NEW $K_Ü$ CALCULATED signal is present.
- The NEW $K_Ü$ CALCULATED signal is reset to 0 when the new $K_Ü$ is activated.
- Once the NEW K CALCULATED signal has changed to 0 the PLC user program must reset the ACTIVATE NEW $K_Ü$ signal to 0.
- Emergency retraction monitoring should be disabled when changing the speed ratio.
- The new speed ratio can also be activated by setting the relevant setting data bit.

9 Axis/PLC Interface (DB 32)

9.1 General

- The SINUMERIK 880 can control a maximum of 24 axes and 6 spindles. DB 32 contains the interfaces for all axes.
- If two PLCs are installed, both of them can evaluate the signals **from** the axis. However, only one PLC can output signals **to** the axis. The axes to be processed by PLC I and those to be processed by PLC II are specified in the PLC machine data for each axis (MD 6016 ... MD 6022 for PLC I, MD 6116 ... MD 6122 for PLC II).
- In the setup modes the axes cannot be influenced by the channel D specific GENERAL FEED DISABLE signal. In these cases only the axis-specific FEED DISABLE signal effects a feed disable.
- In principle each channel can effect motion of all the axes in its mode group. A single axis cannot, however, be controlled by several channels **at the same time.** In exceptional circumstances an axis can be disabled for certain NC channels by means of the NC machine data.
- The NC machine data 568* assign axis numbers to the axis names. The sequence of the axes declared here corresponds to the sequence of the axes in DB 32. In other words, the first declared axis is also the first axis of the axis/PLC interface.
- The axis-specific FEED DISABLE signals can trigger messages at the operator panel. Machine data are used to determine whether a signal causes an error or operational message to be issued if a message is required (see "Output of messages" Section).

9.2 Signals from axis

SPEED CONTROLLER ACTIVE	**DW K, bit 15**

1 signal: Speed controller active.
0 signal: Speed controller inactive.

POSITION CONTROL ACTIVE	**DW K, bit 14**

1 signal: Axis in position control.
0 signal: No position control, e.g. owing to a measuring circuit error.

Example of application:

Activation of holding brake for a vertical axis in the event of position control failure.

RELEASE SI BRAKE [c)] DW K, bit 13

Relevant only in conjunction with IAR:

This signal is provided to allow traversing of the axis during self-installation of the integrated drive control [c)]; the brake has to be released for this purpose:

1 signal: Release brake.
0 signal: Apply brake.

Notes:

- With POWER ON or RESET the RELEASE SI BRAKE signals are reset to 0 by the PLC operating system.
- The signal must be combined with the SI SAFETY SIGNAL; if the self-installation functions are disabled, no reactions are permitted to RELEASE SI BRAKE = 1.

  Also see SI BRAKE RELEASED.

REFERENCE POINT REACHED DW K, bit 12

1 signal: Reference point reached and axis synchronized.
The signal is present until the power supply is switched off.

0 signal:
a) Before synchronizing the axis following machine on.
b) With *DECELERATION during repeated reference point approach.
c) In software version 6, the signal REFERENCE POINT REACHED is deleted, if the PLC signal PARKING AXIS is set.
d) On GA2, software version 1 and higher the signal is not reset until the PLC signal PARKING AXIS is set and the connection between the measuring value encoder and the measuring circuit module is broken.

Note:

- The reference point approach is performed with the measuring system selected by the signal MEASURING SYSTEM 1/2.
- The reference point approach can be performed either manually in REFPOINT mode or with the command G74 in AUTOMATIC mode.
- For each axis, NC MD 560*.4 can be used to determine whether the reference point has to be reached for NC START.
- The signal is set when C-axis mode is selected and reset when it is deselected again, i.e. the software limit switch monitoring and the rounding logic are valid without reference point approach. [d)]

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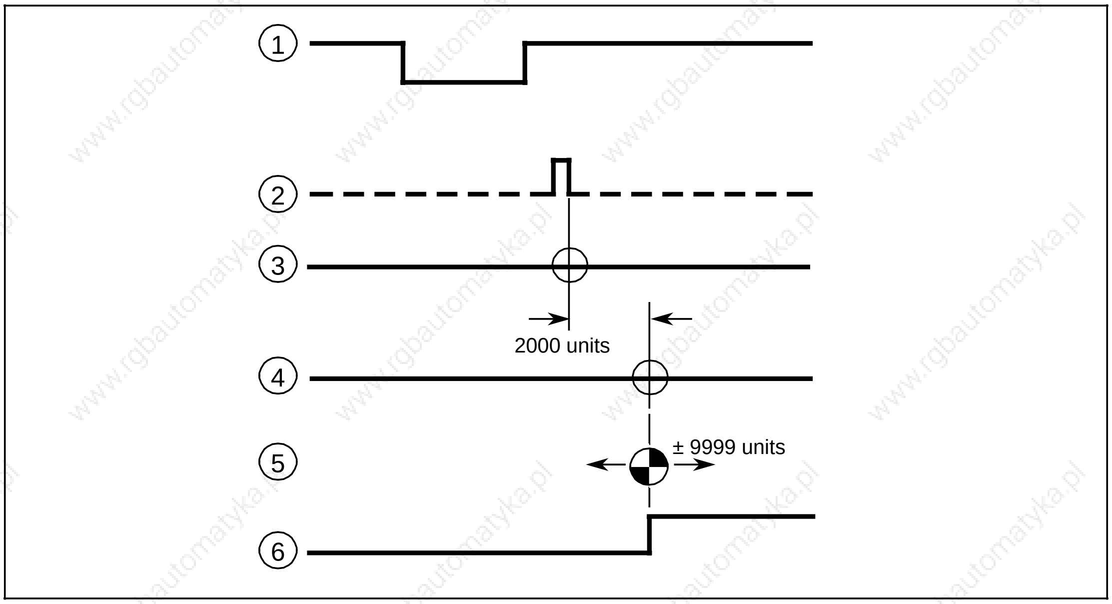
c) up to and including software version 6
d) with GA2, software version 1 and higher

Rotary and linear measuring systems

The reference point can be shifted by means of the "reference point shift" machine data in the range ± 9999 units, referred to the 2000 units point (MD 244*). After reaching the reference point position, the actual value memory of the axis is set to the reference point value (specified in machine data MD 240*) and the REFERENCE POINT REACHED signal is output.



1: *DECELERATION signal
2: Measuring system zero mark signal
3: Measuring system zero mark
4: Zero mark plus 2000 units travel in the reference point approach direction
5: Reference point in the range: zero mark plus (2000 units ± 9999 units ref. point shift)
6: REFERENCE POINT REACHED signal

See the Function Manual "Extended Spindle Functions" for notes on reference point approach of the spindle in C-axis mode.

Linear scales with distance-coded reference marks[d)]

Linear scales with distance-coded reference marks have not only an incremental track but also a reference mark track. The absolute position of the axis is determined by travelling over two reference marks from any position in either direction and the signal REFERENCE POINT REACHED is set.

d) *with GA2, software version 1 and higher*

Note:

- The axis travels over the two adjacent reference marks with reference point approach creep velocity (MD 284*). The axis is stopped when it reaches the second reference mark.
- To calculate the absolute axis position, the absolute encoder offset (offset between the machine system and the linear scale, MD 396*) and the basic distance between the reference marks are required (MD 1300*).
- MD 1808* indicates whether measuring system 1 or 2 is distance-coded (bit 4 and 5), whether the absolute encoder runs in the same direction or in the opposite direction to the machine system (bit 2) and whether the absolute encoder offset is valid (bit 3).

  If the absolute encoder offset (bit 3 = 0) is invalid, referencing is still possible but the signal REFERENCE POINT APPROACH is not set. You have to set bit 3 and reference again.
- If two measuring systems are used on one axis, only one measuring system can be distance-coded.
- If distance-coded reference marks are used, the function "zero monitoring" must be switched off.

Application example:

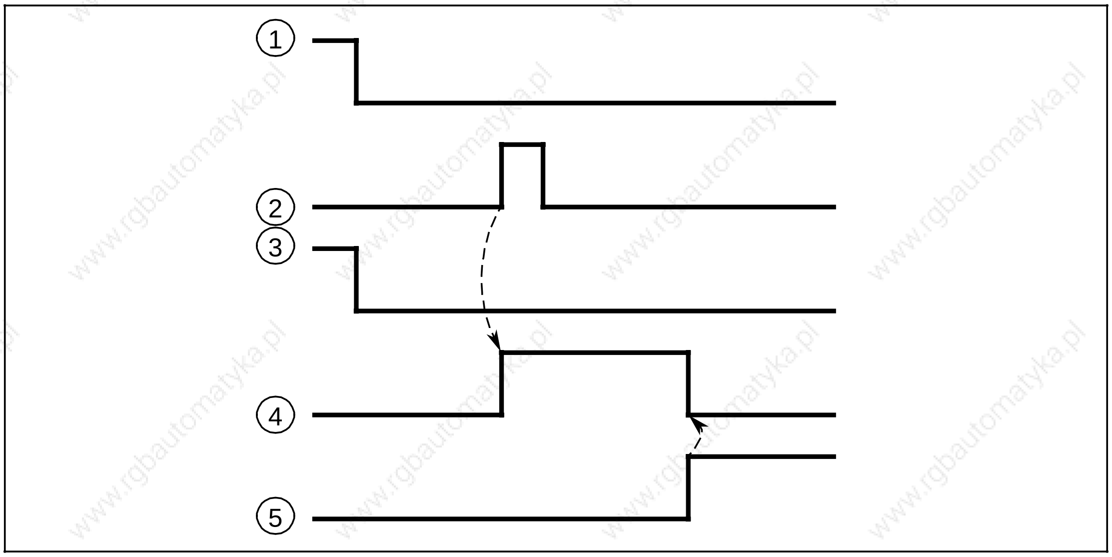
Suppression of the start signal (NC START) if, for example, a parking axis is not synchronized when it is activated.

TRAVEL COMMANDS +, - DW K, bit 11 and bit 10

AUT/MDA mode:

1 signal: If movement is to take place in the relevant axis direction, e.g. after transfer into the main memory of a block containing a coordinate value for the axis.

0 signal:
a) Block executed.
b) Axis disable present.
c) Abort with RESET.



1: READ-IN DISABLE signal
2: Data transfer to main memory
3: GENERAL FEED DISABLE signal
4: TRAVEL COMMAND signal (e.g. X +)
5: Block executed

JOG/INC mode

1 signal: Axis selected and direction key pressed.

0 signal:
a) Direction key no longer pressed and interpolator output is 0.
b) In the increment (INC) mode, after traverse with incremental feed.
c) Abort with RESET.

REF mode

1 signal:
a) Approach to reference point without automatic direction recognition: pressing the relevant direction key for approach to reference point.
b) Approach to reference point with automatic direction recognition: a direction key is pressed.

0 signal: Reference point reached.

Note

With axis clamping, continuous path operation is impossible if the clamp is not released until the travel command is given.

Example of application:

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

POSITION REACHED WITH EXACT STOP COARSE/FINE	DW K, bit 8 and 9

AUT mode

Exact stop coarse

1 signal: a) The axis has reached the programmed setpoint within the coarse exact stop window (machine data MD 204*), or
b) is already within the fine exact stop window.
0 signal: The axis is outside the coarse exact stop window.

Exact stop fine

1 signal: The axis has reached the programmed setpoint within the fine exact stop window (machine data MD 208*).
0 signal: The axis is outside the fine exact stop window.

Note:

The COARSE or FINE POSITION REACHED signals are also "1" if the automatic mode has been interrupted by RESET, an NC alarm or mode change (AUT INTERRUPTED).

Example of application:

Enabling tool change when the turret has reached the change position.

JOG/INCR/REPOS mode

Exact stop coarse

1 signal: a) The axis has reached the specified setpoint within the coarse exact stop window (machine data MD 204*), or
b) is already 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 handwheel has been operated.

Exact stop fine

1 signal: The axis has reached the specified setpoint within the fine exact stop window (machine data MD 208*); no direction key and no handwheel has been operated.
0 signal: The axis is outside the fine exact stop window; a direction key or handwheel has been operated.

MOTOR/ACTUATOR OVERTEMPERATURE[c] **DW K, bit 7**

Only relevant in conjunction with IAR [c]

1 signal: Temperature monitor of motoring or actuator has responded.
0 signal: Limiting value for motor or actuator temperature not exceeded.

TERMINAL 63/64, TERMINAL 65 [c] **DW K, bit 6**
IKA WARNING LIMIT [d]

Terminal 63/64, 65 [c]:

1 signal: Terminal signal 63/64 or terminal signal 65 is on.
0 signal: Neither terminal signal 63/64 nor terminal signal 65 is on.

Note: The terminal signals are triggered by the drive actuator.

IKA warning limit [d]**:**

1 signal: The IKA compensation limit specified in NC MD 356* was exceeded.
0 signal: The IKA compensation limit was not exceeded.

Note:

If you want the compensation axis to be disabled by the PLC program, you have to use the axial PLC signals SERVO DISABLE, FOLLOW-UP MODE, AXIS DISABLE and PARKING AXIS.

The axial feed hold and the channel-specific feed hold or override zero only influence all axes of the mode group via the leading axis or the channel.

AXIS IS C-AXIS **DW K, bit 2**

1 signal: C-axis is active
0 signal: C-axis is not active

ROUNDING AXIS IN POSITION **DW K, bit 4**

0 signal:
a) Axis has not yet reached the reference point
b) Parking axis
c) Follow-up mode for this axis
d) Travel command (+/-) for this axis
e) EMERGENCY OFF signal
f) C-axis in spindle mode

1 signal: Reference point reached and/or axis in rounding position.

Note:

The interface signal ROUNDING AXIS IN POSITION is only active in conjunction with the NC MD 560* bit 2, "Rounding whole/half degree", and bit 3 "Rounding with rotary axes".

---

c) up to and including software version 6
d) with GA2, software version 1 and higher

9.3 Signals to axis

MIRRORING	**DW K+1, bit 15**

Mirroring is possible on all axes. The variants A or B can be selected via an axis-specific machine data.

0 signal: Mirroring not active

1 signal: Variant A
Mirroring of
– programmed values
– cutter radius compensation or tool nose radius compensation (G41, G42)
– tool length correction

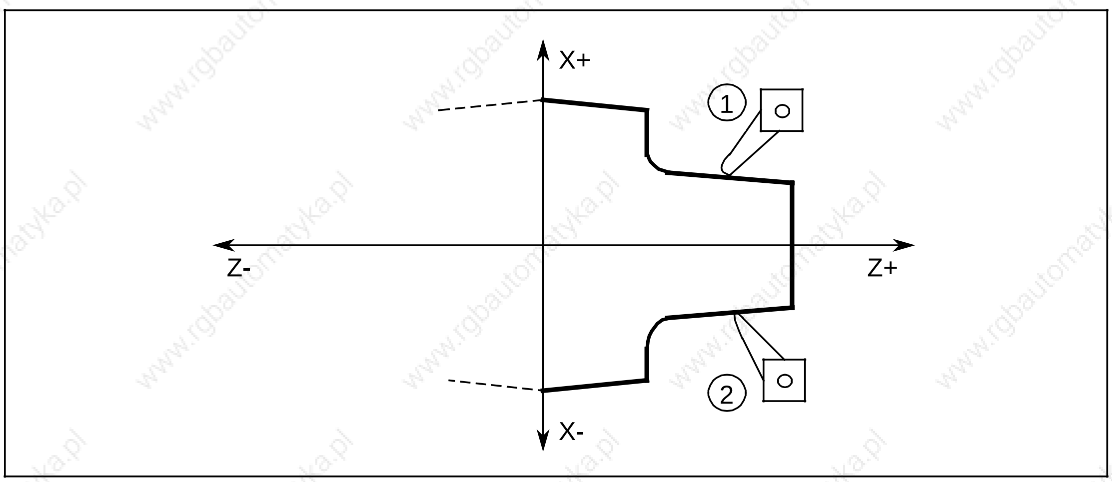
No mirroring of
– zero offset

1 signal: Variant B
Mirroring of
– programmed values
– cutter radius compensation (G41,G42)

No mirroring of
– zero offset
– tool length correction

Example 1, SINUMERIK 880T:

Mirroring X axis, variant A
(With mirroring in the X axis the axis is mirrored)

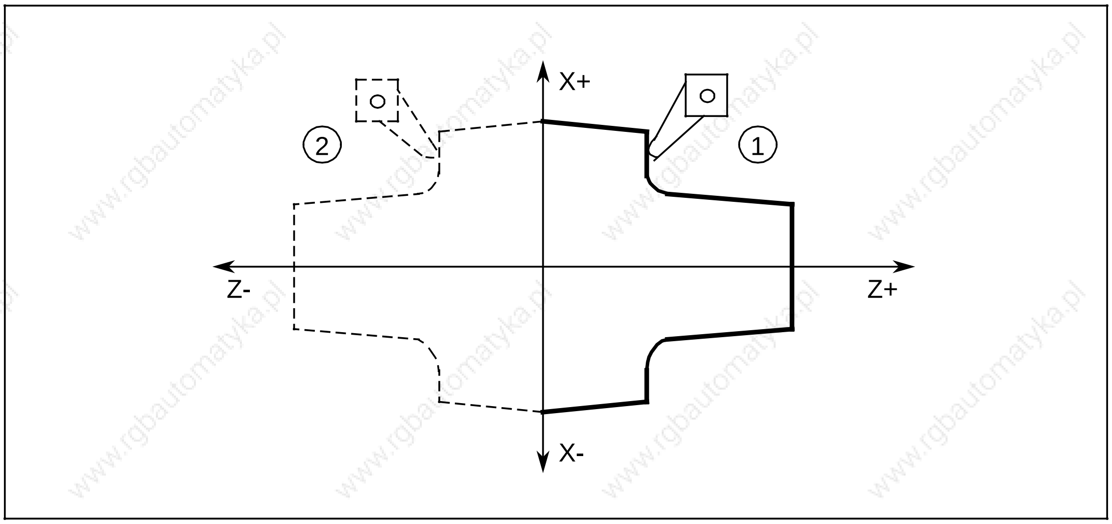


Mirroring in the X axis

1: normal: machining behind the turning centre
2: mirrored: machining in front of the turning centre

Example 2, SINUMERIK 880T:

Mirroring the Z axis, variant B
(with mirroring in the Z axis the **workpiece** is always mirrored)

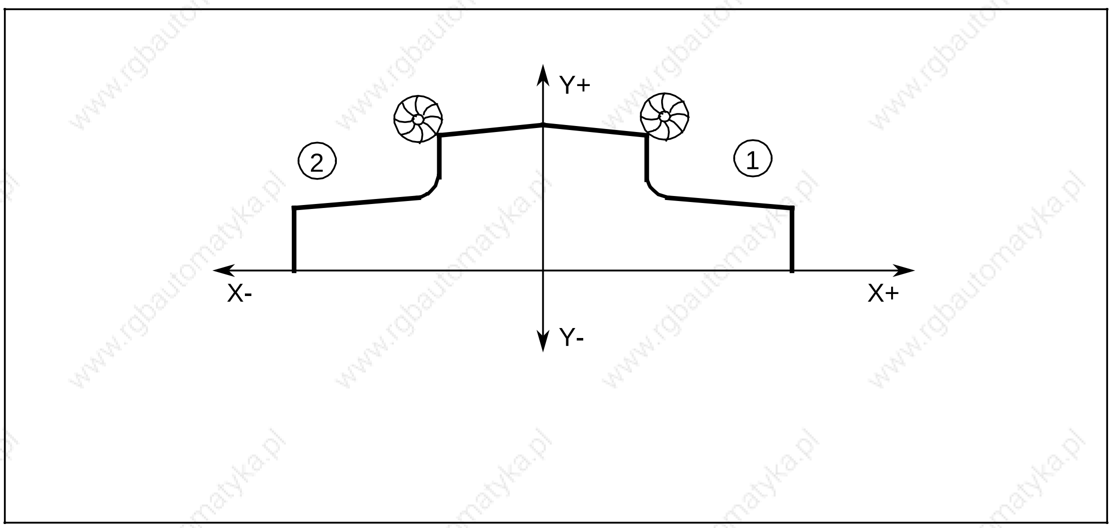


Mirroring in the Z axis

1: normal machining
2: mirrored workpiece

Example 3, SINUMERIK 880M :

Mirroring in the main axis X, variant B
(With mirroring in the main axes X, Y and Z the workpiece is always mirrored)



Mirroring, for example, in the X axis

1: normal machining
2: workpiece mirrored in X

FOLLOW-UP MODE DW K+1, bit 14

1 signal: NC position control loop open; no controller enable; the drives are operated via an external set speed value.
0 signal: Normal state; NC position control loops closed.

Notes:

- With the axis stationary, the 1 signal opens the position control loop.
- If the axis is in motion, the 1 signal effects rapid deceleration with maximum braking current, opens the position control loop after the time delay set by machine data has run down and sets an alarm. Then only the actual position value is held.
- All axes moving with interpolation are stopped if FOLLOW-UP MODE is set for **one axis.** Axes with FOLLOW-UP MODE not set can be stopped only by selecting the set speed value ZERO. The following error of these axes is still eliminated.
- An alarm is output if FOLLOW-UP MODE is specified for an axis moving with interpolation. Further execution of the NC program is then impossible.
- After cancellation of follow-up operation (0 signal), the axis does **not** have to be resynchronized (no approach to reference point) if the max. permissible speed of the axis has not been exceeded at any time.
- **To avoid incorrect positioning, follow-up mode must be cancelled in the AUT mode only if the NC program is in the STOP state.**
- If a rotary axis (C axis) is to be operated as a spindle, the axis-specific monitoring functions can be switched off by setting the FOLLOW-UP MODE and PARKING AXIS signals. Setting the PARKING AXIS signal also cancels the REFERENCE POINT REACHED signal.

  When subsequently switching back to C axis operation the actual value system of the axis must be updated, whereby reference point approach can be avoided.

  In conjunction with the **16-bit servo CPU**[c)] the real actual position of the axis can be calculated and output after the spindle operation with the aid of the "On-the-fly synchronization of C axis" function. In this case, however, the REFERENCE POINT REACHED signal is not set again. Execution of this function is subject to fulfilment of the following preconditions:
  - Enable "On-the-fly synchronization of C axis" function (MD 1808*, bit 7 set)
  - Axis parameterized as rotary axis (MD 564*, bit 5 set)
  - "No start disable for reference point" MD bit set (MD 560*, bit 4)
  - PARKING AXIS and FOLLOW-UP MODE signals set for spindle operation
  - Incremental encoder of C axis has rotated by at least 360° in follow-up mode (otherwise the position is calculated incorrectly, without an alarm)
  - When switching back to C axis operation, PARKING AXIS is set first, then FOLLOW-UP MODE.

  Subject to fulfilment of these preconditions, the actual position of the axis is calculated once the FOLLOW-UP MODE signal is cancelled. Machining with the C axis can then commence straight away.

  In conjunction with the **32-bit servo CPU** these operations are implemented by the "Expanded spindle functions". Please refer to the associated Function Manual for further details.
- While follow-up mode is active the switchover to C-axis mode cannot be performed completely. The block change is delayed.

c) up to and including software version 6

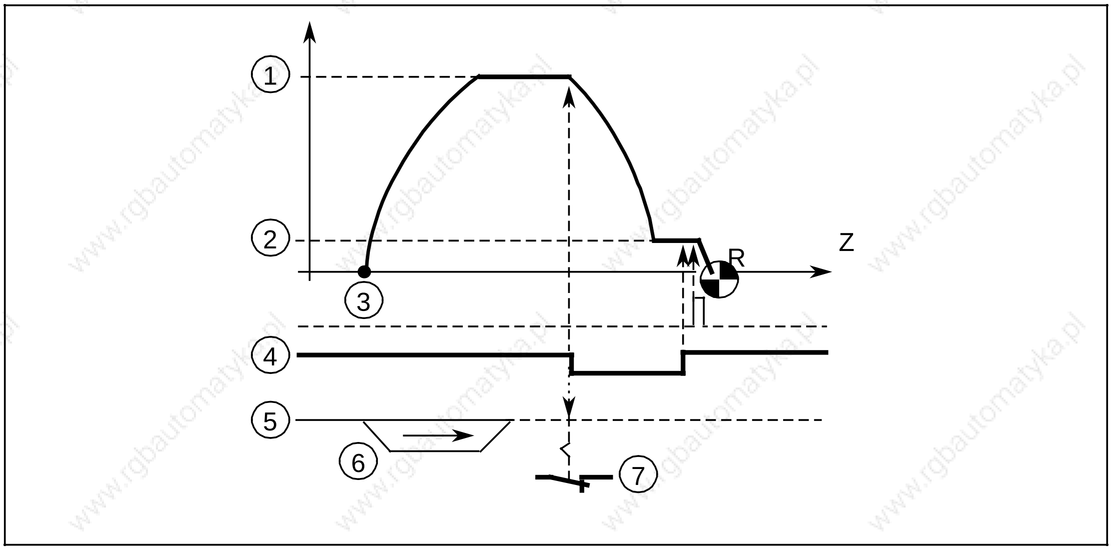
*DECELERATION REFERENCE POINT APPROACH DW K+1, bit 12

REFERENCE POINT APPROACH mode only

1/0 transition: Effects deceleration of the selected axis to the reference point cutoff speed (NC MD 284*).

0/1 transition: Effects traverse to the zero mark of the measuring system + (2000 units travel ± reference point offset).

a) Reference point approach without automatic direction recognition



Signal chart

1: Reference point approach speed
2: Cutoff speed
3: Starting point for reference point approach
4: Measuring system zero mark signal
5: *DECELERATION REFERENCE POINT APPROACH signal
6: Actuating cam
7: Limit switch

Sequence:

The Z axis must be located at the starting point, e.g. in the negative direction from the reference point. The operator presses the Z + key and the axis approaches the reference point. As soon as the actuating cam passes the limit switch, the *DECELERATION REFERENCE POINT APPROACH signal changes from 1 to 0; the axis decelerates to the cutoff speed. When the actuating cam has cleared the limit switch, the *DECELERATION REFERENCE POINT APPROACH signal changes from 0 to 1 and initiates the approach to the next zero mark of the measuring system. As soon as the zero mark signal is given, the axis homes in to the reference point.

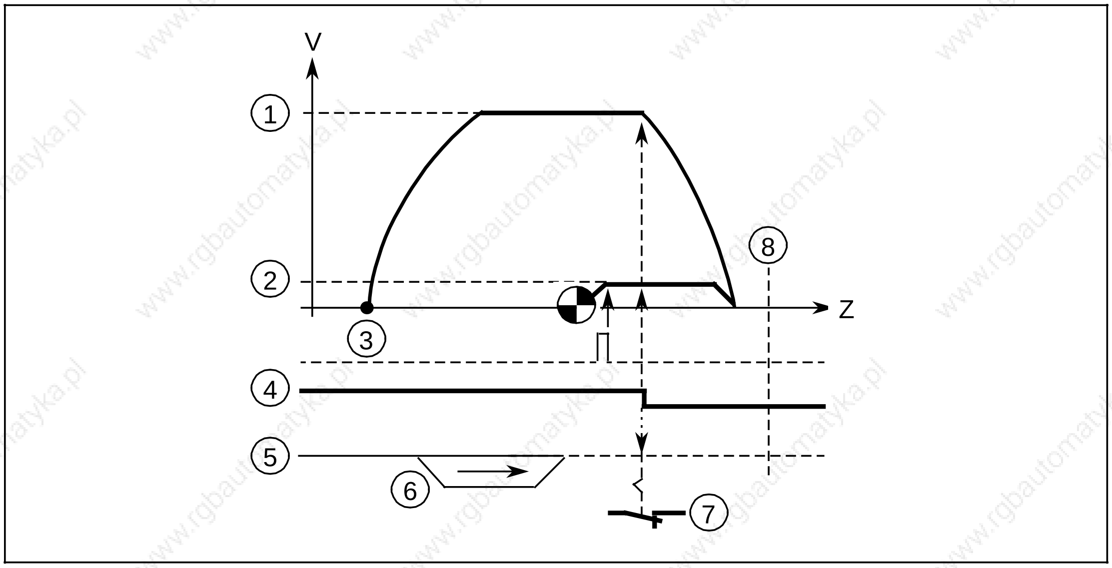
Peripheral condition:

The limit switch that issues the *DECELERATION REFERENCE POINT APPROACH signal should be a normally closed switch. If the connection to the limit switch is interrupted, this can be recognized and actuation of the axis movement prevented.

---

* *Signal is 0 actve*

b) Reference point approach with automatic direction recognition



Signal chart

1: Reference point approach speed
2: Cutoff speed
3: Starting point for reference point approach
4: Measuring system zero mark signal
5: *DECELERATION signal
6: Actuating cam
7: Limit switch
8: Machine end, traverse path limit

Sequence 1:

The Z axis must be located at the starting point, e.g. in the negative direction from the reference point. The operator presses the Z + key declared as the starting key for reference point approach. The axis approaches the machine end at which the reference point is located; the direction is recognized by *DECELERATION signal = 1. As soon as the actuating cam passes the limit switch, the *DECELERATION signal changes from 1 to 0; the axis decelerates to zero and then accelerates to the cutoff speed in the opposite direction. When the actuating cam has cleared the limit switch, the *DECELERATION signal changes from 0 to 1 and initiates the approach to the next zero mark of the measuring system. As soon as the zero mark signal is given, the axis homes in to the reference point.

Sequence 2:

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

Note:

The reference point approach of the C-axis is described in the Function Manual "Extended Spindle Functions".

Peripheral conditions:

- Because of the specific design of the actuating cam (length: from machine end to switching point), this procedure is suitable only for reference points situated near the machine end.
- The cam must not leave the limit switch from the switching point to the machine end, i.e. the *DECELERATION signal remains at 0.
- The limit switch that issues the *DECELERATION signal should be a normally closed switch. If the connection to the limit switch is interrupted (*DECELERATION signal = 0), the axis can accelerate only to the cutoff speed.
- In reference point approach mode the rapid override is active.

PARKING AXIS	**DW K+1, bit 11**

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

Notes:

- If an axis is declared a parking axis, the monitoring of the connection between the measuring sensor and the measuring circuit module is switched off. The position control remains active. No alarm is given if this connection is opened (e.g. to remove an axis, such as a rotary table, from the machine).
- In software version 6, a PARKING AXIS must also be switched to FOLLOW-UP MODE with the FOLLOW-UP MODE signal (DW K+1, bit 14), to prevent actuation of the position control monitors (e.g. standstill monitor).
- With GA2, software version 1 and higher, a parking axis is automatically switched to follow-up mode when the connection between the measured value encoder and the measuring circuit module is broken.
- If the PARKING AXIS signal is removed, either the axis has to be resynchronized or the actual value of the current position must be specified by means of "set actual value" (PRESET).
- When an axis parks in AUTOMATIC mode, the signal REFERENCE POINT REACHED is cancelled.

SERVO ENABLE	**DW K+1, bit 10**

AUT/MDA mode:

1 signal: Closes the position control loop of the relevant axis.
0 signal:
1. With the axis stationary, the position control loop is opened.
2. If the axis is in motion, rapid deceleration is effected.
   The drive is brought to a standstill with maximum braking current and the position control loop opened after the time delay set by machine data has run down. Only actual values are carried (follow-up mode).
3. All axes moving with interpolation are stopped if servo enable is cancelled for **one axis.** Axes with SERVO ENABLE still set can be stopped only by selecting the set speed value ZERO. The following error of these axes is still eliminated.

Note:

If the servo enable signal is cancelled (e.g. to clamp the axis) and the controller is subsequently enabled again, the axis is returned to its position when the servo enable is cancelled to compensate for any change in position caused by mechanical or electrical influences.

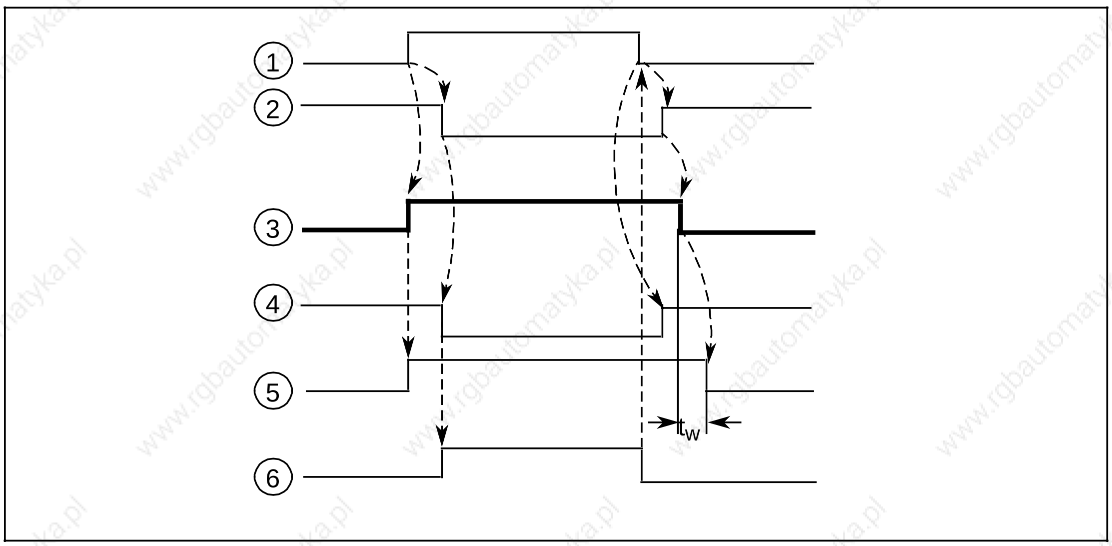
Setup modes

1 signal: Closes position control loop of the relevant axis.

0 signal: 1. With the axis stationary, the position control loop is opened.
2. If the axis is in motion, rapid deceleration is effected.
The drive is brought to a standstill with maximum braking current and the position control loop opened after the time delay set by machine data has run down. Only actual values are carried (follow-up mode).

Notes:

- A following error remaining after rapid deceleration remains stored and is eliminated following a renewed servo enable.
- An NC alarm is output if the servo enable is cancelled while an axis is in motion.
- During normal operation the servo enable signals must be present for all axes to be moved with interpolation.



1: TRAVEL COMMAND signal (e.g. X +)
2: X axis clamp
3: SERVO ENABLE X signal
4: FEED DISABLE X signal
5: *Servo disable X
6: X axis in motion (t_w= delay time)

Sequence:

1) The axis travel command (e.g. X -) releases the clamp and issues servo enable.
2) Servo enable cancels servo disable.
3) As soon as the clamp is released, the feed enable signal is given and axis traverse commences.
4) If the travel command is removed, the axis stops and is clamped again; the feed enable signal is cancelled.
5) After clamping, the servo enable signal is cancelled; the servo disable signal is output again after a delay t_W (machine data).

Self-installation with IAR[c)]

The PLC operating system contains a special program section for self-installation with the integrated drive control. The SERVO ENABLE signals in DB 32 are ignored as long as the self- installation program of the PLC operating system is active. In this case the PLC operating system itself generates a SERVO ENABLE signal for the NC.

2ND SOFTWARE LIMIT SWITCH +/-	**DW K+1, bit 8 and 9**

1 signal: 2nd software limit switch active for +/- direction.
0 signal: 1st software limit switch active.

Example of application:

Reduction of permissible traversing range with the tailstock swung in.

JOG +/-	**DW K+1, bit 6 and 7**

1 signal: In the setup modes, the axis is moved in the preset direction.

0 signal: No effect.

Notes:

- The axis traversing speed is determined by machine data (MD 288* for feedrate, MD 292* for rapid traverse) in accordance with the mode.
- If the plus (+) and minus (-) keys of an axis are pressed at the same time, no travel command is given.
- Per mode group, as many axes can be traversed at the same time as there are channels belonging to the mode group. If several direction keys are pressed at the same time, the sequence in which they are pressed determines which ones are active.
- On the 880M control, FB 79 is used to transfer the DIRECTION KEYS and RAPID TRAVERSE to the axis-specific interface according to the position of the axis selector switch. FB 67 is available for this function on the 880T control.

c) up to and including software version 6

RAPID TRAVERSE OVERLAY — DW K+1, bit 5

1 signal: While traversing in the JOG or REPOS setup modes via JOG +/-, the rapid traverse rate is selected.

0 signal: Traversing in jog mode at the speed determined by machine data (MD 292*).

FEEDRATE 1:100 — DW K+1, bit 4

1 signal: The feedrate is stepped down by a factor of 100 in the setup modes.

0 signal: The feedrate determined by the NC MD for traversing in the jog mode (MD 299*) is active.

Note:

FEEDRATE 1:100 is active only in the setup modes. Here, FEEDRATE 1:100 and the feedrate override switch have a multiplying effect. In the automatic modes, this function is activated by M 36 and M 37.

AXIS DISABLE — DW K+1, bit 3

1 signal: No partial setpoints are output to the relevant machine axis (axis disabled). The position control loop remains closed and the remaining following error is reduced to zero.

0 signal: Normal state.

Notes:

To avoid incorrect positioning, AXIS DISABLE must not be removed until after program end or abort.

Example of application:

Starting up a new NC program for the first time without axis traversing.

HANDWHEEL 1, 2, 3 ACTIVE — DW K+1, bit 0 to 2

Selecting the handwheels assigns them to the axes.

1 signal: The handwheel corresponding to the bit effects axis traversing.
0 signal: The handwheel corresponding to the bit has no effect on the axis.

Notes:

- Each handwheel can be assigned to any axis.
- Each handwheel may be assigned to only one axis at a time.
- Only one handwheel per axis can be active, i.e. only **one of the 3 bits**, DW K+1, bits 0 to 2, can be set.

MEASURING SYSTEM 1/2 d) **DW K+2, bit 12**

1 signal: The actual value of the 2nd measuring system is used.
0 signal: The actual value of the 1st measuring system is used.

Note:

- For axes, the actual value assignment is performed for the first measuring system in the NC MD 200* and for the second measuring system in NC MD 1388*.
- For spindles in C-axis mode, the actual value assignment is performed for the first measuring system in the NC MD 200* and for the second measuring system in NC MD 400*. In spindle modes, the spindle encoder is always used (NC MD 400*) and it is not possible to switch measuring systems.
- If the spindle is assigned to a C-axis, you must enter all measuring-system-specific MDs both for the spindle and for the axis.
- The actual value of the selected measuring system is used for all functions especially for the position control and for the absolute value calculation. The first measuring system (NC MD 200*) is a reference system for axes and spindles in C-axis mode and determined the precision of the position control.
- After a switchover from one measuring system to another the offset is travelled immediately. In MD 1216*, you can specify a tolerance band in which the deviation must be between the actual values. If the difference is greater than the tolerance, the switchover is not made and an alarm is output.
- The reference point approach is performed with the measuring system selected using the signal MEASURING SYSTEM 1/2.

SI BRAKE RELEASED c) **DW K + 2, bit 11**

Only relevant in conjunction with IAR c).

1 signal: Brake is released.
0 signal: Brake is applied.

As long as the self-installation function is active (SI SAFETY SIGNAL = 1), the PLC user program must indicate the position of the brake in SI BRAKE RELEASED.

A brake has to be simulated with the SI BRAKE RELEASED signal on axes without a holding brake.

Also see RELEASE SI BRAKE and SI SAFETY SIGNAL.

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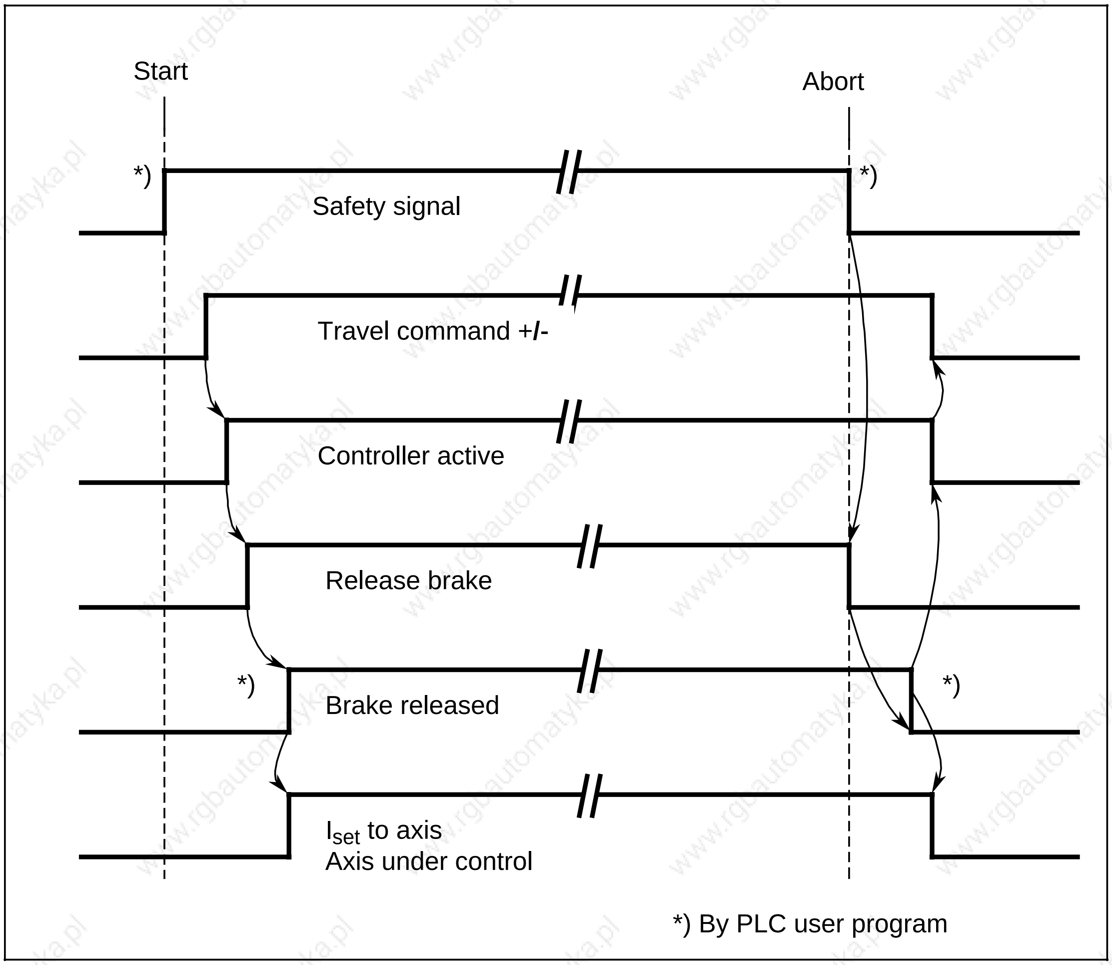
c) up to and including software version 6

d) with GA2, software version 1 and higher

SI SAFETY SIGNAL [c)] DW K+2, bit 10

The self-installation functions for IAR[c)] are enabled, disabled or aborted by the PLC user program.

1 signal: Enable of self-installation functions.
0 signal: Disable or abort of self-installation functions.



c) *up to and including software version 6*

TRAVEL LIMIT +, – DW K+2, bit 8 and 9

The interface control issues a TRAVEL LIMIT signal for both directions of each axis when a travel limit switch is actuated. The provision of these axis and direction-specific signals obviates the need for a retraction logic circuit in the interface control.

1 signal: Effects controlled approach or rapid deceleration with following error elimination, depending on the machine data.

0 signal: Normal state.

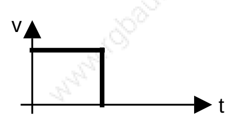
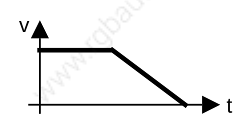
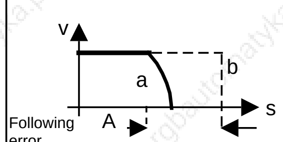
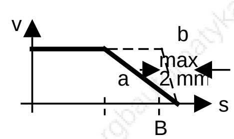
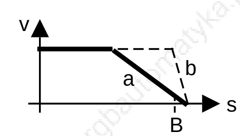
One of three braking methods applies when a travel limit switch is actuated:

a) Controlled approach
Initiated by the TRAVEL LIMIT signal. The NC brakes the axis in accordance with the machine data for acceleration.

b) Rapid deceleration with following error elimination
If the "instant stop at limit switch" bit is set in the machine data (NC MD 5003.7 common to all axes), set speed = 0 is output immediately after the TRAVEL LIMIT signal.
The position control loop remains closed and the following error is eliminated. The program does **not** have to be restarted.

c) Rapid deceleration with maximum braking current
If servo enable is refused at the same time as the TRAVEL LIMIT signal is output, the position control loop is opened; the drives are then normally brought to a standstill with maximum braking current. Any following error is automatically worked in. The program has to be restarted.

Overview

Braking method	Rapid deceleration with maximum braking current c)	Rapid deceleration with following error elimination b)	Controlled approach a)
Digital speed setting (position set value)	(Position control loop opened)		
Machine set value with limit switch signal a = Machine position b = Digital position			
Position control loop	open	closed	closed
Activated by	TRAVEL LIMIT signal + servo enable refusal	TRAVEL LIMIT signal + instant stop at limit switch bit	TRAVEL LIMIT signal

The position of the mechanical travel limit switch is at point A.
The position of the software limit switch is at point.

Software limit switches

The software limit switches are active after the reference point has been approached.

a) Setup modes

The axis is braked **before** the software limit switch is reached so that the switch is **not** tripped.

b) Automatic
Before travel commands are output, a check is carried out at each NC start to determine whether the software limit switch is tripped. If so, the block is not executed and an NC alarm is output.

Notes:

- The mechanical travel limit switch must be positioned in front of the software limit switch because the braking distance has to be added on.
- Provided that technical safety is not compromised, the travel limit +**/-** function can be suppressed by the PLC program after the reference point has been approached to permit fuller utilization of the machine bed.

FEED DISABLE	DW K+3

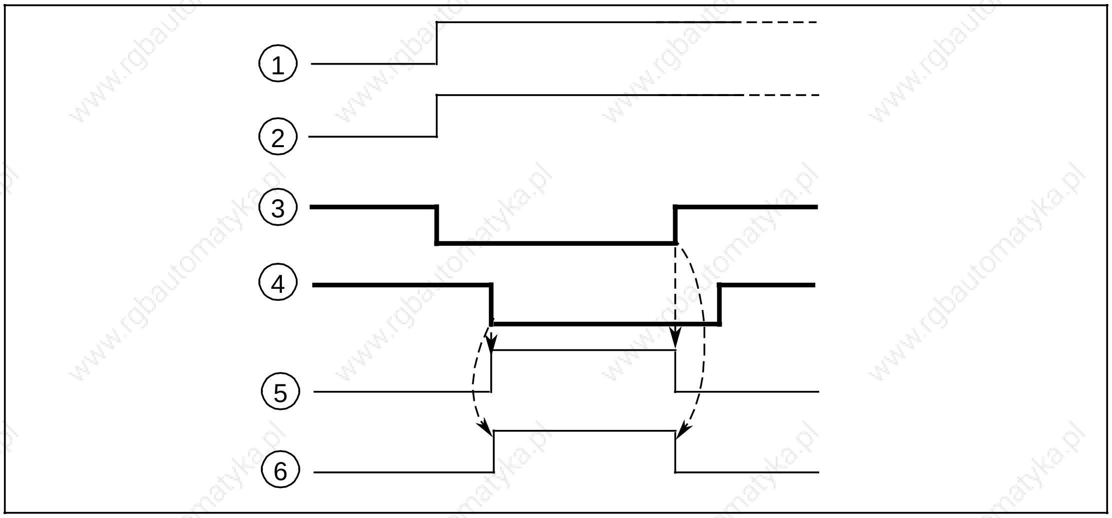
AUT/MDA mode

1 signal: 1. Effects feed disable of the relevant axis.
2. Effects feed disable of **all axes moving with interpolation** if the feed disable signal is given **for one axis.** In this event, all axes are brought to a standstill along the contour. Position control remains operative, i.e. the following error is reduced to zero.

0 signal: No feed disable if all signals in DW K+3 are reset.

Note:

With the axis-specific feedrate disable, setpoint 0 is output at the block change limit with G64.



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

Setup modes:

1 signal: Effects feed disable of the relevant axis.
0 signal: Effects feed enable of the relevant axis.

Self-installation with IAR[c]):

If self-installation with the integrated drive control is active, the FEED DISABLE signals in DB 32 are ignored. In this case the PLC operating system itself generates a FEED DISABLE signal for the NC.

Notes:

- Feed disable is activated if at least one bit is set.
- A message (error or operational message) can be allocated to any bit (see Section 15).
- FEED DISABLE is also active with G33 (NC alarm: stop in thread).

c) up to and including software version 6

10 Tool Management SINUMERIK 880N (DB 33)

The signals of the tool management of the SINUMERIK 880N are described in the document SINUMERIK 880N, Interface Description, Part 1: Signals, Difference Description

11 Data Transfer PLC/NC/COM (DB 36)

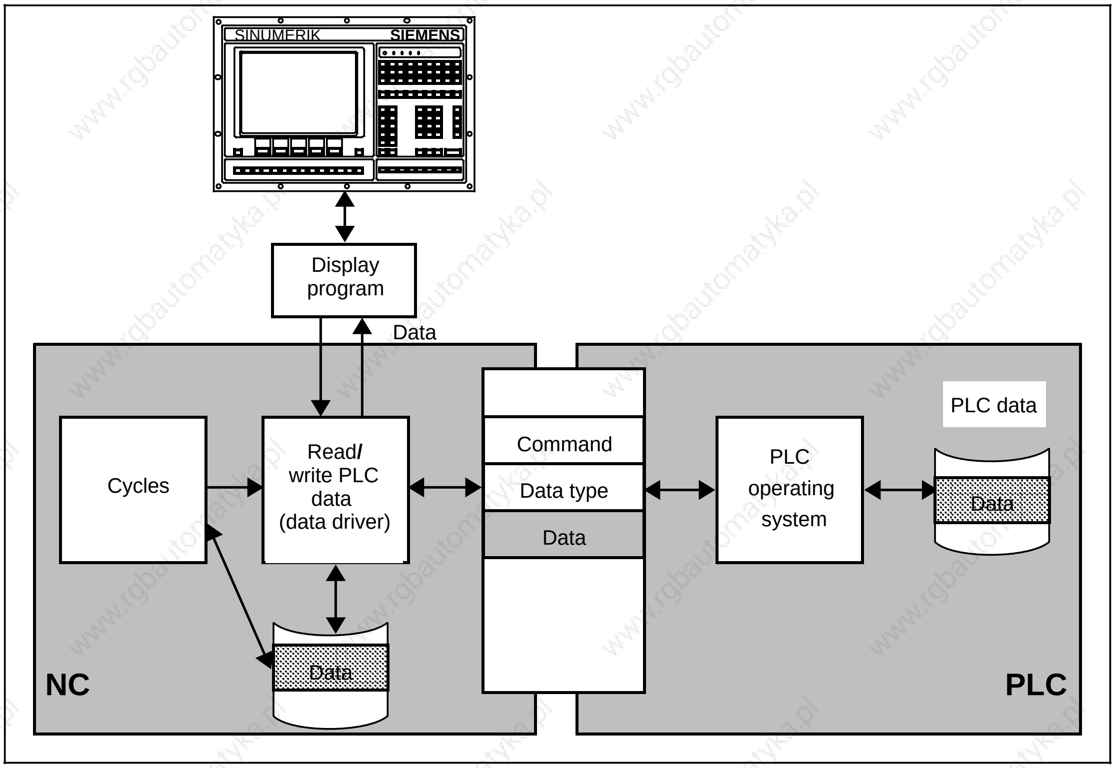
11.1 Introduction

Data transfer can be initiated by the NC or PLC.

Data transfer on NC initiative

In the case of NC initiative the transfer is triggered by commands in cycle language CL 800; all cells in the PLC can be read and written. The data are stored in the NC in R parameters and transferred to the PLC from R parameters.

The PLC user program is generally not affected by data transfer on NC initiative; the PLC operating system assumes responsibility for the transfer operation on the PLC side.



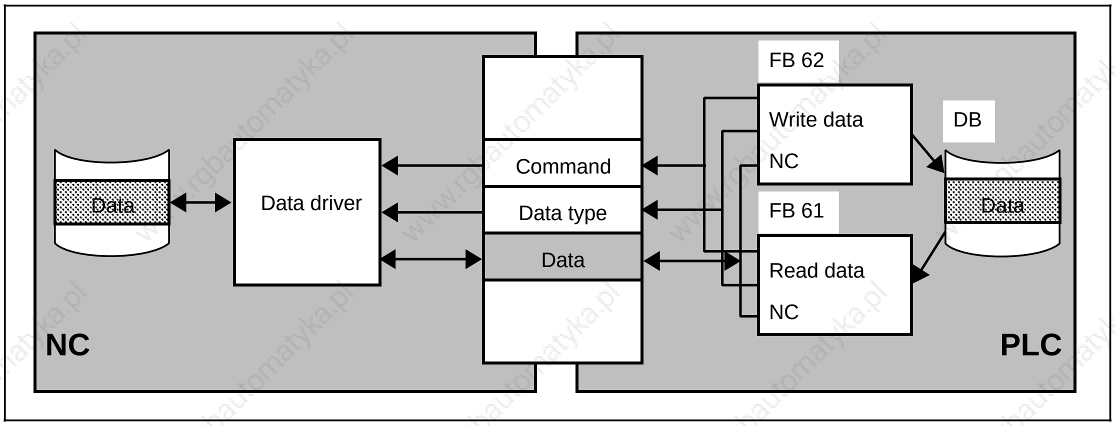
Data transfer on NC initiative

Note:

In the event of indirect addressing via the NC/PLC data channel (NC initiative), the PLC user program must make data addresses available (can be necessary, for example, with specially programmed functions in the UMS).

Data transfer on PLC initiative

The PLC user program parameterizes the function macros FB 61 (read NC data) and FB 62 (write NC data) and calls them.



Data transfer on PLC initiative

With data transfer activated by the PLC, the following NC data, among others, can be read/written:

- Machine data
- Setting data
- Tool offsets
- Zero offset
- Actual values
- Setting data for spindle converter
- External setpoints
- Program data and lengths
- Program selections
- R parameters
- NC alarms
- Date and time

Refer to the description of the function macros FB 61/FB 62 for a complete list of the NC data to which the PLC has access.

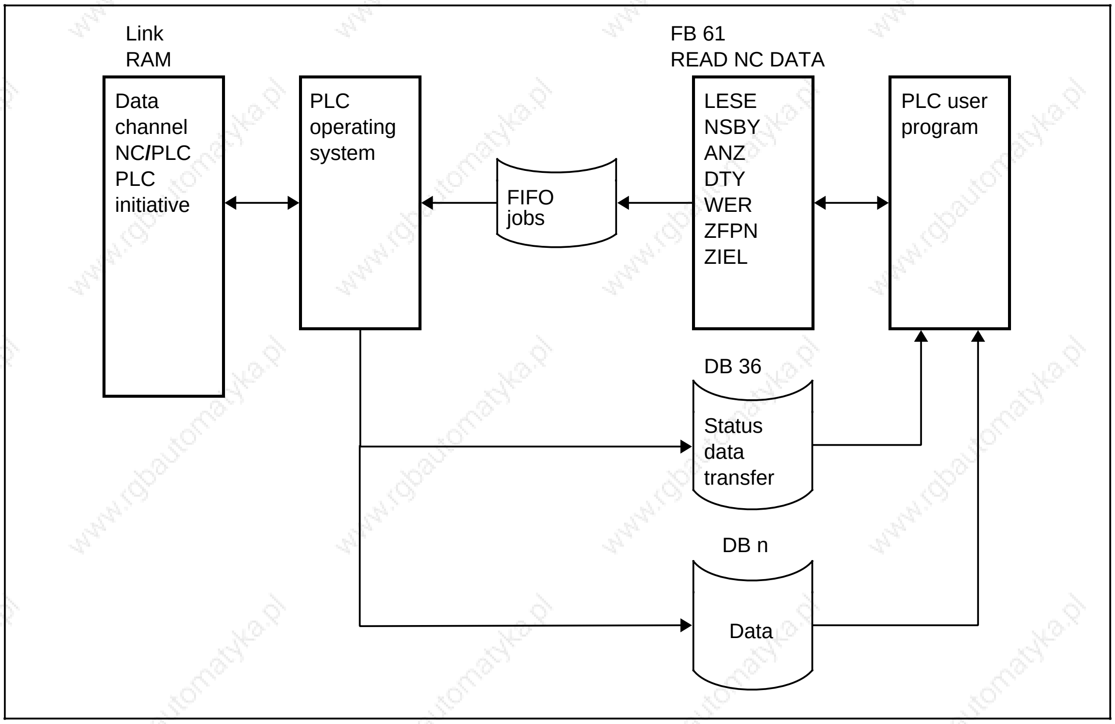
11.2 Data transfer PLC/Initiative

11.2.1 Structure and signal path

Data can be exchanged between the PLC and NC or COM via data channels. If two PLCs are installed, data transfer can be initiated by either of them.

2 function blocks for activating the transfer of data are available in the PLC operating system: read NC data (FB 61) and write NC data (FB 62) (see description of function macros).

The following figure shows the structure of data transfer on PLC initiative.

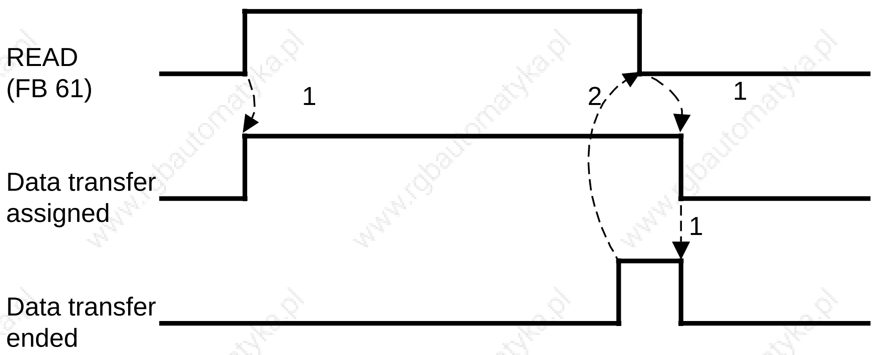


Structure of data transfer on PLC initiative: in this case, reading NC data

The function blocks enter the parameters for data transfer (data type, data source, data destination) in an internal interface. The interface is a first-in first-out (FIFO) register with a maximum capacity of 8 jobs. Even when several jobs are involved, this ensures that they are executed in the correct sequence.

Each job must still be allocated an interface byte indicating the status of data transfer (DB 36, DW 0 ... DL 32 corresponds to 65 interface bytes). Data transfer can be checked and branches implemented in the user program according to these acknowledgements.

Example: Read NC data, principal signals



1 Signal change triggered internally by FB.
2 Signal change triggered by user.

Status byte for interface(DB 36):

Error			Data transfer				
Value 1 - Value 3	Number format	Access disabled	ended	assigned	busy	FIFO full	Data transfer requested

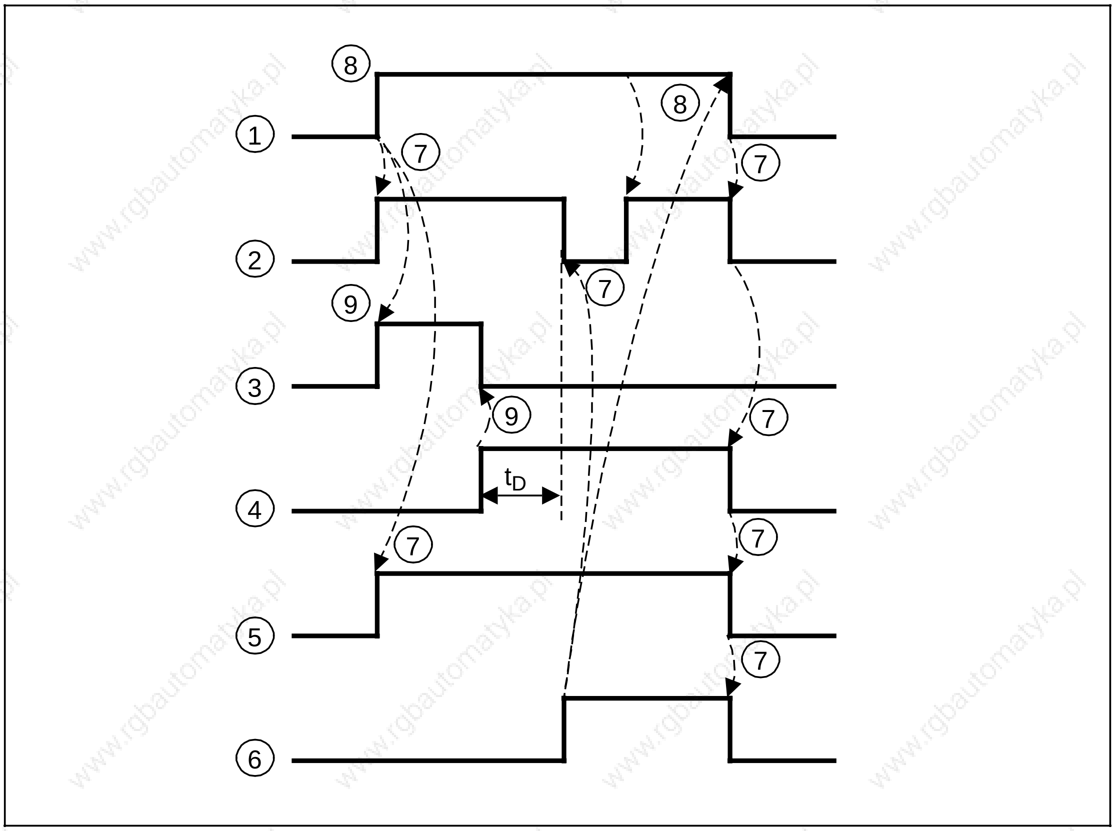
Principal signal paths with data transfer NC/PLC, PLC initiative

If data transfer is initiated at FB 61 at the READ input, for example, the DATA TRANSFER ASSIGNED signal is immediately output at the interface. Since this signal remains present until the end of data transfer, it can be used to effect read-in disable, for instance. When data transfer has ended, the DATA TRANSFER ENDED signal is output; this signal is not reset until the user cancels the READ signal at the FB.

In order to reduce the load on the PLC program caused by repeated calls of the FB 61/62 function blocks, they can be called either unconditionally or conditionally. The advantage of an unconditional block call is that the FB can be easily initialized. However, in the inactive state of data transfer, approx. 0.2 ms of the PLC cycle are taken up by the block change and some logic operations.

Signal chart with unconditional block call

The following chart showns the paths of all signals when a block is called unconditionally.

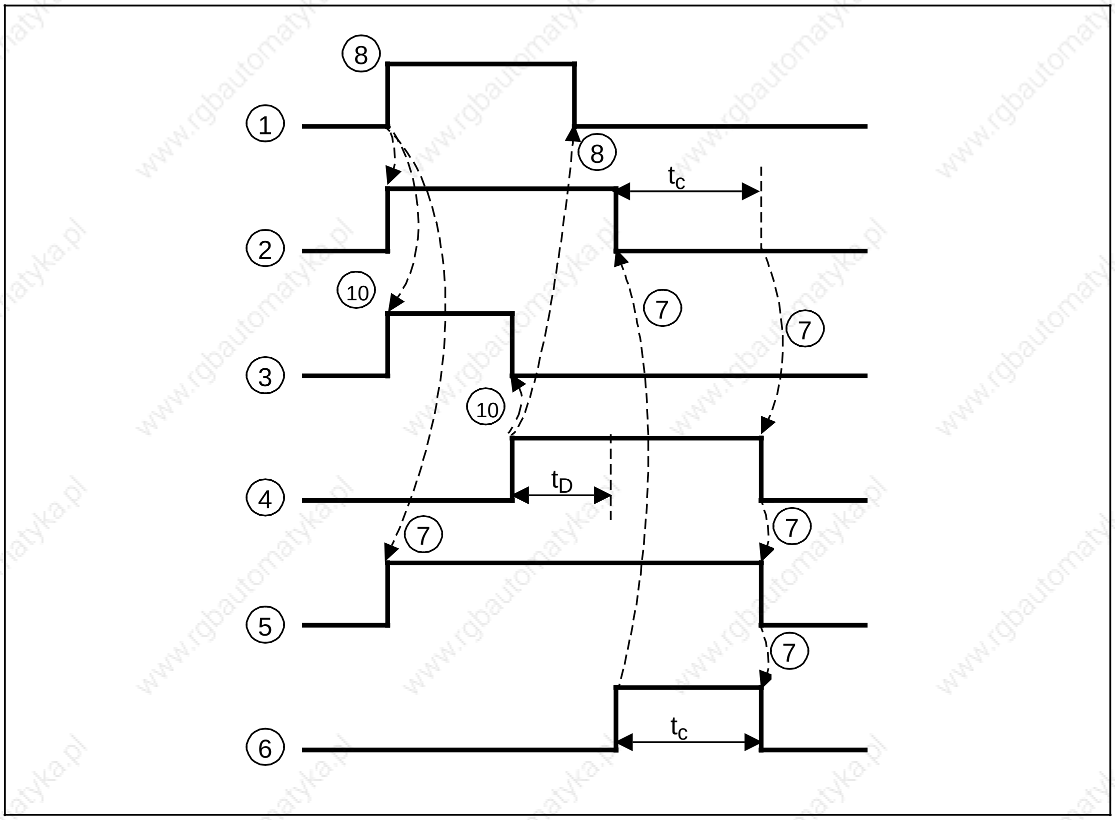


Signal chart with unconditional block call

1: READ/WRITE
2: DATA TRANSFER REQUESTED
3: FIFO ASSIGNED
4: DATA TRANSFER BUSY
5: DATA TRANSFER ASSIGNED
6: DATA TRANSFER ENDED and (possibly) error
7: Signal change by FB
8: Signal change by user
9: Signal change by FB; omitted if FIFO not yet full
t_D: Internal interface assigned by data transfer

Signal chart with conditional block call

Alternatively, the FBs can also be called conditionally; i.e. the FBs have to be processed only until the job has been transferred to the job buffer (FIFO). This is indicated by the DATA TRANSFER BUSY signal. In the inactive state of data transfer, only approx. 0.008 ms of the PLC cycle are taken up.



Signal chart with conditional block call

1: READ/WRITE
2: DATA TRANSFER REQUESTED
3: FIFO FULL
4: DATA TRANSFER BUSY
5: DATA TRANSFER ASSIGNED
6: DATA TRANSFER ENDED and (possibly) error
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: Internal interface assigned by data transfer

Speed of data transfer

The PLC operating system can transfer a value to the NC or read an NC value every 20 ms. If two PLCs are installed, a value is transferred alternately from PLC I and PLC II, so that value transfer takes place only every 40 ms per PLC.

Example:

Transfer of 6 values to the NC (with 1 PLC):

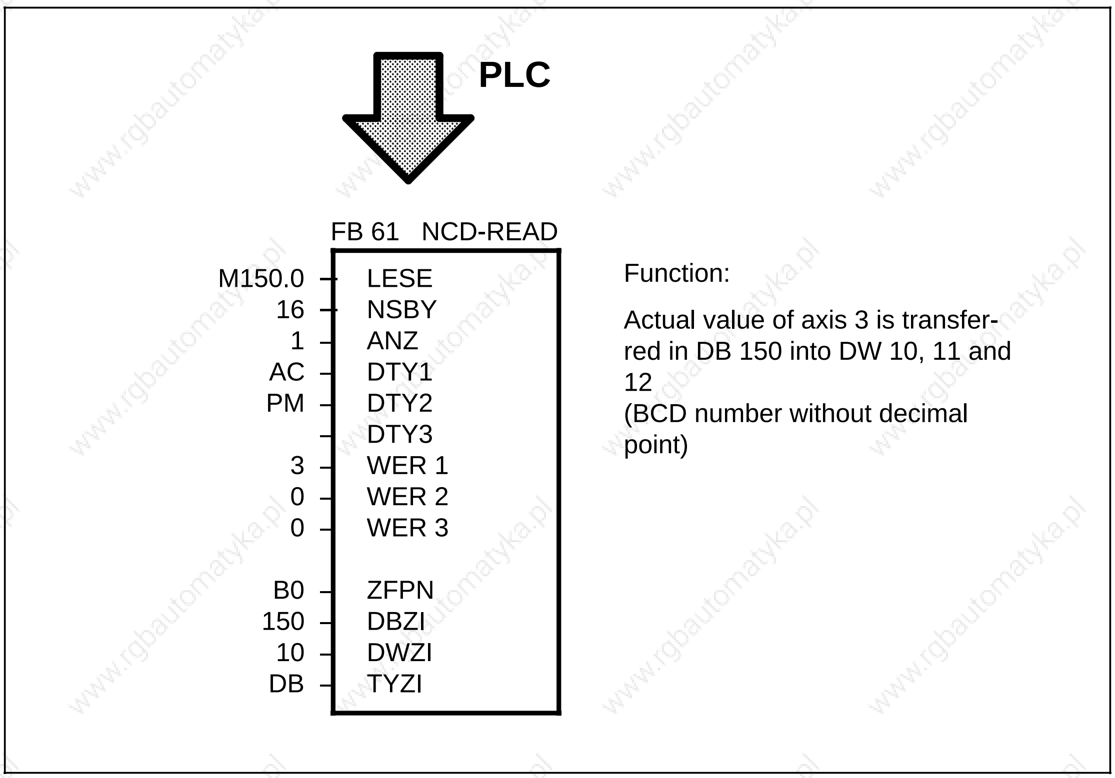
a) With a PLC cycle time of 50 ms, a new job cannot be executed until after **4 PLC cycle times** = 200 ms at the earliest.

b) With a PLC cycle time of 250 ms, a new job can be executed after **1 PLC cycle time** = 250 ms.

If the function blocks are incorrectly parameterized (e.g. data source in the PLC unknown), 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.

Examples of parameterization of FB 61

The figure below shows the parameterization of FB 61 for reading the "machine-oriented actual axis value" of the 3rd axis (data type ACPM). The actual value is to be stored in DB 150 in data words 10, 11 and 12.

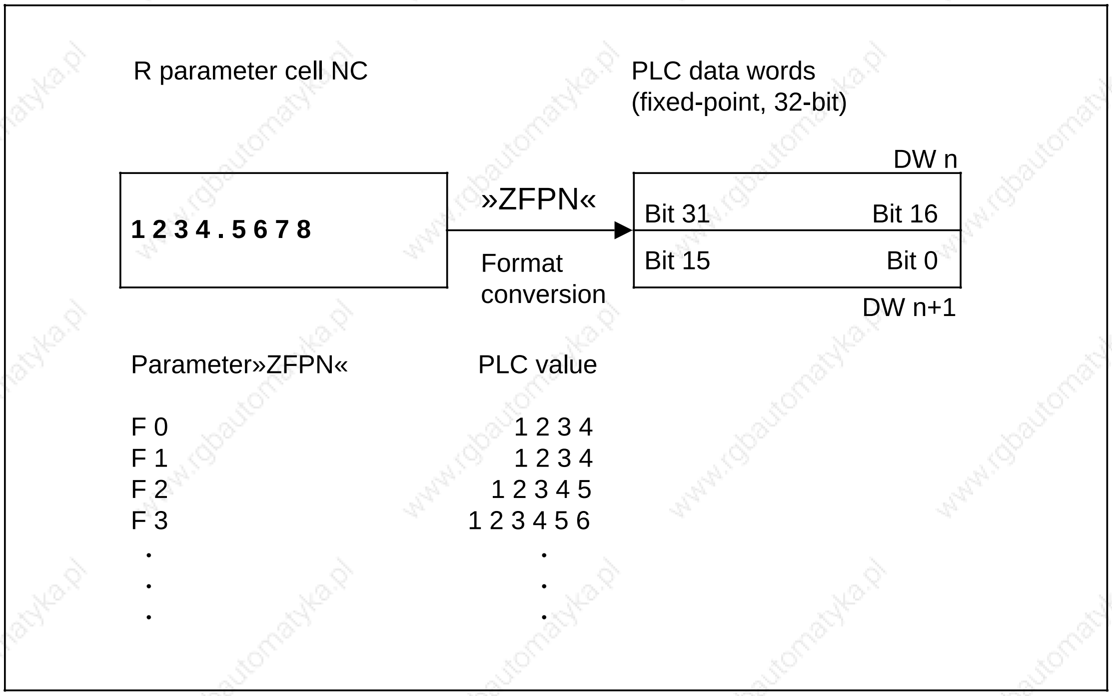


Example: Reading actual axis value with FB 61

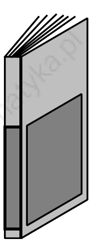
Number formats and format conversion

In the case of data transfer by the PLC, the number format is converted according to parameter ZFPN of FBs 61 and 62. In principle, the following number formats are possible:

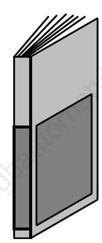
Parameter ZFPN	Format	Destination/source in PLC DBs
BI	Bit pattern	DR n
F.	Fixed-point number, 32-bit	DW n, DW n+1
B.	BCD number with sign and comma	DW n, DW n+1, DW n+2



NC/PLC data transfer, format conversion



Refer to the description of "Function Macros" publication for the SINUMERIK 880 for further information on using FB 61 and FB 62.



11.2.2 Description of job-specific interface signals

Notes:

- Some principal signal paths are described in greater detail in the preceding Subsection.
- Address m: Number of the interface byte in DB 36, value range 1 ... 65. A job with interface byte 65 is processed before all other jobs (e.g. for alarm processing).

VALUE 1 - VALUE 3 ERROR	**DB m, bit 7**

1 signal: Job completed with NC error message. The VALUE 1 VALUE 3 FB 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.

NUMBER FORMAT ERROR	**DB m, bit 6**

1 signal: Job completed with NC error message. The number format FB parameter is inadmissible (e.g. actual axis value to be read as a bit pattern).

0 signal: After 1 signal only if READ/WRITE signal is again 0.

ACCESS DISABLED	**DB m, bit 5**

1 signal: The job is refused because the interface is assigned or access to the desired data field is impossible.

0 signal: No significance.

Note:

The job is refused, for instance, if an attempt is made to preselect a program number with FB 62 and the relevant channel is not in the reset state.

DATA TRANSFER ENDED	**DB m, bit 4**

1 signal: Job completed with or without NC error message.

0 signal: After 1 signal if READ or WRITE at FB 61/62 is 0.

DATA TRANSFER ASSIGNED **DB m, bit 3**

1 signal: FIFO FULL or DATA TRANSFER BUSY signal is 1.
0 signal: Otherwise.

Example of application:

Actuation of READ-IN DISABLE during data transfer.

DATA TRANSFER BUSY **DB m, bit 2**

1 signal: Job is entered in buffer or being executed.
0 signal: After 1 signal if DATA TRANSFER ENDED signal is 0.

FIFO FULL **DB m, bit 1**

1 signal: Job cannot be entered in FIFO at the moment. With READ or WRITE = 1, repeated attempts are made until successful.

0 signal: Otherwise.

DATA TRANSFER REQUESTED **DB m, bit 0**

1 signal: FB READ or WRITE signal is 1.

0 signal:
a) With 0 1 edge of DATA TRANSFER ENDED signal or error during data transfer.
b) READ or WRITE signal is 0.

Also see timing diagram in the preceding Subsection.

11.3 Data transfer NC initiative

On the SINUMERIK 880, PLC data can be read/written directly by the NC and COM CPU. The NC or COM requests or supplies data via an interface; data transfer takes place via the PLC operating system.

PLC data for the NC CPU can be read and written using commands in the cycle language CL 800.

Appropriate commands are available for data types I, Q, F, T, C and D (see CL 800 documentation).

Data from the PLC are written in R parameters by the CL 800 command; data to the PLC must be entered in an R parameter before calling the CL 800 command.

This function permits data to be exchanged between the PLC and NC cycles **without** a PLC user program; the user merely has to reserve certain data storage areas (e.g. a data block) in the PLC for data transfer purposes.

Note:

In the event of major data storage areas being altered in the PLC by an NC program, users are recommended to set a strobe bit in the PLC after completing the data transfer. This obviates the need for time-consuming comparisons of data fields to identify alterations. Certain bits can be set in the PLC as strobes via CL 800; M functions can also be used to identify data alterations.

11.4 Data transfer COM initiative (available soon)

PLC-COM transfer on COM initiative is required in cases where display programs have to be supplied with PLC data. The displays have to be compiled with the NC programming terminal and stored in the EPROM in the COM area. When compiling displays with the NC programming terminal, the exact data source in the PLC (I, Q, F, T, C, D) has to be stated for each variable.

When a display with PLC variables is selected at the NC, the display program requests the content of the PLC variables from the PLC operating system, carries out any necessary format conversions and then displays the variables.

If PLC data are to be written after an input at the NC operator panel keyboard, the same procedure is followed in the reverse sequence.

No additional function blocks are required in the PLC for obtaining displays with PLC variables; **all** functions needed to obtain the display are contained in the **NC** display program or PLC operating system.

Exception:

Function blocks from FB package 0 are required to display and interrogate PLC messages.

12 Serial Interface (DB 37)

12.1 Description of interface signals

On the 880 System, **one** serial interface can be activated by the PLC. The PLC is assigned to an interface by means of the NC machine data MD 200; processing for a PLC is enabled by the PLC machine data (PLC I 6026.7, PLC II 6126.7).

RS232C (V.24) BUSY: 1 to 4	**DW 0, bit 8 to 11**

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

Note:

The RS232C (V.24) BUSY signal is set if data are being input/output via one of the four RS232C (V.24) interfaces irrespective of whether activation was by the PLC or NC (operator).

RS 232 ABORT	**DW 1, bit 10**

1 signal: Discontinuation of data input/output
0 signal: By the user at TRANSFER ENDED.

DATA START OUTPUT	**DW 1, bit 9**

1 signal: Start of data output via RS232C (V.24).

0 signal: By the user at:
a) TRANSFER ENDED
b) ERROR DURING DATA TRANSFER

Note:

Before the start of data output, the DATA TYPE, INITIAL NUMBER and END NUMBER parameters have to be provided.

DATA START INPUT	DW 1, bit 8

1 signal: Start of data input via RS232C (V.24).
0 signal: By the user at:
a) TRANSFER ENDED
b) ERROR DURING DATA TRANSFER

Note:

After the start of data input, data must be available at the interface within 20 s at the latest or else the monitor will trip (RS232C (V.24)).

ERROR DURING DATA TRANSFER	DW 1, bit 1

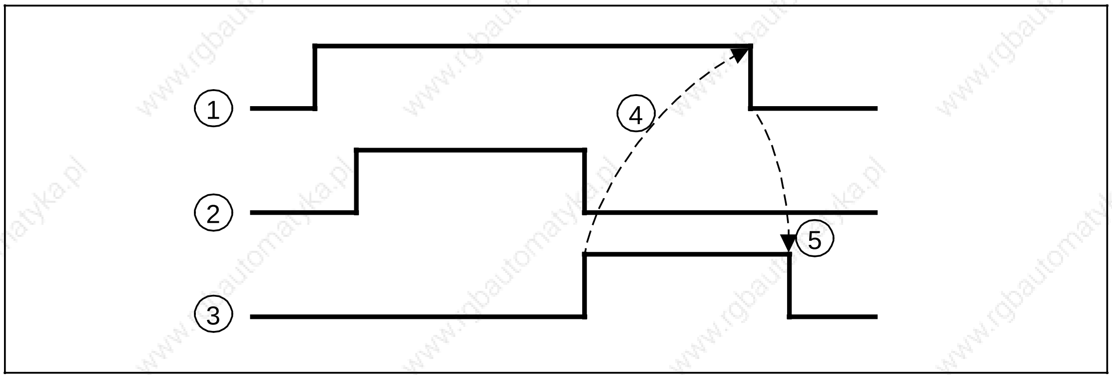
1 signal: After incorrect RS232C (V.24) activation
0 signal: After the 1 signal if the
– DATA START INPUT
– DATA START OUTPUT
– ABORT
signals are 0

Note:

The error message can be triggered by:

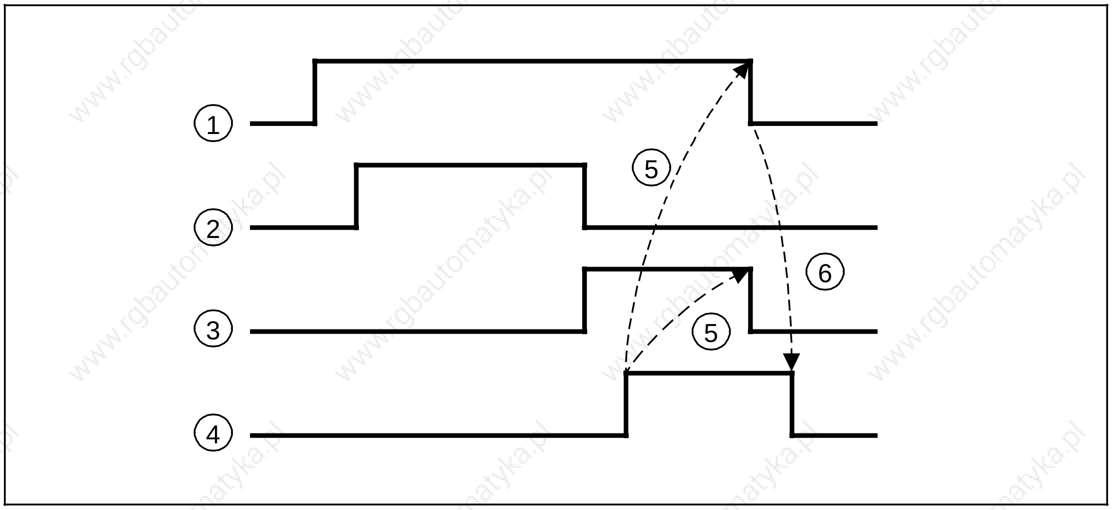
a) Unavailable or erroneous data in the case of data input
b) Incorrect data type in the case of data output
c) Activation of a local programmer while remote programmer is active.

Signal paths:



Data input/output without abort

1: DATA START OUTPUT or DATA START INPUT
2: RS232C (V.24) busy
3: TRANSFER ENDED or ERROR DURING DATA TRANSFER
4: User cancels signal 1
5: PLC operating system cancels signal 3



Data input/output with abort

1: DATA START OUTPUT or DATA START INPUT
2: RS232C (V.24) busy
3: ABORT
4: TRANSFER ENDED
5: User cancels signals 1 and 3
6: PLC operating system cancels signal 4.

DATA TRANSFER ENDED	**DW 1, bit 0**

1 signal: After recognition of the end criterion of data input/output
0 signal: a) Otherwise
b) After the 1 signal if the
– DATA START INPUT
– DATA START OUTPUT
– ABORT
signals are 0.

DATA TYPE FOR DATA OUTPUT	**DW 2, DW 3**
INITIAL NUMBER	**DW 4**
END NUMBER	**DW 5**
CHANNEL NUMBER	**DW 6**

The parameters must be assigned according to the following table:

Data type for data output (DB 37, DW 2, 3)	Meaning	Initial number (DB 37, DW 4) KF	End number (DB 37, DW 5) KF	Channel number (DB 37, DL 6) KF
IKA 1	IKA relations	1...32	1...32	–
IKA 2	Error curve pointer	1...32	1...32	–
IKA 3	Compensation points	1...3000	1...3000	–
MPF	Part program	0...9999	0...9999	–
PCF	PLC texts	0...9999	0...9999	–
RPA	R parameters – channel-specific – central	 0...599 900...999	 0...599 900...999	– 1...16 –
SEA	Setting data	0...5799	0...5799	–
SEA 4	Cycle setting data	0	949	1...16
SPF	Subroutine	1...999	1...999	–
TEA 1	NC machine data	0....18223	0...18223	–
TEA 2	PLC machine data	0...8199	0...8199	–
TEA 3	IAR machine data	1000	5303	–
TEA 4	Cycle machine data – channel-specific – central	 0 1000	 949 8049	 1...16 –
TOA	Tool offsets	1...409	1...409	1...16
TOG	Tool offsets Graphics	1...127	1...127	17, 18
ZOA	Zero offsets (G54...G57)	–	–	0...16

Parameter assignment

Note:

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

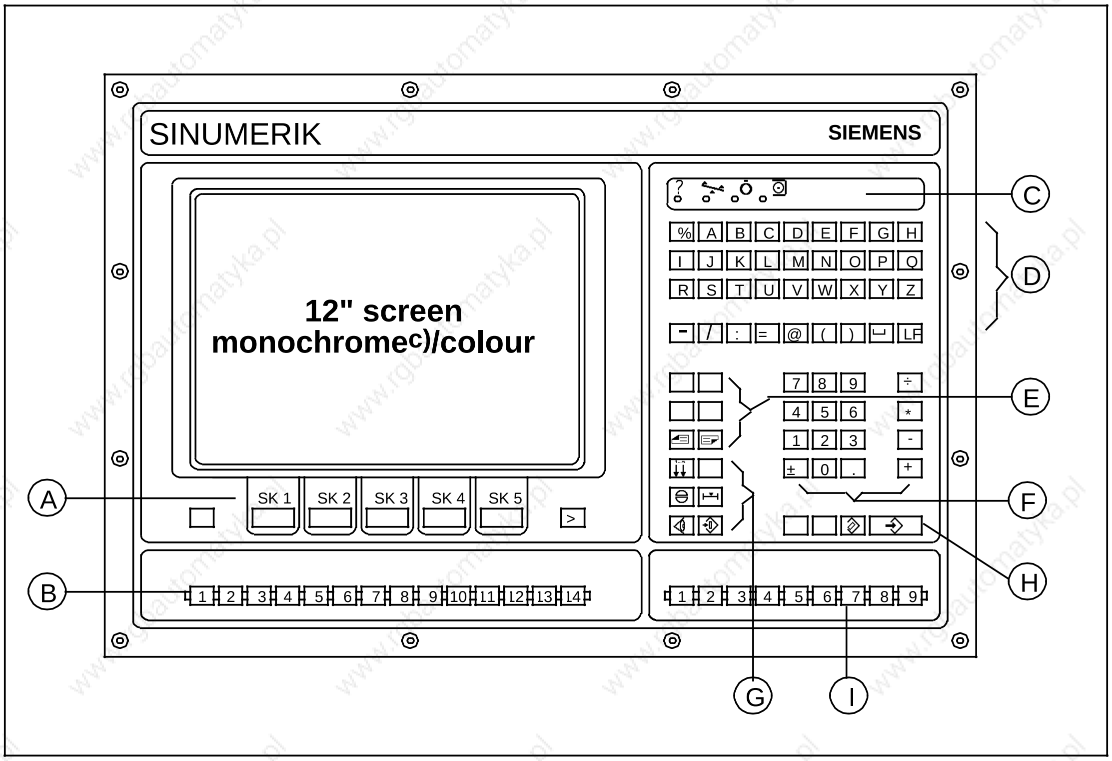
Example:

Output of part programs 10 to 20

```
:
C   DB 37
L   KCMP
T   DW 2
L   KCF
T   DW 3
L   KF 10
T   DW 4
L   KF 20
T   DW 5
SU  D 1.9
:
```

13 Operator Panel Interface (DB 40)

13.1 Operator controls



Operator panel SINUMERIK 880

The operator control elements are divided into 9 groups:

Group	Designation
A	Softkeys
B	Freely assignable keys
C	Displays
D	ASCII keyboard with special characters
E	Cursor keys
F	Numeric keypad with arithmetic function keys
G	Testing aids
H	Editing
I	Special functions

c) *up to and including software version 6*

13.2 Key signals from operator panel

Note:

The operator panel key symbols are not transferred to the PLC with acknowledgement control (except for configured softkey function numbers).

The PLC operating system updates the key image in DB 40 at the start of the PLC cycle. If a key is pressed for less than the duration of one PLC cycle, the key signal is **not** updated in DB 40.

STATIC KEY SIGNALS	DR 0 to DR 6

1 signal: Key pressed.
0 signal: Key not pressed.

Note:

If several keys are pressed at the same time, only the key that was pressed **first** will have any effect (exception: several keys can be pressed at the same time in group B).

DYNAMIC KEY SIGNALS	DL 0 to DL 6

1 signal: Key pressed.
0 signal: a) Key not pressed.
b) After one PLC cycle.

Note:

If several keys are pressed at the same time, only the key that was pressed **first** will have any effect (exception: several keys can be pressed at the same time in group B).

MODE GROUP	DR 7

The display on the screen can be switched over specific to the mode group with keys 1 to 8 of key group I. In DR 7 the number of the mode group valid for the display is output as a binary number. In DL 7, the number of the last key of key group I to have been pressed is output as a binary number.

When the control is switched on, 0 is output; that is **not** the mode group that is obtained automatically after the control has run up.

Example of application:

Several mode groups are required on some configurations of the 880 System (e.g. one for the machine and one for the loader). If only one machine control panel is available, mode group-specific signals (e.g. mode selection switch) can be accordingly routed by the MODE GROUP signal.

KEY HEXADECIMAL CODE DL 7

The key signals of groups A, D, E, F, G, H and I are output in the KEY HEXADECIMAL CODE byte. The following allocations apply.

KEY HEXADECIMAL CODE Group A: Softkeys

Key	Hexd. code (KH)
SK1	80
SK2	81
SK3	82
SK4	83
SK5	84
> (ETC)	85
(RECALL)	86

KEY HEXADECIMAL CODE Group D: ASCII keyboard with special characters

Key	Hexd. code (KH)	Key	Hexd. code (KH)
%	25		
A	41	a	61
B	42	b	62
C	43	c	63
D	44	d	64
E	45	e	65
F	46	f	66
G	47	g	67
H	48	h	68
I	49	i	69
J	4A	j	6A
K	4B	k	6B
L	4C	l	6C
M	4D	m	6D
N	4E	n	6E
O	4F	o	6F
P	50	p	70
Q	51	q	71
R	52	r	72
S	53	s	73
T	54	t	74
U	55	u	75
V	56	v	76
W	57	w	77
X	58	x	78
Y	59	y	79
Z	5A	z	7A

KEY HEXADECIMAL CODE Group D: ASCII keyboard with special characters (continued)

Key	Hexd. code (KH)
–	2F
:	3A
=	3D
@	40
(	28
)	29
Space	20
LF	0A
/	2F
[	5B
]	5D

KEY HEXADECIMAL CODE Group E: Cursor positioning

Key	Hexd. code (KH)
Page	8E
Page	8F
<	90
>	91
	92
	93

KEY HEXADECIMAL CODE Group F: Numeric keypad, arithmetic functions

Key	Hexd. code (KH)
.	2E
+/ –	87
0	30
1	31
2	32
3	33
4	34
5	35
6	36
7	37
8	38
9	39
+	2B
–	2D
*	2A
÷	2F

KEY HEXADECIMAL CODE Group G: Testing aids

Key	Hexd. code (KH)
Search	8D
INBETR.	96
IW. ANZ.	94
AL. QUIT	95
Channel switchover	99

KEY HEXADECIMAL CODE Group H: Editing

Key	Hexd. code (KH)
INPUT	89
EDIT	8A
CANCEL	8B
CLEAR	8C

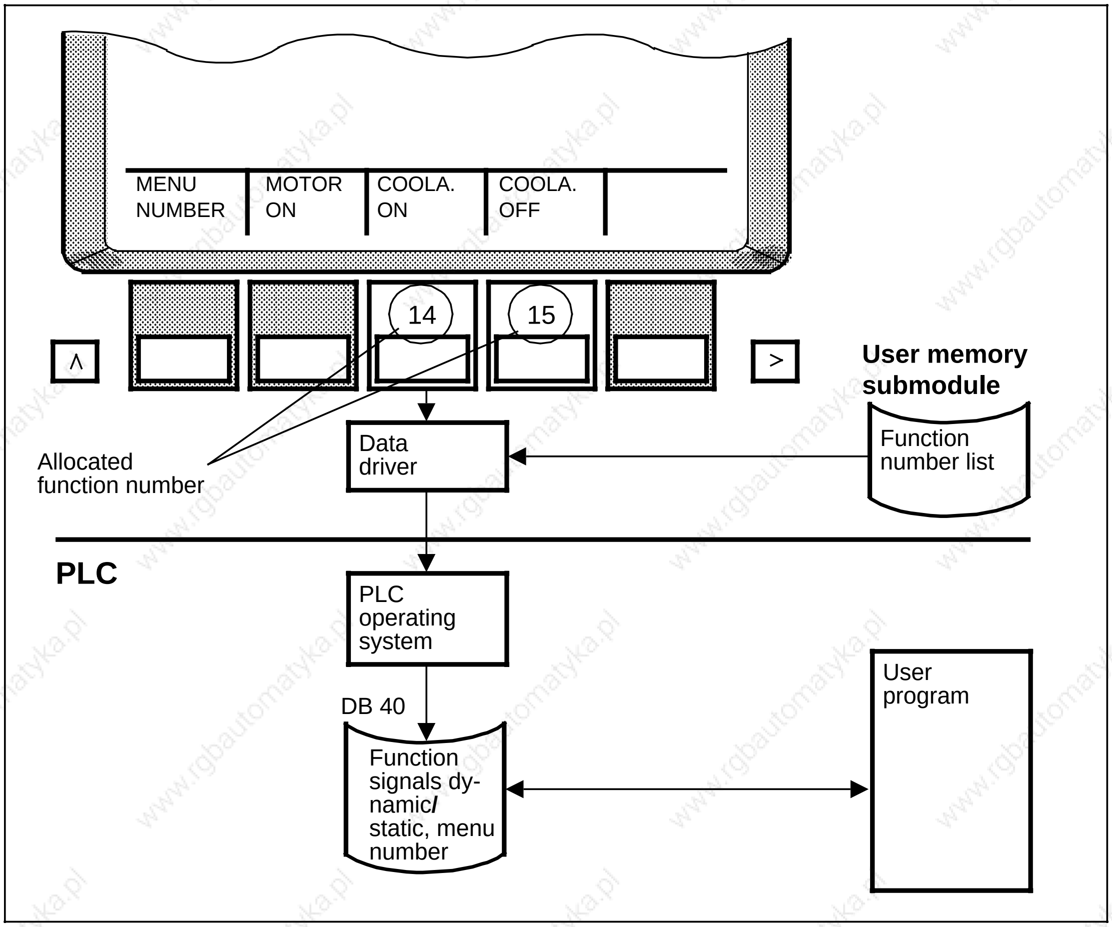
KEY HEXADECIMAL CODE Group I: Special functions

Key	Hexd. code (KH)
1	A5
2	A6
3	A7
4	A8
5	A9
6	AA
7	AB
8	AC
9	AD

13.3 Softkey function signals

The user can program both displays and softkey menus at the NC programming terminal in order to adapt operation to a specific machine. To permit this, a signal definitely allocated to the softkey must be output to the PLC after the softkey is pressed. The NC programming terminal **can** be used to allocate a function number to each configured softkey.

When the softkey is pressed, this function number is output to the PLC. The output SOFTKEY FUNCTION NUMBERS in the range 0 to 255 are decoded by the PLC program like the M functions; i.e. a static and a dynamic bit are output.



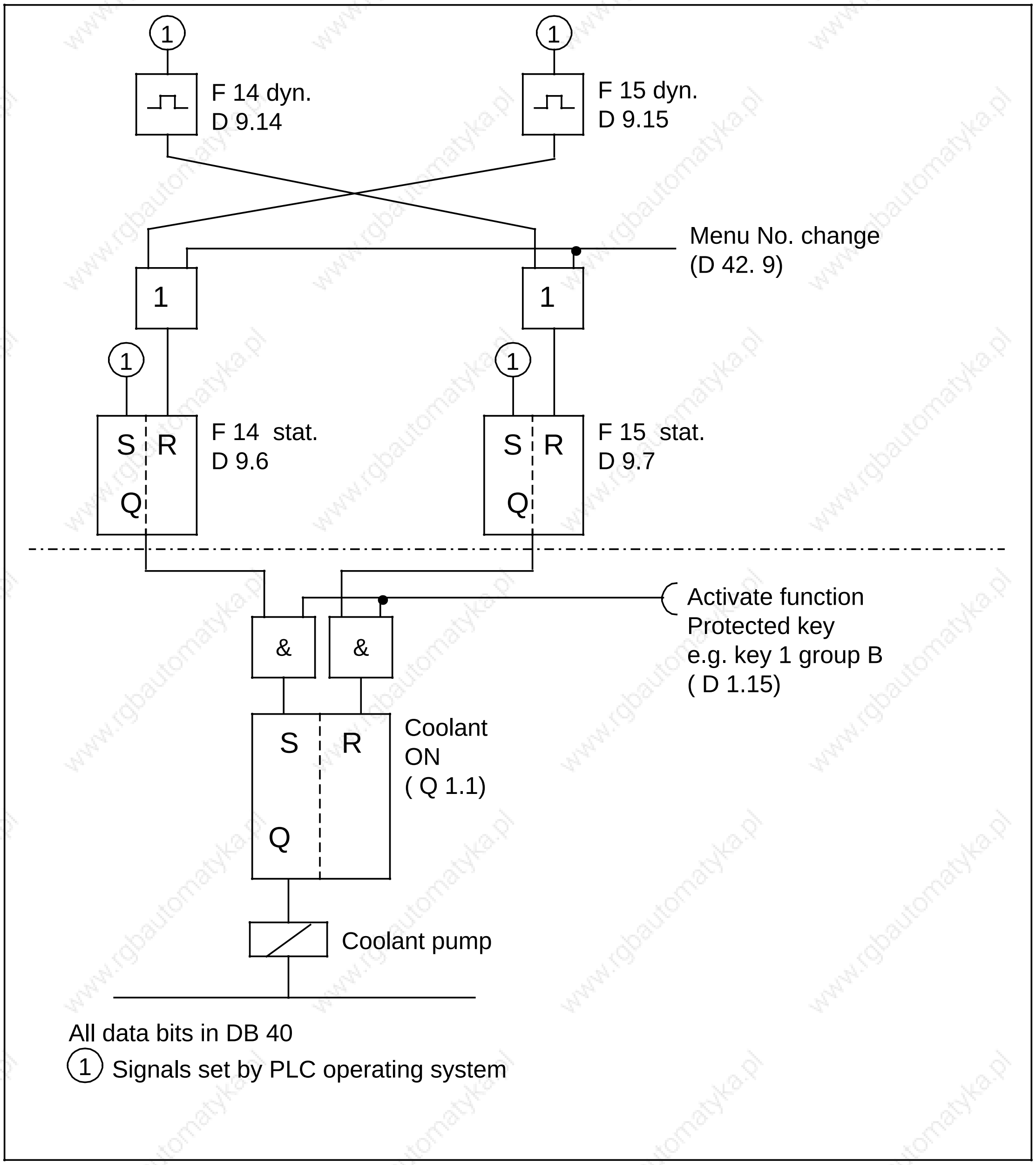
Softkey function signals

Softkey-controlled machine operation can thus be accomplished using SOFTKEY FUNCTION NUMBERS.

Note that machine protection regulations prohibit softkey operation from initiating any movements. Only keys protected against accidental operation may be used for this purpose. On the SINUMERIK operator panel Group B keys can be used. In such cases, the softkeys may be used for function preselection only.

Example:

The following shows the logic structure for initiation of the COOLANT ON function with function number 14 and of the COOLANT OFF function with function number 15 by way of example. When the "COOLANT ON" softkey is pressed, the PLC operating systemsets the static signal (DB 40, DR 9.6) and the dynamic signal (DB 40, DL 9.14) for number 14. With the dynamic signal, the store must be made ready for the counter command (COOLANT OFF). The store state is transferred to the output store with the activation key. To ensure that the preselection stores are effective only for as long as the relevant display is on the screen, all preselection bits are cancelled when the display is deselected (/\ = menu number change).



Logic structure for interpretation of a function number

Relevant PLC program in a statement list:

```
          .
          .
 C   DB40

 L   DW9         Function signals 8 ... 15
 T   FW224       Load

 L   DL1         Dynamic signals customer keys
 T   FY226       1 ... 8 load

 L   DL42        Menu number change
 T   FY227       Load

 A   F 224.6     Coolant on, dynamic
 O   F 227.1     Coolant off, static
 R   F 225.7

 A   F224.7
 O   F 227.1     Coolant off, dynamic
 R   F 225.6     Coolant on, static

 A   F 226.7
 A   F 225.6     Function COOLANT ON
 S   Q 1.1       Activate

 A   F 226.7
 A   F 225.7     Function COOLANT OFF
 S   Q 1.1       Activate

          .
          .
          .
          .
```

The user can also send back the number of a dialog text line and a function result (to DB 40).Both values returned refer to the function number of the softkey pressed. The dialog text line number and/or function result must be entered in the same PLC cycle in which the SOFTKEY FUNCTION NUMBER is made available in DB 40/DW 49. In this way, dialog texts can be displayed at the operator panel and/or subsequent menus stated that also have to be generated via a programming workstation.

If a softkey with configured softkey function number is pressed on the operator panel, this SOFTKEY FUNCTION NUMBER is transferred (DW 41) and a strobe bit (DB 40, DW 49, bit 14) set to "1".

The user can now obtain the function number and send back a function result (DL 50) and a dialog text number (DR 50) to DB 40 in the **same** PLC cycle; these are declared valid by means of an acknowledgement bit (DB 40, DW 49, bit 15).

DYNAMIC FUNCTION SIGNALS	DL 8 to DL 39

1 signal: Configured softkey operated
0 signal: After **one** PLC cycle

STATIC FUNCTION SIGNALS	DR 8 to DR 39

1 signal: Configured softkey operated
0 signal: By user

Note:

SOFTKEY FUNCTION NUMBERS 0 ... 255 are decoded and transferred to DB 40 with acknowledgement control.

SOFTKEY FUNCTION NUMBER CHANGE	DW 40, bit 0

1 signal: FUNCTION NUMBER changed
0 signal: After one PLC cycle

Note:

This signal is available twice; see DW 49, bit 14.

SOFTKEY FUNCTION NUMBER — DW 41

SOFTKEY FUNCTION NUMBER of the last softkey operated with a softkey function number. A SOFTKEY FUNCTION NUMBER is valid only during SOFTKEY FUNCTION NUMBER CHANGE. A 16-bit fixed-point number is output. Only the numbers 0 ... 255 are decoded. The softkey function numbers must be input with the NC programming workstation.

Note:

Some softkey function numbers are assigned by the PLC operating system for display and operation purposes:

F No.	Function	
F000	Spare	
F001	Spare	
F002	Display	Message group channel 1
F003	Spare	
F004	Spare	
F005	Spare	
F006	Spare	
F007	Spare	
F008	Spare	
F009	Spare	
F00A	Display	Messages spindle
F00B	Display	Messages axis
F00C	Display	Messages PLC I
F00D	Display	Messages PLC II

Example of application:

Indexed call of blocks following softkey operation:

.

```
C     DB 40
TB    D 40.0
DO    DW 41
JC    PB 0
```

Function number

Dec.	Hex.		Reserved for
0 ⋮ 255	0000 ⋮ 0FFF	Statically and dynamically decoded	User / Manufacturer
256 ⋮ 4096	0100 ⋮ 0FFF	Function number available only in absolute form	
4097 ⋮ 61440	1000 ⋮ EFFF		
	F000 ⋮ F0FF	(Not statically / dynamically decoded)	SIEMENS/ GWE
	F100 ⋮ FFFF		SIEMENS/ Nürnberg-Moorenbrunn

F100 ⋮ F13F } Reserved for Package 3 (operation for tool management)

F140 F141 } Reserved for contour calculators and technology computers

PLC STATUS IMAGE SELECTED	DW 42, bit 11

1 signal: Status image of PLC selected and displayed.
0 signal: Status image of PLC not selected.

START-UP MENU	DW 42, bit 10

1 signal: The binary number entered in the MENU NUMBER byte refers to a menu from the start-up menu tree.

0 signal: Otherwise.

Note:

The start-up menu tree can be selected in two ways:

- By switching on the NC with selector switch position 1 on the COM CPU.
- By pressing the START-UP key and inputting the password.

MENU NUMBER CHANGE	DW 42, bit 9

1 signal: The MENU NUMBER has changed.
0 signal: Otherwise.

USER MENU	DW 42, bit 8

1 signal: The binary number entered in the MENU NUMBER byte refers to a menu from the user menu tree.

0 signal: The binary number entered in the MENU NUMBER byte refers to a menu from the user menu tree if the START-UP MENU signal is 0.

MENU NUMBER	DW 42

The texts or symbols for the 5 softkeys are referred to as menus. Each block of 5 has a separate MENU NUMBER. The MENU NUMBER of the current menu is output to the PLC. The menu type is indicated by additional bits (START-UP MENU, USER MENU).

Value range: 1 ... 255

Number format: Binary, 8 bits

SELECTION OPERATOR PANEL	DW 43, bits 8 to 10

1 signal: Selection of operator panel by user.
0 signal: Deselection of operator panel by user.

Only one operator panel can be selected at a time. Only 1 bit can be set. If more than 1 bit is set, the previously selected operator panel remains active.

Also see "Operation without operator panel".

ERROR IN 2ND OPERATOR PANEL	DW 43, bit 6
ERROR IN 3RD OPERATOR PANEL	DW 43, bit 7

If a selected operator panel does not respond or indicates an error, the appropriate bit is set here. An error in the first operator panel is not indicated here. Use the signals to cancel selection of the faulty panel.

ACTIVE MESSAGE OPERATOR PANEL	DW 43, bits 0 to 2

1 signal: Operator panel active.
0 signal: Operator panel not active.

Example of application:

Activation of programs that interpret function signal, for instance.

ACKNOWLEDGEMENT, FUNCTION RESULT VALID	DW 49, bit 15

1 signal: The dialog text number has changed and is now valid.
0 signal: No significance.

SOFTKEY FUNCTION NUMBER CHANGE	DW 49, bit 14

1 signal: The FUNCTION NUMBER has changed, i.e. a softkey with configured function number has been pressed on the operator panel.

0 signal: After one PLC cycle.

Note:

This signal is available twice; see DW 40, bit 0.

FUNCTION NUMBER DR 49

Softkey function number of the last softkey operated with a softkey function number. A softkey function number is valid only during SOFTKEY FUNCTION NUMBER CHANGE. A 16-bit fixed-point number is output. Only numbers 0 ... 255 are decoded.

FUNCTION RESULT DL 50

See WS 800A description.

DIALOG TEXT NUMBER DR 50

The dialog text number selects a dialog text stored in the user memory submodule; it is displayed at the operator panel. The dialog text number is declared valid as far as the NC is concerned with ACKNOWLEDGEMENT, FUNCTION RESULT VALID.

Note:

The new dialog text number must be specified in the same PLC cycle in which the SOFTKEY FUNCTION NUMBER CHANGE signal is also present.

13.4 Menu selection interface

The PLC can interrupt the present menu tree structure and insert a menu itself via a interface in DB 40 (not in startup mode).

When the RECALL key is pressed the inserted menu (entry menu EM) is replaced on the screen by the previous menu (exit menu XM) (Fig. 1).

The PLC is also able to specify a new XM which is displayed rather than the previous XM when the RECALL key is pressed (Fig. 2).

As many insertions as required can be made from the PLC. The original exit menu is obtained, however, with RECALL.

The SPECIAL RECALL functions are used to disable exits using the RECALL key. When the RECALL key is pressed, the SPECIAL RECALL bit in DB40 is made available to the user for one PLC cycle. The user can then define his own exit menus (which he has previously stored).

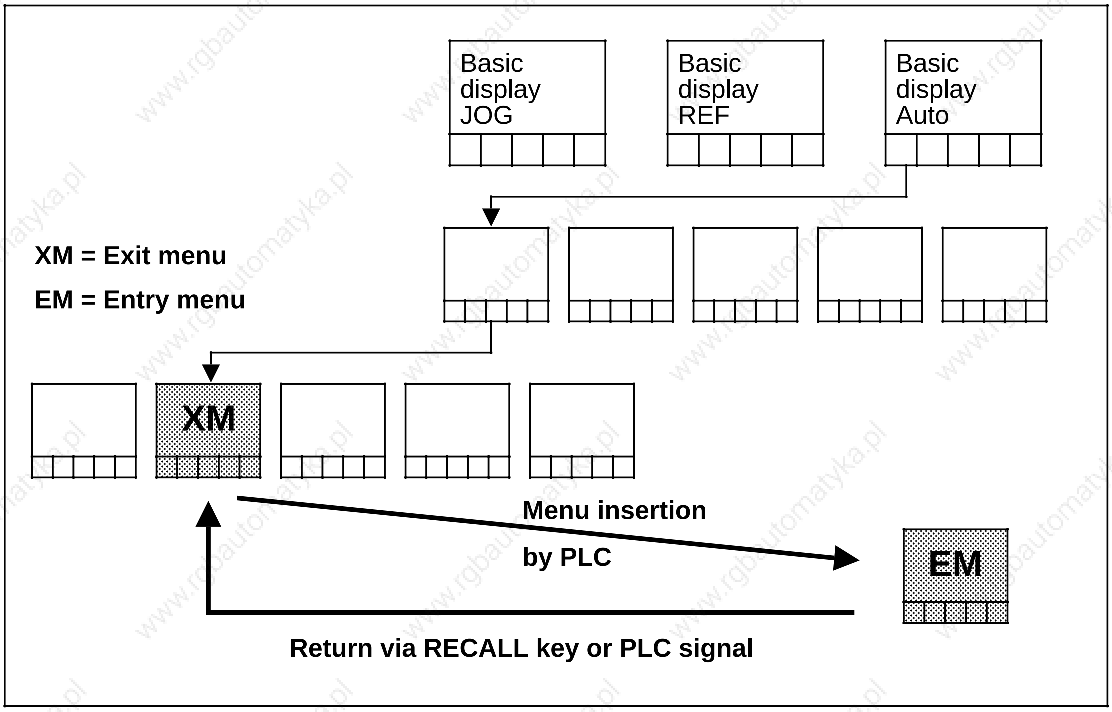
An additional function, NO BASIC IMAGE WITH MODE OR MODE GROUP CHANGE, is available to the PLC to prevent the relevant basic image being displayed in the event of a mode or mode group change. If this function is activated before a mode or mode group change, the previous insertions are stored for reactivation after returning to the original mode or mode group. If the signal is not set, all insertions are cleared in the event of a mode or mode group change. No "genuine" insertions can be made in the new mode or mode group so that if the recall function is initiated in the new mode or mode group, the recall menu **configured** in this menu will be displayed instead of the XM.

The INPUT, EDIT and CANCEL keys can be independently disabled or enabled with individual bits.

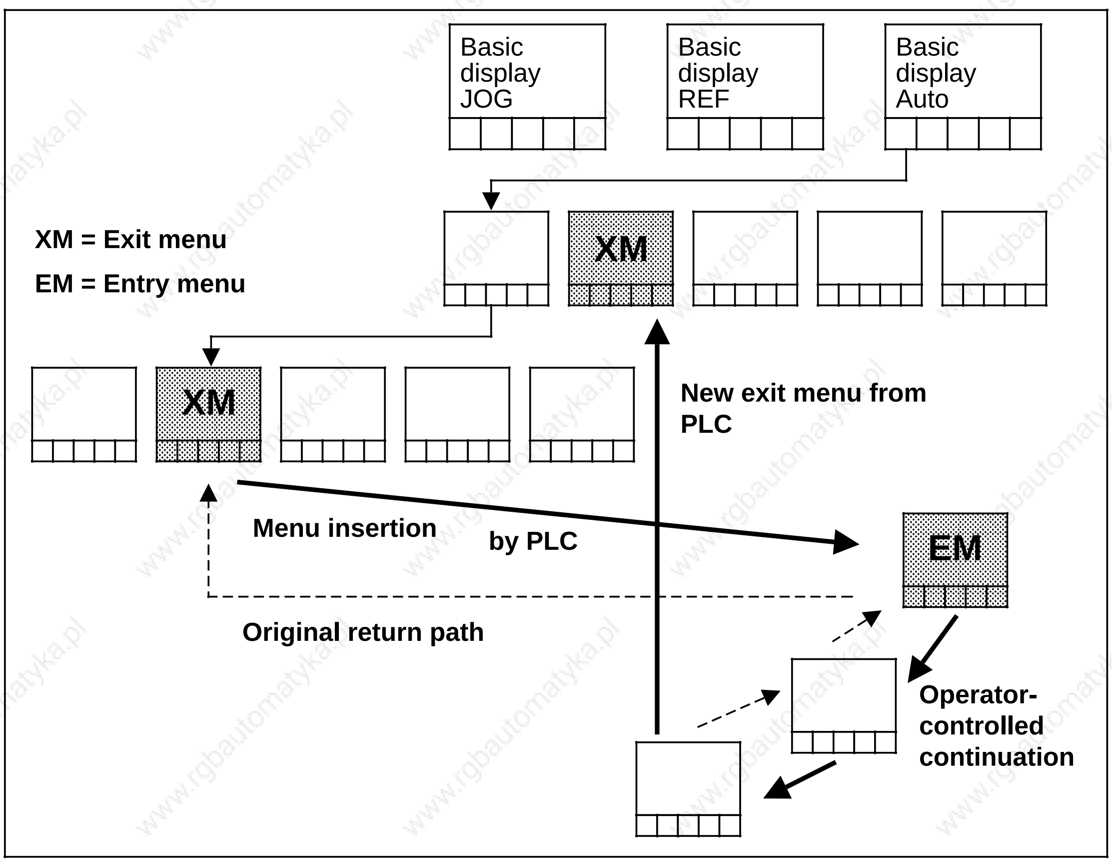
Besides menu changes, the PLC is also able to execute channel and mode group changes. Independent mode group or channel changes (without menu insertion) can be effected.

The MENU STACK RESET function deletes all stored insertions. This function can be triggered by the PLC or by the operator (SHIFT RECALL).

The active mode group number at the interface is transferred to the PLC. This is no longer the mode group key code, but the actual mode group number. The activated NC channel at the operator panel is also reported to the PLC.



Menu insertion by PLC and return to exit menu



Menu insertion by PLC with specification of a new RECALL menu

Menus can also be inserted by softkey, in the same way as by the PLC. This menu insertion facility is configured with the softkey function number, but the menu being inserted does not have to be integrated in the normal operating sequence tree. The menu that is to be inserted can take the form of an isolated menu or it may be a menu integrated in another menu tree. As is the case with PLC insertion, any number of insertions can be made.

Mixed insertions are also possible. There are two distinct cases.. In the first case (if the PLC has not set any priority) up to 2 insertions can be active: one from the PLC and one by softkey. Any attempt to make a further insertion, either from the PLC or by softkey, is aborted and results in a fault message. In the second instance (PLC has set priority before the first PLC insertion) an inserted PLC menu (with priority) can be masked by a softkey menu, but the PLC is nevertheless able to insert additional menus.

Any user menus (UMS menus) can be specified as new mode basic menus by means of 6 new machine data (MD). These MD become effective with POWER ON. If the MD value is = 0, the normal system basic menu is displayed in the relevant mode.

The following MDs are effective for the modes stated below:

MD	Mode
227	PRESET
228	MDI AUTOMATIC
229	JOG and INC (1...10000)
230	REPOS
231	AUTOMATIC
232	REFPOINT

Note:

Menus can thus be inserted at practically any time anywhere in the normal operator tree. Menus that otherwise occur in the REPOS mode, for example, can also be inserted in the AUTOMATIC mode. The permanently configured tree structure can be abandoned at will. Impractical menu sequences may result in this connection, especially in the case of insertions with mode and mode group changes. As far as menu insertions are concerned, it is up to the PLC user program to ensure that the operating sequences are sensible. No checking or monitoring can be implemented by the system program.
For example, it is not permitted to select a simulation menu without having called the softkey function for selecting simulation. You cannot call the selection display SIMULATION (menu number 150) directly after POWER ON.

Signals from PLC

START SIGNAL FROM USER	DW 51, bit 8

1 signal: The user sets this signal after checking that no insertion has been activated by another PLC (D 51.7) and after entering
- a function number and
- a menu number or
- a mode group number or
- a channel number

in the NC-PLC interface.

0 signal: By the user after receiving:
- a positive acknowledgement for menu selection
- following a negative acknowledgement (error or insertion from other PLC already active).

Acknowledgements

INSERTION EXECUTED	DW 51, bit 0

1 signal: By the PLC operating system if a menu selection requested by the user has been executed.

0 signal: By the PLC operating system after the user has confirmed the acknowledgement by resetting START SIGNAL.

ERROR	**DW 51, bit 1**

1 signal: By the PLC operating system if the user has entered an illegal menu number or function number in the user interface or if the PLC is to make another insertion in conjunction with composite insertion (no PLC priority).

0 signal: By the PLC operating system after the user has confirmed the acknowledgement by resetting START SIGNAL.

Negative acknowledgements are output to the PLC in the event of the following errors:

- If the entry menu (EM) is not configured.
- If entry menu equals exit menu (EM = XM).
- Insertion attempts by the PLC from a startup menu.
- If a user memory submodule (UMS) menu has been selected but no UMS is available (MD 5015 bit 6 = 0)
- If, in the case of mixed insertions (PLC and softkey menu already active), the PLC wishes to specify a new XM but has not yet implemented the first insertion. Priority is ignored in this case.
- If, in the case of mixed insertions, no priority has been set and the PLC attempts to insert a second menu.
- If the PLC attempts to specify priority even though a PLC insertion is active. This also applies to special recall.
- In the event of RECALL by the PLC while SPECIAL RECALL is requested.
- In the event of a mode group change if the mode group is not defined.
- In the event of a channel change if the channel in the mode group is not defined.

INSERTION ALREADY ACTIVE	DW 51, bit 2

1 signal: By the PLC operating system if recognition that a **different** PLC has already activated a menu selection does not occur until **after** triggering a menu selection. This bit is set if several PLCs attempt to execute an insertion **at the same time** in a **single** cycle.

0 signal: By the PLC operating system after the user has confirmed the acknowledgement by resetting START SIGNAL.

OWN INSERTION ACTIVE	DW 51, bit 6

1 signal: By the PLC operating system if the first insertion was implemented without any errors. The PLC is therefore in the first insertion menu at least.

0 signal: By the PLC operating system if no own PLC insertion is active.

INSERTION FROM OTHER PLC ACTIVE	DW 51, bit 7

1 signal: An insertion from another PLC is active.
0 signal: No insertion from another PLC is active.

Note:

This is a static signal that is updated by the PLC operating system every cycle.

This signal should be scanned by the PLC user program before an insertion. Insertions cannot be made if the other PLC has inserted a menu.

JOB NUMBER DW 52

The PLC can select the desired function here:

Job number	Meaning
0:	No request
1:	Insert menu from system area (plus mode group and channel)
2:	Insert menu from user area (plus mode group and channel)
3:	New exit menu in system area
4:	New exit menu in user area
5:	Execute recall
6:	Request priority for PLC
7:	Deselect priority for PLC (incl. "Special recall")
8:	Request "Special recall" + priority
9:	Deselect "Special recall" (priority remains)
0A:	Request "No basic image with mode change"
0B:	Deselect "No basic image with mode change"
0C:	Execute mode group change
0D:	Execute channel change
0E:	Initiate menu stack reset

MENU NUMBER	DW 53

Here the user specifies the menu number to be inserted.

MODE GROUP NUMBER	DL 54

Here the user specifies the desired mode group number.

CHANNEL NUMBER	DR 54

Here the user specifies the desired channel number.

KEY DISABLE TO NC (EDIT, INPUT, CANCEL)	DW 55, bits 8 to10

1 signal: Disables relevant key for operator.
0 signal: Enables relevant key for operator.

Each key can be disabled or enabled individually. These disable and enable signals are not transferred from the PLC operating system to the NC cyclically, but only if the "REQUEST FOR KEY DISABLE" bit is set to 1.

REQUEST FOR KEY DISABLE	DW 55, bit 15

The disables selected in bits 8 ... 10 are accepted and transferred to the NC with the positive edge. The disables are cancelled with the next positive edge and logic 0 of bits 8 ... 10 are reset.

Note:

If a PLC has executed a menu insertion, it is also able systematically to disable or enable the INPUT, EDIT or CANCEL keys. Other PLCs are then unable to make any modifications. If **no** PLC has activated an insertion, any PLC can disable or enable a key following a user request. The user must decide which PLC is permitted to disable or enable a key. The PLC operating system does not check whether a key has been disabled or enabled by another PLC.

Signals from the NC to the PLC

SPECIAL RECALL	**DW 56, bit 8**

1 signal: The PLC operating system sets this signal to "1" for one PLC cycle if the relevant PLC has requested the special recall from the NC and the RECALL key is pressed. The user must then define the required "recall menu" on the interface and initiate it with the special recall.

0 signal: After one PLC cycle with special recall set, otherwise no significance.

DISPLAYED CHANNEL FROM NC	**DR 56**

The number of the channel displayed at the operator panel is updated by the PLC operating system every PLC cycle.

13.5 Cursor data to PLC

The actual cursor position on the NC screen is transferred to the PLC.

The field definitions of the data indicated in the field are transferred. Users are familiar with these field definitions from the WS 800 Planning Guide:

- Data group
- Data type
- Data number
- Data block number (for PLC data).

These parameters are referred to as "cursor data" in the following.

Note:

The content of the field indicated by the cursor is **not** transferred.

The PLC can evaluate the actual cursor position in **all** image types of both the standard and user areas.

Functional procedure:

The cursor data are transferred to the user interface only if a change occurs.

Interface signals

List of cursor data

Designation:

- Data group: Base
- Data type: Base
- Data block No.: Base
- Data number base: Base
- Data group: Pointer
- Data type: Pointer
- Data block No.: Pointer
- Data number: Pointer

Meaning of the cursor data during transfer to the PLC

Display type / Cursor data	Mixed display (input display)	List display (table)	Extended input display (indirect addressing)	Extended table display (absolute block numbering)	Extended table display (relative block numbering)
Base address: Data group Data type Data number Data block[1)]	Address of NC/PLC data Effective data number	Address of NC/PLC data Effective data number	Address of NC/PLC data With base data number	Address of NC/PLC data Effective data number	Address of NC/PLC data Effective data number
Pointer address: Data group Data type Data number Data block[1)]	X	X	Address of pointer containing the offset data number (can be omitted)	X	X
Block number: = Line number in a table	X	X	X	Absolute block number = Effective data number	Relative block number

1) Only with display of PLC data

Further display types:

Static graphic display
PP processing display Cursor data same as mixed display
Actual value display

Text display
PP list display No cursor provided
Graphic simulation

Configuring and operation

The "Cursor position to PLC" function is a system function that does not require any additional configuring by the operator.

The user must decide how to use the data made available at the user interface. To do so, however, he must know the field definitions used when configuring displays (identifiers for data group, type, number ...). To use this function it is therefore **essential** to be familiar with the WS 800 Planning Guide.

Example:

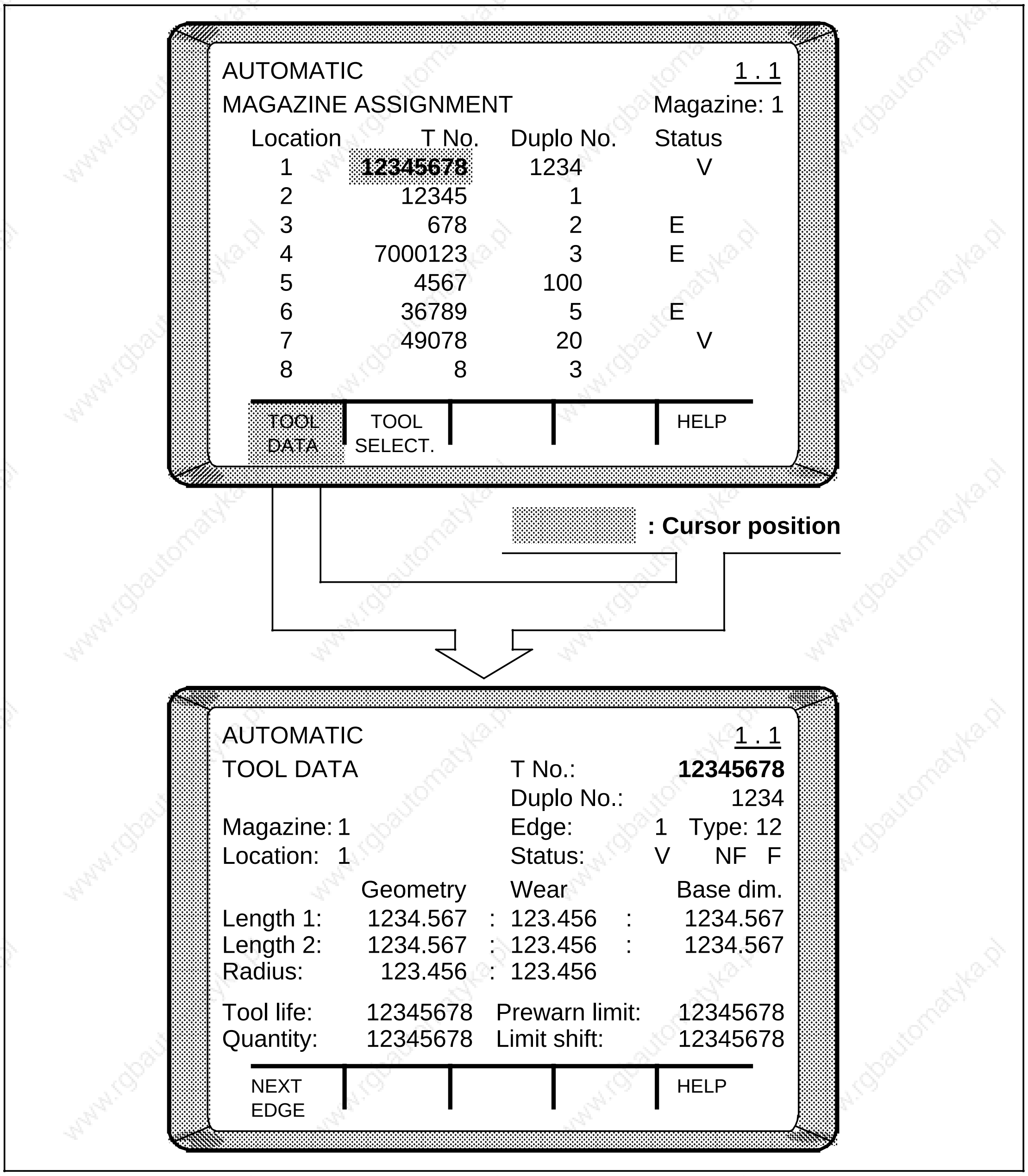
The following describes how to display all the data relating to a tool starting from a tabular display of magazine assignment.

Position the cursor on a magazine location in the tabular display.

The relevant cursor data are transferred to the PLC. With reference to the cursor data + menu number, a user function block determines that the cursor in the magazine table is positioned at magazine location 1 and searches the corresponding D number in the relevant data block.

This D number is transferred to the NC in a pointer for the following "Tool data" display (extended input display).

The PLC then inserts the "Tool data" display containing both TO and magazine data.



Magazine table (PLC)

	DBZW	Identifiers		T number		Duplo No.	D No.
	DB 150	DB 151	DB 152	DB 153	DB 154	DB 155	DB 156
DW 0							
		Tool buffer					
DW 31		1		1234	5678	1234	15
DW 32				1	2345	1	16
DW 33			1		678	2	17
			1	700	0123	3	18
					4567	100	19
			1	3	6789	5	20
				4	9078	20	21
		1			8	3	22

The tool data are stored in a magazine table in the PLC. The NC display is configured as an "Extended table display" with relative block numbering (line numbering). The following cursor data are transferred in the user interface:

- Data group base: 87_H (data block type DB)
- Data type base: 80_H (double word parallel)
- Data block No. base: 99_H (=153 dec.)
- Data number base: 19_H (=31 dec., DW No.)
- Data group pointer: 00_H
- Data type pointer: 00_H
- Data block No. pointer: 00_H
- Data number pointer: 00_H
- Block number: 01_H (=1 dec., = location No.)

14 Command Channel (DB 41)

14.1 General

The PLC user program can trigger functions in the NC by means of the command channel. For that purpose, user data are transferred to the NC (e.g. speed, acceleration time constant) or read from the NC d) ("Read NC data via command channel" function). The format of the user data depends on the NC function concerned.

The command channel comprises up to 8 user interfaces (UIs), all of which are contained in DB 41). The number of command channel user interfaces that are to be processed by the PLC operating system is specified in the PLC machine data.

Number of user interfaces:	MD 033	Value range: 0 ... 8 (PLC I)
	MD 233	Value range: 0 ... 8 (PLC II)

	DL								DR							
Data word / **Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DW 0	Reserved								Request bits of user interface 8	7	6	5	4	3	2	1
DW 1	Reserved								Error bits of user interface 8	7	6	5	4	3	2	1
DW 2	Reserved								Reserved							
DW 3	Reserved															
DW 4	Reserved															
DW 5	Reserved															
DW m	No. of command channel function															
DW m+1	Error number															
DW m+2	0:DB 1:DX	No. of user data DB/DX														
DW m+3	No. of data word in user data DB/DX															
DW m+4	0:DB 1:DX	No. of the target DB/DX d)														
DW m+5	No. of data word in the target DB/DX d)															
DW m+6	Reserved															

User interface	1	2	3	4	5	6	7	8
Address m	6	13	20	27	34	41	48	55

Structure of DB 41

d) with GA2, software version 1 and higher

14.2 Signals in command channel head

The request and error bits of the individual user interfaces are contained in the command channel head. The PLC can trigger different functions in the NC at the same time (as long as they are not mutually exclusive) via the command channel.

REQUEST BITS 1ST TO 8TH USER INTERFACE	DR 0

1 signal: Set by the user after entering:

- the relevant user data in the user data DB
- the function number
- the DB number
- the DW number

in the relevant user interface.

0 signal: Reset by the PLC operating system on conclusion of the initiated function. In the event of an error, the error bit of the relevant user interface is set. In this case an error code is stored in the user interface.

ERROR BITS 1ST TO 8TH USER INTERFACE	DR 1

1 signal: Set by the PLC operating system if an error has led to abortion of the initiated function. For a more detailed error analysis, an error number (see error list) is also entered in the relevant user interface.

0 signal: The signal must be acknowledged (reset) by the PLC user program.

14.3 User interface signal

FUNCTION NUMBER	DW m

The function number of the desired function is entered in DW m:

Function	Function number
Specified path dimension, static	1
Division increment	2
S external	3
Specified path dimension, dynamic	4
M19 over several revolutions (incremental spindle positioning)	5
Transformation	6
Coupled motion	7
Specified path dimension, dynamic with exact stop	8
Temperature compensation[d)]	9
Read NC data via command channel [d)]	10
Write NC data via command channel[d)]	11

ERROR NUMBER	DW m + 1

The PLC operating system enters an error number here if the function has not been completed properly. The error number is valid if the error bit of the user interface has changed to 1 after the request bit has been reset (by the PLC operating system). Also see the typical signal paths on the following pages.

The possibile error codes are described in the "General errors" or "Function-related errors" Section.

The word must be cleared by the PLC user program.

DB/DX	DW m+2, bit 15

1 signal: The data block in which the user data are stored is of the DX type.
0 signal: The data block is of the DB type.

d) with GA2, software version 1 and higher

USEFUL DATA DB/DX NUMBER	DR m+2

The number of the data block in which the user data for the NC functions are stored is stated here. The data block can be type DB or DX, as specified in the DB/DX signal (DW m + 2, bit 15).

Note:

If the useful data DB/DX and the target DB/DX are identical when the function "Read NC data via command channel"d) is executed, the data specification in the useful data DB/DX is overwritten by the supplied NC data after the transfer. The length specification is replaced by the number of words read.

DATA WORD NUMBER IN USEFUL DATA DB/DX	DW m+3

The number of the 1st data word of the user data in the USEFUL DATA DB is stated here. (dataword with length specification).

DB/DXd)	DW m+4, bit 15

1 signal: The target data block in which the NC data are stored when the function "read NC data via command channel" is executed is of type DX.

0 signal: The target data block is of type DB.

TARGET DB/DX NUMBERd)	DR m+4

Here the number of the data block is specified in which the number of words read and the NC data are stored when the function "read NC data via command channel" is executed. The user data DB/DX and the target DB/DX can be identical.

The data block can be of type DB or DX. This is specified in the bit DB/DX (DW m + 4, bit 15).

DATA WORD IN TARGET DB/DXd)	DR m+5

Here the number of the data word in the target DB/DX is specified in which the PLC operating system enters the length of the NC data supplied when the function "read NC data via command channel" is executed.

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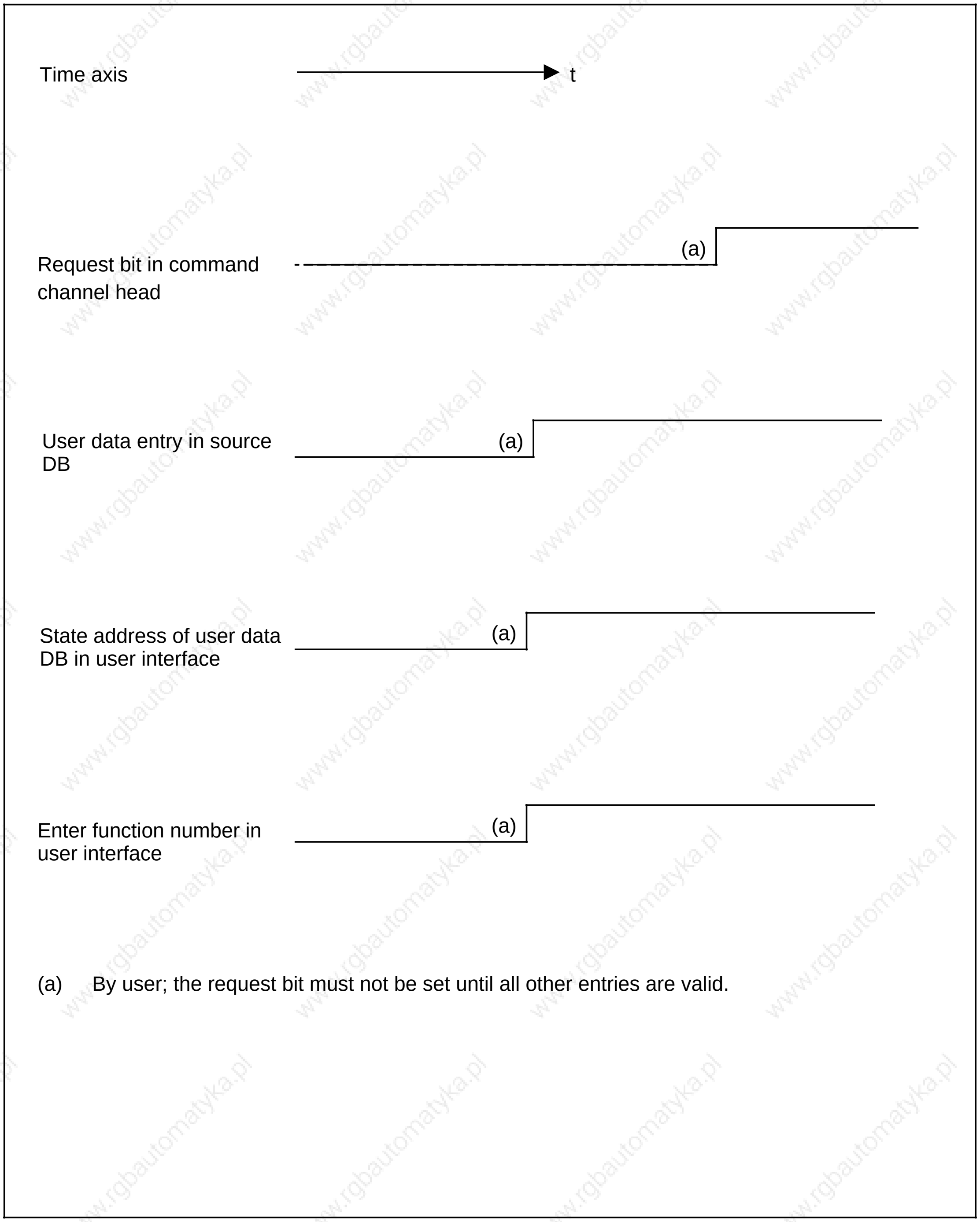
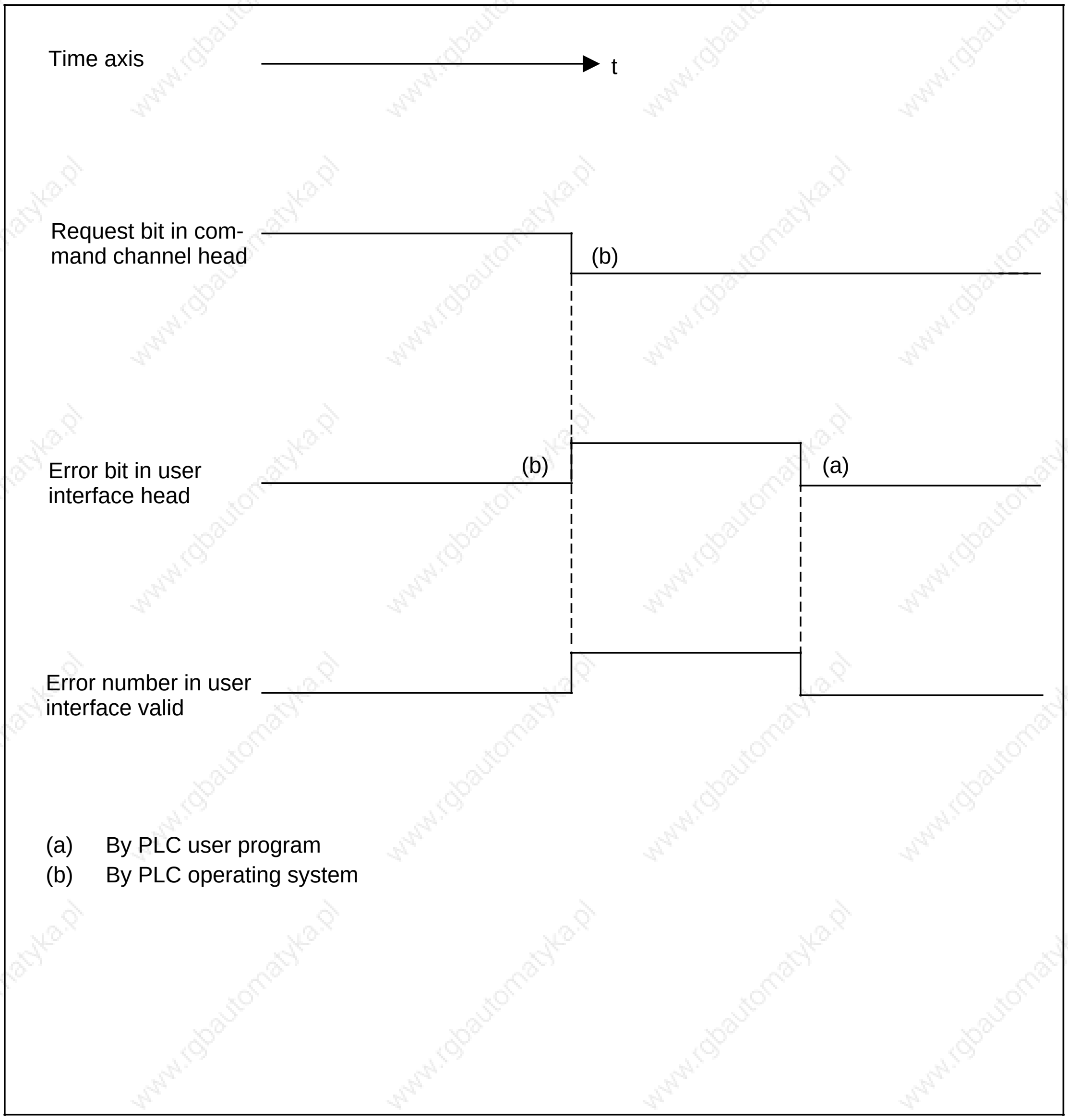
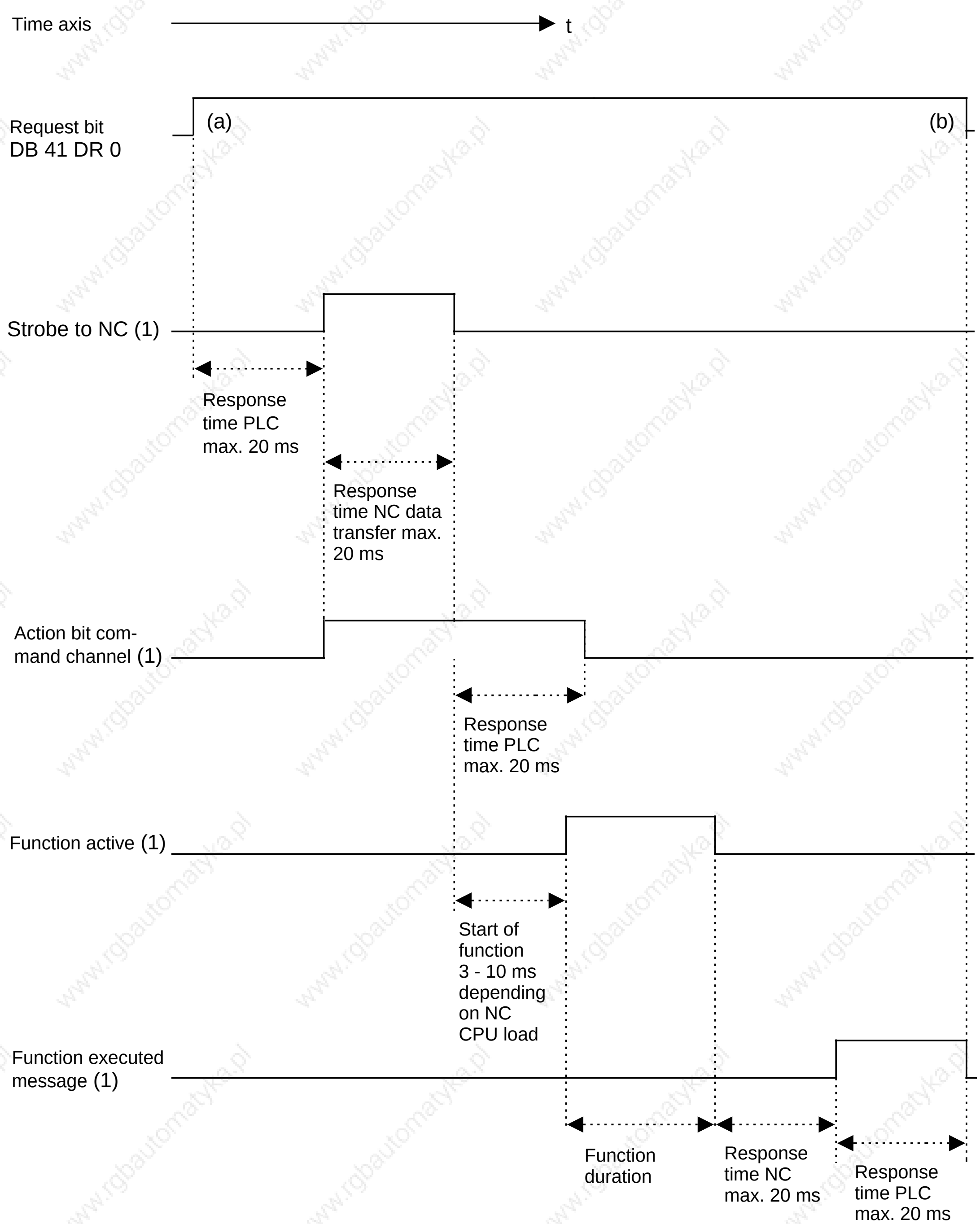
d) with GA2, software version 1 and higher



Signal chart for initiating a command channel function



Signal chart for abortion of command channel function owing to error



(a) By user
(b) By PLC operating system

(1) Internal signals of no significance to user

Time pattern for NC function start via command channel

14.4 User data for command channel

The user data are set up by the PLC user program in a user data block; the address of the user data is stated in the user interface (DB/DX, USEFUL DATA DB, USEFUL DATA DW).

14.4.1 User data for "path dimension" function

Function number 1 (DW m in user interface)

All values in fixed-point format (binary with sign).

<table>
<tr><th>Useful data DB/DX</th><th colspan="8">DL
Bit 15</th><th colspan="8">DR
Bit 0</th></tr>
<tr><td>DW x</td><td colspan="16">Length in words: 6</td></tr>
<tr><td>DW x+1</td><td colspan="8">Channel number</td><td colspan="8">Axis number</td></tr>
<tr><td>DW x+2</td><td colspan="16" rowspan="2">± Position</td></tr>
<tr><td>DW x+3</td></tr>
<tr><td>DW x+4</td><td colspan="16" rowspan="2">Axis feedrate</td></tr>
<tr><td>DW x+5</td></tr>
<tr><td>DW x+6</td><td></td><td></td><td></td><td></td><td></td><td>G68</td><td>G94/95</td><td>G90/91</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Overview of user data for "path dimension" function

Data	Unit	Limits
Channel number	–	1...16
Axis number	–	1...24
Position	Units of input resolution	Software limit switch + Software limit switch –
Feedrate (G94) Feedrate (G95)	0.001 mm/min 0.0001 inch/min 0.001 mm/rev 0.0001 inch/rev	MD 280*: Max. axial speed
Preparatory function	–	Bit 8: 0: G90 1: G91 Bit 9: 0: G94 1: G95 Bit 10: 1: G68 0: G01

In the case of feedrate with G95 the "Thread cutting and revolutional feedrate" Option must be available.

14.4.2 User data for "division increment" function

Function number 2 (DW are in the user interface).

All values in fixed-point format (binary with sign).

Useful data DB/DX	DL (Bit 15)							DR (Bit 0)
DW x	Length in words: 5							
DW x+1	Channel number							Axis number
DW x+2	± Division number							
DW x+3	Axial feedrate							
DW x+4								
DW x+5						G68	G90/91	Reserved

Overview of user data for "division increment" function

Data	Unit	Limits
Channel number	–	1...16
Axis number	–	1...24
Division number	–	G90/G68: Number of divisions (axis-spec. MD 1104*) G91: none
Feedrate	0.01 deg./min 0.01 mm/min 0.001 inch/min	MD 280*: Max. axial speed
Preparatory function	–	Bit 8: 0 G90 1 G91 Bit 9: 0 no G68 1 G68

14.4.3 User data for "S external" function

Function number 3

If the "S external" function is programmed, the spindle operates in the control mode. The speed and direction of rotation can be specified in the user data.

The user data for the function must be entered in the user data DB in the following format.

Bit	15	9	8	7	3	2	1	0
DW x	Length of user data in words: 4							
DW x+1	Spindle number				S	M5	M4	M3
DW x+2	Spindle speed (higher-order component)							
DW x+3	Spindle speed (lower-order component)							
DW x+4		RSET	USET					

x = Number of data word containing first parameter of function in user data DB.

Overview of user data for "S external" function

c) up to and including software version 6

Meaning of parameters

LENGTH OF USER DATA IN WORDS	**DW x**

Length: 4

SPINDLE NUMBER	**DL x + 1**

The number of the spindle to be controlled is entered here.
Permissible values: 1 to 6.

S	**DR x + 1, bit 3**

If the bit is set, the programmed speed value is accepted.

M5	**DR x+1, bit 2**

If the bit is set, the spindle is brought to a standstill.

M3, M4	**DR x+1, bit 0 and 1**

These bits determine the direction of rotation of the spindle. It is not allowed to set both bits at the same time.

c) up to and including software version 6

SPINDLE SPEED	**DW x+2, DW x+3**

The desired speed is entered here. The following limiting values apply to the spindle speed:

32-bit servo:

max. 30,000 rpm **with** encoder
max. 99,999 rpm **without** encoder

16-bit servo:[c)]

max. 16,000 rpm with and without encoder

The significance of the entry is determined by MD 520*, bit 3:

MD 520*, bit 3 = 0: Speed in rpm
MD 520*, bit 3 = 1: Speed in 0.1 rpm

RSET	**DW x+4, Bit 9**

If the bit is set, the USET bit is reset internally. This cancels the NC command disable again.

The RSET and USET bits cannot both be set at the same time.

USET	**DW x+4, Bit 8**

If the bit is not set, the spindle reacts to commands from the NC and the command channel. If both are present at the same time, the command channel takes priority.

If the bit is set, the spindle reacts only to commands from the command channel. Incoming spindle function commands from the NC are stored and the request last received becomes active as soon as the USET selector is reset and the RSET selector is reset.

The RSET and USET bits cannot both be set at the same time.

c) up to and including software version 6

14.4.4 User data for "dynamic path dimension" function

Function number 4

Useful data DB/DX	DL								DR							
	Bit 15															Bit 0
DW x	Length in words: 8															
DW x+1	Channel number								Axis number							
DW x+2	± Position															
DW x+3																
DW x+4	Axis feedrate															
DW x+5																
DW x+6						G68	G94/95	G90/91								
DW x+7	Servo gain factor															
DW x+8	Acceleration															

All values in fixed-point format (binary with sign).

Overview of user data for "dynamic path dimension" function

Data	Unit	Limits
Channel number	–	1...16
Axis number	–	1...24
Position	Units of input resolution	Software limit switch + Software limit switch –
Feedrate (G94) Feedrate (G95)	0.001 mm/min 0.0001 inch/min 0.001 mm/rev 0.0001 mm/rev	MD 280*: Max. axial speed
Preparatory function	–	Bit 8: 0: G90 1: G91 Bit 9: 0: G94 1: G95 Bit 10: 1: G68 0: G01
K_v factor	0.01/s	Max. input: 1000
Acceleration	10^4 Units/s^2 input resolution	Max. input: $7FFF_H$

Note:
In the case of feedrate with G95 the "Thread cutting and revolutional feedrate" Option must be available.

14.4.5 User data for "M19 over several revolutions (incremental spindle position)" function

If the "M19 over several revolutions (incremental spindle position)" function is programmed, the spindle operates in the positioning mode.

In this case, the spindle is not moved to an absolute position, but by a specified ("incremental") distance. This distance can be greater than one revolution. The starting point is the position at which the spindle was last positioned. Refer to the "Extended Spindle Functions" Function Manual for the SINUMERIK 880 for further details.

All the data required for the positioning mode are transferred in the user DB. The user data for the function must be entered in the user data DB in the following format.

Bit	Bit 15		Bit 0
DW x	Length of user data in words: 8		
DW x+1	Spindle number		Feedrate active
DW x+2	Spindle speed (higher-order component)		
DW x+3	Spindle speed (lower-order component)		
DW x+4	Incremental path (higher-order component)		
DW x+5	Incremental path (lower-order component)		
DW x+6	Acceleration time constant		
DW x+7	Servo gain factor		
DW x+8	Position window		

x = Number of data word containing first parameter of function in user data DB.

Overview of user data for "M19 over several revolutions" function

Meaning of parameters

LENGTH OF USER DATA IN WORDS	**DW x**

The value for the "M19 over several revolutions (incremental spindle positioning)" function must be entered here:

Length: 8

SPINDLE NUMBER	**DL x+1**

The number of the spindle to be positioned is entered here.

Permissible values: 1 to 6.

FEEDRATE OVERRIDE ACTIVE	**DR x+1, Bit 0**

If the bit is set, the channel-specific feedrate override is taken into account when determining the maximum speed during positioning.

SPINDLE SPEED	**DW x+2, DW x+3**

The desired speed is entered here. The limiting value for the spindle speed is 30,000 rpm (16,000 rpm with 16-bit servo) because the availability of an encoder at the spindle is a precondition for the positioning mode.

The significance of the entry is determined by MD 520*, bit 3:

MD 520*, bit 3 = 0: Speed in rpm
MD 520*, bit 3 = 1: Speed in 0.1 rpm

SPINDLE PATH	**DW x+4, DW x+5**

The incremental distance to be covered by the spindle is entered here. The sign determines the direction of rotation.

Value range: - 99 999 999 ... 99 999 999
Unit: 0.01 degree

c) up to and including software version 6

ACCELERATION TIME CONSTANT DW x+6

The acceleration to be used for accelerating and decelerating operations during positioning is stated here.

Value range: 0 ... 16 000
Unit: 4 ms [c)] or 1 ms [d)]

SERVO GAIN FACTOR DW x+7

The gain factor to be used for position control during positioning is entered here.

Value range: 0 ... 10 000
Unit: rpm/360 degrees

POSITION WINDOW DW x+8

The SPINDLE POSITION REACHED signal is set when the spindle is positioned in the position window. An attempt is nonetheless made to reach the position as exactly as possible even if the signal is already set.

Value range: 1 ... 4 096
Unit: Measuring system resolution

Notes:

- Each spindle is assigned to a channel in DB 31. The feedrate override of this channel is interpreted if the FEEDRATE OVERRIDE ACTIVE bit is set.
- The specified spindle path is converted internally, whereby an overrun can occur. The function is not executed if this is the case; a corresponding error number is entered in the user interface.
- The function can also be programmed for the leading spindle in the synchronous mode. In this case, note that the K_v factors for the leading and following spindles must be the same, otherwise inaccuracies can result.

Example of application:

Positioning spindle heads whose drives must perform several revolutions owing to speed ratios.

- A spindle for which "M19 over several revolutions" has been requested via the command channel cannot process any further command channel functions until the "M19 over several revolutions" functions has been concluded or aborted (see REQUEST and ERROR BITS in command channel head).

c) up to and including software version 6
d) with GA2, software version 1 and higher

14.4.6 User data of "transformation" function

Function number 6

Useful data DB/DX	DL (Bit 15)	DR (Bit 0)
DW x	Length in words: 2	
DW x+1	Channel number	
DW x+2	Transformation type (G function)	

Overview of user data for "transformation" function

LENGTH IN WORDS **DW x**

Length of user data for the "transformation" function; the value 2 must be entered here.

TRANSFORMATION TYPE **DW x + 2**

The desired G function is entered here right-justified as a 3-digit BCD value.

Example for G231:

	DL		DR	
DW x+2	0	2	3	1

The top 4 bits in DL x + 2 are always 0.

Value range (permissible G functions):

G130, G131, G133, G135,
G230, G231, G233, G235,
G330, G331, G333, G335.

CHANNEL NUMBER **DL x+1**

Number of the NC channel, value range 1 to 16.

14.4.7 User data for "coupled motion" function

Function number 7

If the function was selected via the command channel there is a difference between the AUTOMATIC and JOG/INC FEED ... modes.

In AUTOMATIC mode, the "coupled-axis" function can be selected in all channels.

In JOG and INC FEED ..., it is only possible to select the function in the first channel of a mode group (the master channel).

Useful data DB/DX	DL (Bit 15)		DR (Bit 0)
DW x	Length in words: 2		
DW x+1	Channel number		Mode
DW x+2	Coupled motion combination (G function)		

Mode: 0 = Automatic
1 = Jog

The 3-digit G function (G150 to G159) is entered as a BCD value in the coupled motion combination.

Input of the G function in DW x + 2 is as follows:

DW x+2	0	1	5	2	= G152

Channel number: 1 to 16

Overview of user data for "coupled motion" function

LENGTH IN WORDS **DW x**

Length of user data for the "coupled motion" function; the value 2 must be entered here.

CHANNEL NUMBER **DL x+1**

Number of the NC channel, value range 1 to 16.

MODE **DR x+1, bit 0**

1 signal: Jog
0 signal: Automatic

COUPLED MOTION COMBINATION **DW x+2**

The G function for the desired coupled motion combination is entered here right-justified as a 3-digit BCD value (**the top 4 bits** of DL x + 2 are always 0).

Value range: according to G150 to G159.

14.4.8 User data for "dynamic path dimension with exact stop" function

Function number 8

Useful data DB/DX	DL (Bit 15)								DR							(Bit 0)
DW x	Length in words: 9															
DW x+1	Channel number								Axis number							
DW x+2 / DW x+3	± Position															
DW x+4 / DW x+5	Axis feedrate															
DW x+6						G68	G94/95	G90/91								
DW x+7	K_V factor															
DW x+8	Acceleration															
DW x+9	Exact stop fine															

All values in fixed-point format (binary with sign).

Overview of user data for "dynamic path dimension with exact stop" function

Data	Unit	Limits
Channel number	–	1...16
Axis number	–	1...24
Position	Units of input resolution	Software limit switch + Software limit switch –
Feedrate (G94) Feedrate (G95)	0.001 mm/min 0.0001 inch/min 0.001 mm/rev 0.0001 inch/rev	MD 280*: Max. axial speed
Preparatory function	–	Bit 8: 0: G90 1: G91 Bit 9: 0: G94 1: G95 Bit 10: 1: G68 0: G01
K_v factor	0.01/s	Max. input: 1000
Acceleration	10^4 units/s^2 (input resolution)	Max. input: $7FFF_H$
Exact stop fine	Units (input resolution)	10 ... 16 000

Note:

In the case of feedrate with G95 the THREAD CUTTING AND REVOLUTIONAL FEEDRATE Option must be available.

14.4.9 Useful data of the function "temperature compensation"

Function number 9

Temperature compensation is required if the thermal expansion of certain machine parts causes an offset between the measuring system and the tool or workpiece.

There are two types of compensation, which can be used individually or together.

In position-dependent temperature compensation, the compensation value is directly proportional to the distance between the actual value and a reference point at which no compensation is required. The resulting error curve is defined by the reference point and its gradient (coefficient).

In absolute temperature compensation, the deviation of the measuring system is compensated independently of the position.

Useful data DB/DX	DL (Bit 15)							DR (Bit 0)
DW x	Length of the useful data in words: 7							
DW x+1	Axis number						U	A
DW x+2	High Absolute temperature compensation							
DW x+3	Low							
DW x+4	High Coefficient							
DW x+5	Low							
DW x+6	High Reference point							
DW x+7	Low							

Overview of the useful data for the "temperature compensation" function"[d)]

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d) with GA2, software version 1 and higher

Meaning of the parameters

LENGTH OF THE USEFUL DATA IN WORDS	DW x

7 is entered for the TEMPERATURE COMPENSATION function.

AXIS NUMBER	DL x+1

Number of the axis for which the compensation values are intended.

Value range: 1 to 24

Activation flags

With these flags you can control what type of temperature influence is to be compensated. The data is provided via the command channel and the type of influence activated. Temperature compensation does not become active until the function conditions have been fulfilled.

ACTIVATION FLAG A	DW x+1, bit 0

1 signal: Position-dependent temperature compensation is active.
0 signal: Position-dependent temperature compensation is not active.

ACTIVATION FLAG U	DW x+1, bit 1

1 signal: Absolute temperature compensation is active.
0 signal: Absolute temperature compensation is not active.

ABSOLUTE TEMPERATURE COMPENSATION VALUE	DW x+2, DW x+3

The measured axis actual value deviates from the real actual value by an absolute temperature-dependent value. This value, which is independent of the position of the axis, is entered here.

Value range: –3FFF FFFF to +3FFF FFFF
(In fact the value range is limited by the working range of the machine)

Unit: In MS units with sign

COEFFICIENT **DW x+4, DW x+5**

The coefficient (tan ß) for the position-dependent temperature compensation describes the gradient of the error in the reference point.

Value range for tan ß: –1 to+1, place value 2^{-31}

The following table shows the data format of tan ß:

ß	tan ß	(tan ß) · (2^{31}–1) (dec.)	(tan ß) · (2^{31}–1) (hex.)
0	0	0	0000:0000
30	0.577	1 239 850 262	49E6:9D16
45	1	2 147 483 647	7FFF:7FFF
-30	-0.577	-1 239 850 262	B619:62EA
-45	-1	-2 147 483 647	8000:0001

REFERENCE POINT **DW x+6, DW x+7**

The reference position of the axis at which no position-dependent temperature compensation is required.

Value range: –3FFF FFFF to +3FFF FFFF
(In fact the value range is limited by the working range of the machine)

Unit: In MS units with sign

Note:

- The temperature compensation data are transferred to the NC even when the compensation axis is active. This can cause jumps in the setpoint which can reduce the surface quality of the workpiece. Despite this, transfer must be possible with active axes to allow influence on the compensation behaviour during long traverse blocks.
- Controlled data transfer is possible if the signals in the axis-specific NC-PLC interface are used.
- If the measuring system is changed the compensation value must remain constant to avoid jumps.
- The temperature compensation data are deleted on POWER-ON.

14.4.10 Useful data of the function "read/write NC data via command channel"[d)]

Function numbers 10 and 11

You can use the functions "read/write NC data via command channel" to exchange data directly between the PLC and the NC. Data transfer using these command channel functions is much faster than transfer using function blocks FB 61 and FB 62.

When the function "read NC data via command channel" is executed the PLC user program inputs the length and the specification of the data in the useful data DB/DX. The PLC operating system enters the number of words read and the supplied NC data in the target DB/DX.

The useful data DB/DX and the target DB/DX can be identical. In this case, the PLC operating system overwrites the data specification with the supplied data. The length is replaced by the number of words read.

When the function "write NC data via command channel" is executed the PLC user program inputs the length and the specification of the data and the actual data in the useful data DB/DX.

Note:

In GA2, software version 1, only the transfer of data group 03_H "interpolatory compensation with absolute values" (IKA data) is possible with the functions "read/write NC data via command channel".

Useful data DB/DX	DL Bit 15		DR Bit 0
DW x	Length in useful data in words		
DW x+1	Channel number		Number of parameters
DW x+2	Data group identifier		Data type
DW x+3	Data number		
DW x+4		OCB	Offset data type/number
DW x+5	Number format		Dimension identifier

Length and specification of the data for the function "read/write NC data via command channel"[d)]

OCB = Offset Control Bit

d) *with GA2, software version 1 and higher*

Meaning of the parameters

LENGTH OF THE USEFUL DATA IN WORDS	DW x

5 is entered for the function "read NC data via command channel".

5 + the number of words to be written is entered for the function "write NC data via command channel".

CHANNEL NUMBER	DL x+1

For channel-specific data you must enter the number of the channel in question. In all other cases, enter 0.

NUMBER OF PARAMETERS	DR x+1

Number of data (blocks) in a data group that are to be transferred when the function is called.

DATA GROUP IDENTIFIER	DL x+2

The data group identifier determines the functional range of the data that are to be transferred.

DATA TYPE	DR x+2

The data type depends on the data group used and permits a detailed selection within the data group.

DATA NUMBER	DW x+3

The data number determines the element of a data group starting from which the data (blocks) are to be transmitted.

OFFSET CONTROL BIT (OCB)	**DW x+4, Bit 8**

The offset control bit defines whether the offset (DR x + 4) is to be added to the data type or to the data number.

1 signal: Offset added to data type
0 signal: Offset added to data number

OFFSET DATA TYPE/NUMBER	**DR x+4**

The offset determines the additive offset value of the starting element. The offset is added either to the data type or to the data number depending on the offset control bit.

Example: Relation between the parameters DATA NUMBER, DATA TYPE, OFFSET and OFFSET CONTROL BIT.

A data group contains four data blocks, every data block contains eight data words (data types). If two data words are to be transferred (NUMBER OF PARAMETERS), you can enter the following parameters in the data specification:

Data specification			**Data words transferred**
Data number:	3	(data block 3)	Data words 2 and 6
Data type:	2	(transfer from word 2)	of data block 3
Offset:	4		
Offset control bit:	1	(offset added to data type)	
Data number:	1	(transfer from block 1)	Data word 4
Data type:	4	(data word 4)	of data block 1 and
Offset:	2		data word 4
Offset control bit:	0	(offset added to data number)	of data block 3

Example: IKA data

A data group (e.g. IKA data) contains 32 data blocks (IKA relations). A further subdivision of the data blocks into data types is not possible with IKA data. The data type is therefore always 0 and the offset control bit is also always 0. The data number specifies from which IKA relation the data are to be transferred.

Data specification		**Data words transferred**
Data number:	4	IKA relations 4, 6 and 8
Data type:	0	were transferred
Offset:	2	
Offset control bit:	0	
Number of parameters: (IKA relations)	3	

NUMBER FORMAT **DL x+5**

The number format defines how the NC data are to be stored in the useful data DB/DX or in the target DB/DX.

DIMENSION IDENTIFIER **DR x+5**

The position of the decimal point of BCD numbers is entered here.

Note:

The valid value range of the parameters of the data specification depends on the data group to be transferred. Parts of the data specification are not required for certain data groups.

14.4.10.1 Useful data of the data group 03_H (IKA data)[d)]

Parameterization of the data specification.

For the parameterization of the data specification the values from the following table apply:

Data	Function	Unit	Limits
Number of parameters	Number of IKA relations	–	1...4
Channel number	–	–	0
Data type	–	–	–
Data group identifier	IKA data	–	03_H
Data number	Number of the first IKA relation	–	1...32
Offset data type/number	Offset of data number	–	1...31
Offset control bit	Offset control bit	–	–
Dimension identifier	–	–	–
Number format	–	–	–

Data specification for the data group 03_H[d)]

d) *with GA2, software version 1 and higher*

Read IKA data[d)]

The PLC operating system enters the supplied data of data group 03_H "interpolatory compensation with absolute values" (IKA data) and the number of words read in the target DB/DX in the following format. The number of IKA data blocks to be transferred per function call is limited to four.

Target DB/DX

	DL (Bit 15)					DR (Bit 0)
DW y	Length in words					
DW y+1	Flags	K	P	R	B	Number of the error curve
DW y+2	Compensation axis					Basic axis
DW y+3	Weighting factor					
DW y+4	Reference point high					
DW y+5	Reference point low					
DW y+6	Flags	K	P	R	B	Number of the error curve
DW y+7	Compensation axis					Basic axis
DW y+8	Weighting factor					
DW y+9	Reference point high					
DW y+10	Reference point low					
DW y+11	Flags	K	P	R	B	Number of the error curve
DW y+12	Compensation axis					Basic axis
DW y+13	Weighting factor					
DW y+14	Reference point high					
DW y+15	Reference point low					
DW y+16	Flags	K	P	R	B	Number of the error curve
DW y+17	Compensation axis					Basic axis
DW y+18	Weighting factor					
DW y+19	Reference point high					
DW y+20	Reference point low					

Overview of the data of the data group 03_H (read IKA data) [d)]

d) *with GA2, software version 1 and higher*

Write IKA data[d)]

The PLC user program enters the IKA data in the useful data DB/DX in the following format. The number of IKA data blocks to be transferred per function call is limited to four.

Useful data DB/DX

	DL (Bit 15)					DR (Bit 0)
DW x	Length in words					
DW x+1	Channel number (=0)					Number of the IKA relations
DW x+2	Data group identifier (=03)					Data type (=0)
DW x+3	Data number					
DW x+4					OSB	Offset data type/number
DW x+5	Number format (=0)					Dimension identifier (0=)
DW x+6	Flags	K	P	R	B	Number of the error curve
DW x+7	Compensation axis					Basic axis
DW x+8	Weighting factor					
DW x+9	Reference point high					
DW x+10	Reference point low					
. . .	. . .					
DW x+21	Flags	K	P	R	B	Number of the error curve
DW x+22	Compensation axis					Basic axis
DW x+23	Weighting factor					
DW x+24	Reference point high					
DW x+25	Reference point low					

Overview of the data of the data group 03_H (read IKA data) [d)]

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d) with GA2, software version 1 and higher

Meaning of the parameters

FLAG K	**DW x+6, bit 11** **DW y+1, bit 11**

1 signal: Back compensation of the compensation value (compensated actual value)
0 signal: No calculation of the compensation value (uncompensated actual value)

FLAG P	**DW x+6, bit 10** **DW y+1, bit 10**

1 signal: Compensation applies in the negative direction
0 signal: Compensation applies in the positive direction

FLAG R	**DW x+6, bit 9** **DW y+1, bit 9**

1 signal: Compensation applies direction-dependently
0 signal: Compensation applies direction-independently

FLAG B	**DW x+6, bit 8** **DW y+1, bit 8**

1 signal: IKA are active
0 signal: IKA are not active

NUMBER OF THE ERROR CURVE	**DR x+6** **DR y+1**

Error curves are required to calculate the compensation values. An error curve establishes the relation between the positions of the basic axis and the compensation values for the compensation axis. The data of the error curves are stored in the compensation data.

The number of the error curve is entered here.

Value range: 1 to 32

COMPENSATION AXIS	**DL x+7** **DL y+2**

The absolute machine position of a compensation axis can be influenced by the position of a basic axis. The number of the axis to be compensated for is entered here.
Value range: 1 to 24

BASIC AXIS	**DR x+7** **DR y+2**

Number of the axis whose position influences the actual position of the compensation axis.
Value range: 1 to 24

WEIGHTING FACTOR	**DW x+8** **DW y+3**

The compensation value can also be influenced with a weighting factor. The weighting factor can be used, for example, to take account of the influence of the tool without changing the error curves.
Value range: –16000 to +16000

REFERENCE POINT	**DW x+9, DW x+10** **DW y+4, DW y+5**

The reference position of the axis at which no IKA compensation is necessary. Using the reference point you can offset an error curve in the direction of the basic axis.
Value range: –99 999 999 to +99 999 999
Unit: MS units of the basic axis with sign

Note:

- The IKA data must be transferred to the NC when the compensation axis is active too. This can cause jumps in the setpoint which can reduce the surface quality of the workpiece. Despite this, transfer must be possible with active axes to allow influence on the compensation behaviour during long traverse blocks.
- Controlled data transfer is possible if the signals in the axis-specific NC-PLC interface are used.
- If the measuring system is changed the compensation value must remain constant to avoid jumps.
- The temperature compensation data are deleted on POWER-ON.
- You can also use the interpolatory compensation as a leadscrew error compensation if you select the basic axis to be the same as the compensation axis. Unlike with leadscrew error compensation with IKA the spacing between the compensation points can be variable.

14.5 Error codes, general errors

Error number 1)	Error meaning
1	Channel number incorrect or channel not available, legal values: 1...16
2	Spindle number incorrect or spindle not available, legal values: 1...6
3	Function number incorrect
4	Function active
5	Data insufficient
6	Useful data DB/DX missing
7	1st stated DW not in useful data DB/DX
8	Parameter too long (useful data DB/DX too short)
9	Excessive length specified for command channel (command channel too short)
10	155 U: useful data DB cannot be DB 0
11 d)	155 U: target DB cannot be DB 0
12 d)	Axis number is incorrect or axis is not present
13 d)	Target DB/DX is not present (on reading data)
14 d)	Target DB/DX is too short (on reading data)

1) Data format: fixed-point decimal

d) with GA2, software version 1 and higher

14.6 Error codes, function-related

14.6.1 Errors with functions 1, 4 and 8, "path dimension"

Error number	Error meaning
100 (64_H)	Axis number not allowed for this mode group or NC channel
101 (65_H)	Incorrect mode
102 (66_H)	Channel already assigned
103 (66_H)	No NC stop state (safety function for AUTOMATIC)
104 (68_H)	No NC stop state or no read-in enable (without safety function for AUTOMATIC)
105 (69_H)	Axis already active in another channel
106 ($6A_H$)	Impermissible user data length for the function concerned
107 ($6B_H$)	Impermissible user data
108 ($6C_H$)	Option not available
109 ($6D_H$)	(Not in use)
110 ($6E_H$)	Block search active
200 ($C8_H$)	Abort by: Reset, mode change, emergency stop, warm restart, servo disable, NC alarms, follow-up mode, parking axis, coupled motion, transmit, position behind software limit switch, etc.

14.6.2 Errors with function 2, "division increment"

Error number	Error meaning
100 (64_H)	Axis number not allowed for this mode group or NC channel
101 (65_H)	Incorrect mode
102 (66_H)	Channel already assigned
103 (67_H)	No NC stop state (safety function for AUTOMATIC)
104 (68_H)	No NC stop or no read-in enable (without safety function for AUTOMATIC)
105 (69_H)	Axis already active in another channel
106 ($6A_H$)	User data length not equal to 5
107 ($6B_H$)	Impermissible user data
108 ($6C_H$)	Option not available
109 ($6D_H$)	Incorrect division increment, i.e. division increment > number of divisions (G90), division number too great with rotary axes, C axis is not indexing axis (G91)
110 ($6E_H$)	Block search active
200 ($C8_H$)	Abort by: Reset, mode change, emergency stop, warm restart, servo disable, NC alarms, follow-up mode, parking axis, coupled motion, transmit, position behind software limit switch, etc.

14.6.3 Errors with function 3, "S external"

Error number	Error meaning
100 (64_H)	Programmed speed too high
101 (65_H)	M19 active at function start
107 ($6B_H$)	Spindle functioning as following spindle in synchronous mode on function start
109 ($6D_H$)	Spindle functioning in C-axis mode on function test

14.6.4 Errors with function 5, "M19 over several revolutions"

Error number	Error meaning
100 (64_H)	Spindle speed <>0 on start
101 (65_H)	M19 active at function start
102 (66_H)	PLC spindle control active at function start
103 (67_H)	Option M19 not available
104 (68_H)	Function execution aborted
105 (69_H)	Spindle not synchronized at function start
106 ($6A_H$)	Servo enable not available at function start
107 ($6B_H$)	Spindle operating as following spindle in synchronous mode at function start
108 ($6C_H$)	Programmed path too great (path converted internally with MD 455*, MD 456*)
109 ($6D_H$)	Spindle operating in C axis mode at function start
110 ($6E_H$)	Value range infringement with "spindle speed" parameter
111 ($6F_H$)	Value range infringement with "incremental path" parameter
113 (71_H)	Value range infringement with "acceleration time constant" parameter
114 (72_H)	Value range infringement with "position window" parameter

14.6.5 Errors with function 6, "transformation"

The error number is made up as follows:

Error number:

n xxx

xxx → Currently active G function in channel
Value range: G130 ... G138, G230 ... G238, G330 ... G338

n → Error type

Error number: 100 ... 32788 (fixed-point decimal)
64 ... 7FFF (HEX)

Error number (HEX)	Error meaning
n xxx 1130_H	Impermissible G function
$2130 ... 2138_H$ $2230 ... 2238_H$ $2330 ... 2338_H$	G function not allowed in channel
3132_H 3232_H 3332_H	Coordinates cannot be reproduced
$4130 ... 4138_H$ $4230 ... 4238_H$ $4330 ... 4338_H$	Selection/deselection not allowed in mode
$5130 ... 5138_H$ $5230 ... 5238_H$ $5330 ... 5338_H$	Transformation group axes assigned
$6130 ... 6138_H$ $6230 ... 6238_H$ $6330 ... 6338_H$	Log abort by RESET (key, mode change)
$7130 ... 7138_H$ $7230 ... 7238_H$ $7330 ... 7338_H$	Transformation undefined
$8130 ... 8138_H$ $8230 ... 8238_H$ $8330 ... 8338_H$	Transformation selection in zero point (turning centre)

14.6.6 Errors with function 7, "coupled motion"

Eror number	Error meaning
100 (64_H)	Incorrect G function number
101 (65_H)	Incorrect identifier AUTOMATIC/JOG
102 (66_H)	Channel is not master channel of mode group (relevant only for JOG mode)

14.6.7 Errors in function 9 "temperature compensation" d)

Error number	Meaning
12 ($0C_H$)	Axis number is incorrect or axis is not present
100 (64_H)	Length in words incorrect
101 (65_H)	Option not available
102 (66_H)	Absolute temperature compensation impermissible
103 (67_H)	Reference point impermissible

d) with GA2, software version 1 and higher

14.6.8 Errors in functions 10 and 11"read/write NC data via command channel"[d)]

Error number	Meaning
100 (64_H)	General data error
101 (65_H)	Data group impermissible
102 (66_H)	Data number impermissible
103 (67_H)	Number of parameters impermissible
104 (68_H)	Offset impermissible
105 (69_H)	Writing not allowed

d) with GA2, software version 1 and higher

Errors in reading/writing the data of the data group 03_H (IKA data)*d)*

Error number	Meaning
100 (64_H)	General data error
101 (65_H)	Data group impermissible
102 (66_H)	Data number impermissible
103 (67_H)	Number of IKA data blocks impermissible

d) with GA2, software version 1 and higher

15 Communication Area/PLC Interface (DB 48)

15.1 Signals to communication area

STATUS DISABLE	DW 0, bit 15

1 signal: PLC data cannot be **edited** in the "PLC status" display.
0 signal: No significance.

The machine manufacturer can use this bit to prevent the machine operator from modifying data in the PLC via the "PLC status" display.

KEYSWITCH	DW 0, bit 14

0 signal: Inputs at the NC operator panel keyboard are disabled for areas that can be specified in machine data.
1 signal: Inputs at the NC operator panel keyboard are enabled.

Note:

The KEYSWITCH signal can be set either by the KEYSWITCH on the machine control panel or by the PLC program.

SCREEN DARKENING	DW 0, bit 13

0 signal: Operator panel(s) bright
- by user
- by PLC operating system after warm or cold restart

1 signal: Operator panel(s) dark
- by user

Note:

- If several operator panels are connected, all are darkened when the signal is set.
- If the signal VT 340 ACTIVE is set, this signal must be reset.

OPERATOR PANEL DISABLE — DW 0, bit 12

0 signal: Operator panel not disabled
- by user
- by PLC operating system after warm or cold restart

1 signal: Operator panel disabled
- by user

Notes:

- The operator panels are disabled only for the NC. The PLC can still evaluate operator panel keys even when the panel is disabled.
- If two PLCs are used, the signals described above are ORed together. If several operator panels are connected, all are disabled together.

CYCLE DISABLE — DW 0, bit 11

1 signal: Cycles (manufacturer's fixed subroutines) cannot be selected for editing, erasing or display etc.

0 signal: Access to the cycles is possible.

Notes:

- In case servicing work should become necessary, a program capable of removing the cycle disable should be provided.
- The CYCLE execution rate is **not** influenced by CYCLE DISABLE.

CONTROL WITHOUT OPERATOR PANEL — DW 0, bit 10

The CONTROL WITHOUT OPERATOR PANEL function is selected by the PLC and offers the following operations:

- Power On/Off without operator panel.
- Connect/disconnect operator panel during NC operation.

The machine control panel must be connected via PLC I/O modules. The control startup must generally be performed with an operator panel.

1 signal: CONTROL WITHOUT OPERATOR PANEL mode selected.

0 signal: Control **with** operator panel.

Notes:

- The operator panel must have a switch of its own for Power On/Off.
- When the "Control without operator panel" option bit is set, the PLC user program must scan the switch position and enter it in DB 48, DW 0, bit 10 during both startup (OB 20) and cyclic operation (OB 1).

- The control can be switched on/off only if it was started up with an operator panel.
- Disconnecting operator panel during NC operation:
  Subject to the condition that the NC/PLC has already been started up with the operator panel and that the PLC function CONTROL WITHOUT OPERATOR PANEL (NC/PLC interface signal) was selected before switching off.

  Switch off the operator panel and pull out the MPC connector at the operator panel.
- Connecting operator panel during NC operation:
  Same preconditions apply as for "disconnecting" except that the operator panel must be connected to the MPC system while switched off. When the operator panel is then switched on, the CONTROL WITHOUT OPERATOR PANEL interface signal is cancelled by the PLC.

WARM RESTART	**DW 0, bit 8**

1 signal: Activates a warm restart of the NC.
0 signal: No effect.

Notes on application:

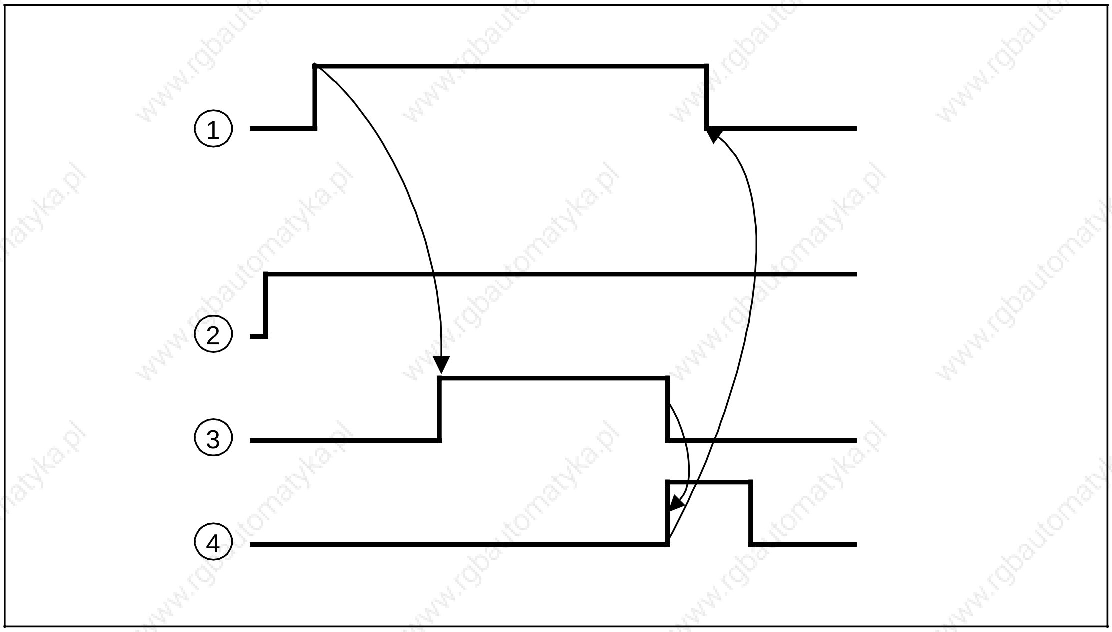
If any of the following are altered during machine operation:

- channel allocation to a mode group
- axis allocation to a mode group
- spindle allocation a to mode group

an NC warm restart has to be initiated after overwriting the machine data. Following the warm restart, the changes take effect on the NC and can be accessed by the program.

Notes:

- A warm restart is activated only if the NC is in the reset state.
- No NC start signal may be given in any NC channel during a warm restart.
- Neither the axis and spindle-specific NC/PLC interfaces nor the NC/PLC interface for EMERGENCY STOP signals are processed while the function is being executed.
- Position control of the axes remains operative during the warm restart.
- The "M 19 active" spindle position control is cancelled.
- If the function is requested again during the warm restart, the request is ignored. Moreover, it is not activated after the current function has been completed.
- All spindles must be stationary before the warm restart.



1: Warm restart request by setting the WARM RESTART signal at the user interface.
2: Initiate the RESET state of all mode groups or channels (by user).
3: The warm restart function is executed in the NC.
4: The WARM RESTART ENDED signal is output to the interface.

INITIATE REORG **DW 0, bit 7**

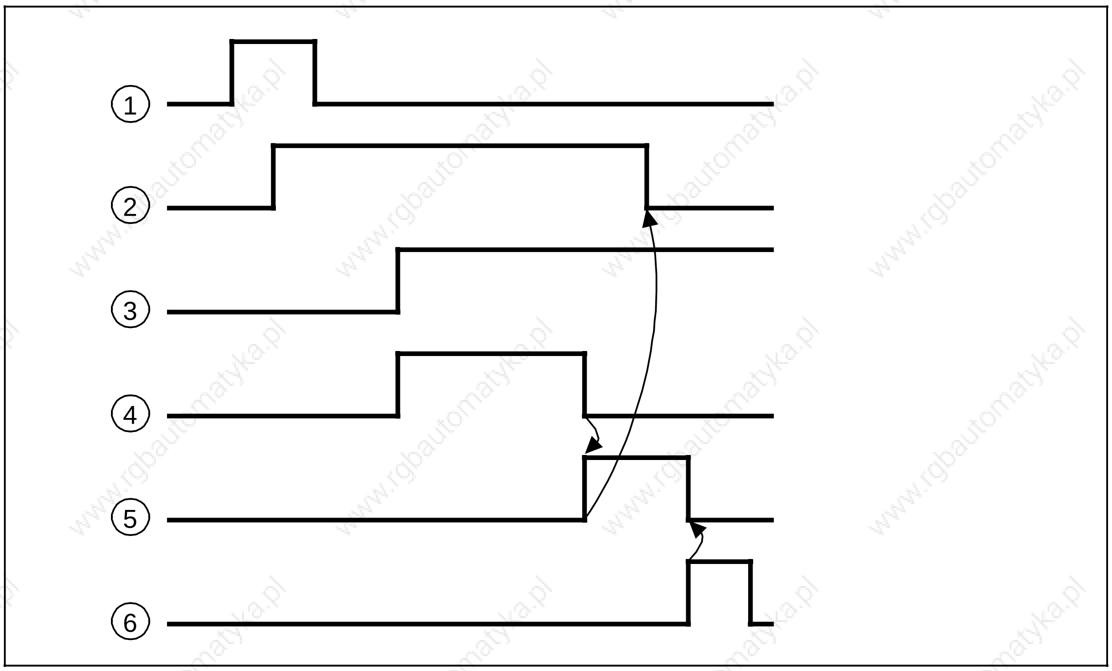
Is only output for the computer link for reasons of compatibility.

1 signal: Initiates a reorganization of the NC part program memory from the PLC.

0 signal: No effect.

Notes:

- The REORG initiation is stored until all mode groups or channels are in the RESET state. REORG is then executed automatically.
- The INITIATE REORG signal must be set and then reset by the user within one PLC cycle. If it is not cancelled or cancelled too late, REORG is executed several times or continuously repeated.
- If an NC start signal is given in one or more channels during the reorganization, it is ignored and not stored. The user must then repeat the NC start after completion of the reorganization routine.



Signal chart for requesting reorganization of part program memory

1: Reorganization activated by the INITIATE REORG signal.
2: The REORG ACTIVATED signal is output to the interface.
3: RESET state of all mode groups or channels.
4: The reorganization function is executed in the NC.
5: The REORG ENDED signal is output.
6: The user resets the REORG ENDED signal.

15.2 Signals from communication area

REORG ACTIVATED	DW 1, bit 15

Is only output for the computer link for reasons of compatibility.

1 signal: Reorganisation of the NC part program memory initiated by the PLC is being executed.
0 signal: a) The reorganisation has been completed, or reorganisation has been initiated but the mode groups or channels are not yet in the RESET state, or REORG has not been requested.
b) Reorganisation was initiated by the file transfer interface.

Note:

If an NC start signal is given in one or more channels while the REORG ACTIVE signal is set, it is ignored and not stored.

REORG ACTIVATED BY FILE TRANSFER	DW 1, bit 14

Is only output for the computer link for reasons of compatibility.

1 signal: Reorganisation of the NC part program memory initiated by the file transfer interface is being executed.
0 signal: a) Reorganisation of the NC part program memory initiated by the file transfer interface has been completed.
b) Reorganisation was initiated by the PLC signal INITIATE REORG.
c) Reorganisation was initiated by the file transfer interface but the mode groups or channels are not yet in the RESET state.

Note:

If an NC start signal is given in one or more channels while the REORG ACTIVATED BY FILE TRANSFER signal is set, it is ignored and not stored.

REORG BY FILE TRANSFER ENDED	DW 1, bit 9

Is only output for the computer link for reasons of compatibility.

1 signal: Reorganisation initiated by the file transfer interfacce has been completed.
0 signal: Reorganisation initiated by the file transfer interface is still active or a reorganisation initiated by the PLC has been completed.

Note:

The signal REORG BY FILE TRANSFER ENDED is only output to the interface and has to be reset, so that the end of a subsequent reorganisation initiation can be recognized. The RESET is performed automatically by the function blocks of package 4, computer link. If the user is not using package 4 or is using it in a modified form, he must make sure the signal is set himself.

REORG ENDED	**DW 1, bit 8**

Is only output for the computer link for reasons of compatibility.

1 signal: The reorganization function initiated by the PLC has been completed.
0 signal: The reorganization function initiated by the PLC is still active or a reorganization routine initiated by the file transfer interface has been completed.

Note:

The REORG ENDED signal must be reset by the user.

FILE TRANSFER BUSY	**DW 1, bit 2**

1 signal: Data are transferred via the file transfer interface.
0 signal: No data are transferred via the file transfer interface.

WARM RESTART ENDED	**DW 1, bit 0**

1 signal: The WARM RESTART function has been completed without any errors or interrupted with NC alarms 70 and 80 due to an error.
0 signal: The WARM RESTART function is active or no WARM RESTART function has been activated.

Notes:

- If the machine data that can be edited with the WARM RESTART function contain errors, the NC outputs alarms 70 and 80. At the same time, the MODE GROUP READY signal is cancelled and the WARM RESTART ENDED signal set.
- In such cases, the system control can be made ready again only by correcting the machine data and subsequently executing POWER ON RESET.
- The WARM RESTART ENDED signal is present for one PLC cycle only, (dynamic signal).

VT 340 ACTIVE (TERMINAL EMULATION ACTIVE)[d)]	**DW 2, bit 15**

1 signal: The control is in a terminal emulation. It is not possible to operate the NC in this mode. Any screen saver must be cancelled (DB 48, DB 12).
The customer keys are passed on for processing even if VT 340 is active.
0 signal: The terminal emulation is not active.

d) with GA2, software version 1 and higher

LINK ACTIVE[d)] **DW 2, bit 11**

1 signal: There is a data link between the service system and the customer's system.
0 signal: There is no data link.

Note:

- The state of this signal remains even after POWER ON.
- The signal is only reset when the link is aborted with a softkey. If the link is aborted with an adapter (reset) the signal is not reset.

TELESERVICE WITH INPUT MODE[d)] **DW 2, bit 10**

1 signal: The function TELESERVICE is in INPUT MODE. In this mode, service cannot operate the customer's control.
0 signal: The mode TELESERVICE WITH INPUT MODE is not active

Note:

The signal is reset on POWER ON within teleservice.

TELESERVICE WITH DISPLAY MODE[d)] **DW 2, bit 9**

1 signal: The function TELESERVICE is in DISPLAY MODE. In this mode, service cannot operate the customer's control.
0 signal: The mode TELESERVICE WITH DISPLAY MODE is not active

Note:

The signal is reset on POWER ON within teleservice.

TELESERVICE IS ACTIVE[d)] **DW 2, bit 8**

1 signal: The function TELESERVICE is active, i.e. the customer's control is linked with the service control.
0 signal: The function TELESERVICE is not active

Note:

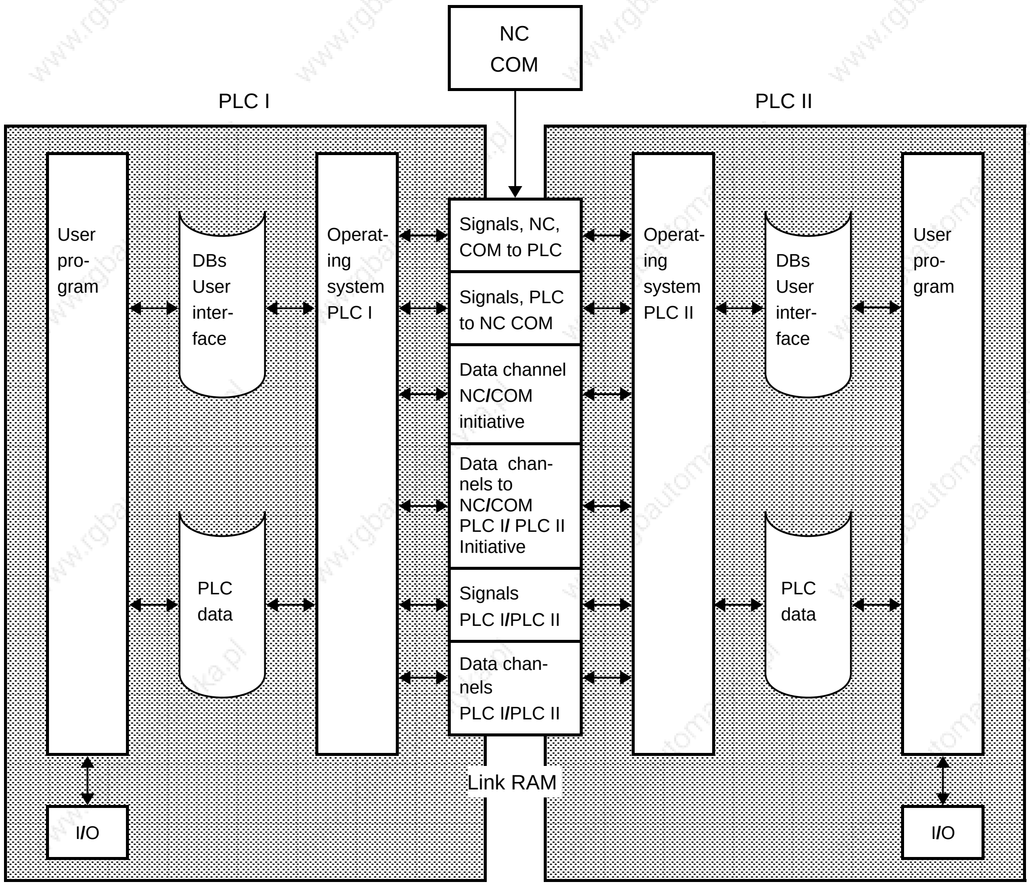
The signal is reset on POWER ON within teleservice.

d) with GA2, software version 1 and higher

16 PLC/PLC Interface (DB 50 ... DB 53, DB 59)

(not with S5-155U)

16.1 Overview



Signals to channel, axis, spindle from PLC I **or** PLC II only
(PLC machine data).

Overview of PLC/PLC interface

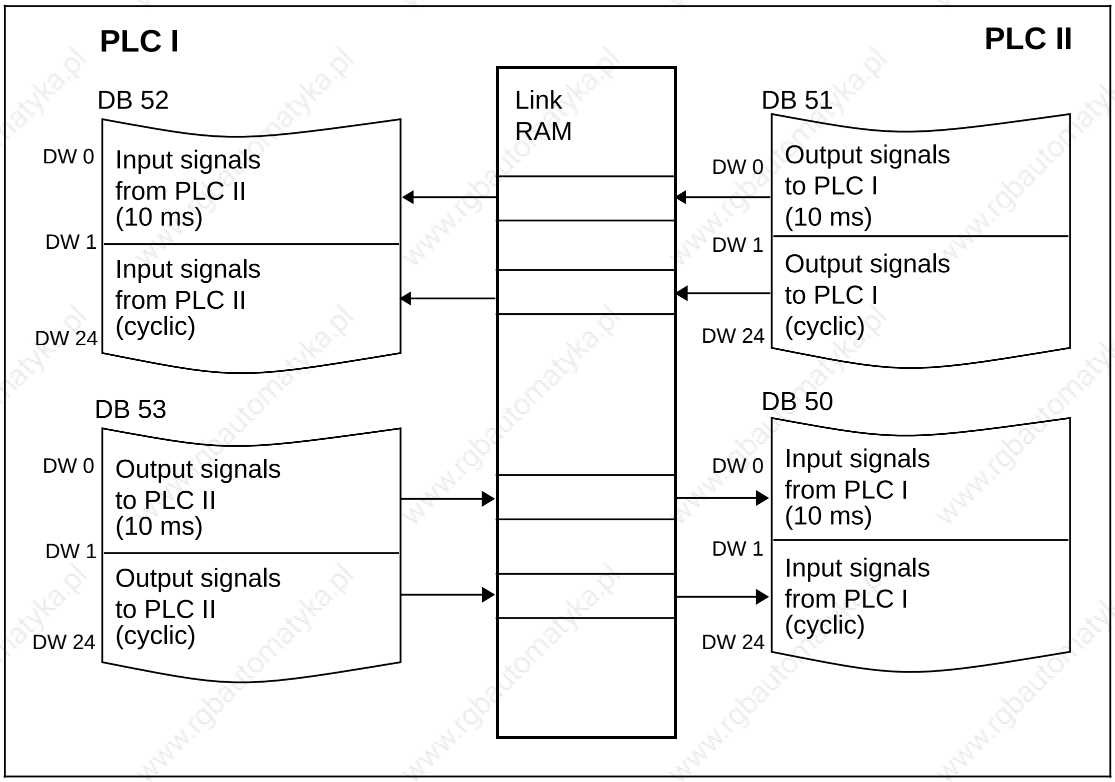
16.2 Static signal transfer (DB 50 ... DB 53)

Static signals can be transferred between PLC I, PLC II by means of DB 50 to DB 53. These data blocks are set up in each PLC. One is for sending and the other for receiving signals.

Two transfer procedures are available:

- 1 word in 10 ms time frame (time-controlled), i.e. maximum transfer time 20 ms.
- 24 words, cyclic transfer

The transfer is executed by the PLC operating system and is activated automatically with more than one PLC.



PLC/PLC interface: Cyclic and periodic signal transfer

16.3 Job-controlled data transfer (DB 50 ... DB 53)

16.3.1 General description

As well as static signal transfer, job-controlled data transfer between PLCs is also possible. Each PLC can read and write data from the other PLC.

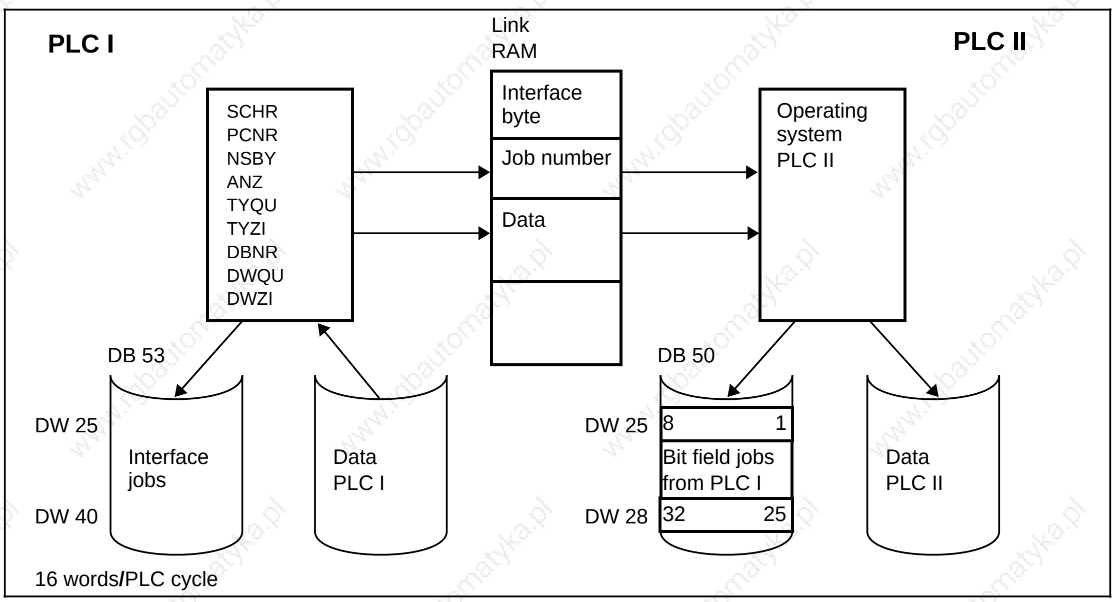
Data transfer is activated by two function blocks: read PLC data (FB 63) and write PLC data (FB 64, see function macros for description, both blocks are PLC operating system componen-ts). The function blocks enter the data transfer parameters (PLC No., data type, source, desti-nation etc.) in a queue. The actual transfer of data is executed by the PLC operating system.

A maximum of 16 words of a single **data group** can be transferred per PLC cycle. If a greater number of words are to be transferred, the job is executed over several PLC cycles.

The function blocks can be called several times for different jobs. However, a different interface byte has to be assigned for each job and each PLC. The assignment of data bytes enables both PLCs to monitor the data traffic:

- The data transfer status for each job (1 byte, of the interface bytes, for each job) is included in DW 25 to DW 40 of the data blocks
  DB 51 (outputs to PLC I)
  DB 53 (outputs to PLC II)
  for each PLC that is to read or write data.
- After a job has been executed, two bits (1x static, 1x dynamic) are set in DW 25 to DW 28 of the data blocks
  DB 50 (inputs from PLC I)
  DB 52 (inputs from PLC II)
  depending on the number of the interface byte (see figure).

These signals indicate to the PLC which is being written in or out of which is being read that data transfer has taken place.



Data transfer between PLC I and PLC II

Branches can be implemented in the user programs of both PLCs according to these acknowledgements.

The function blocks can be called either unconditionally or conditionally (also see the examples).

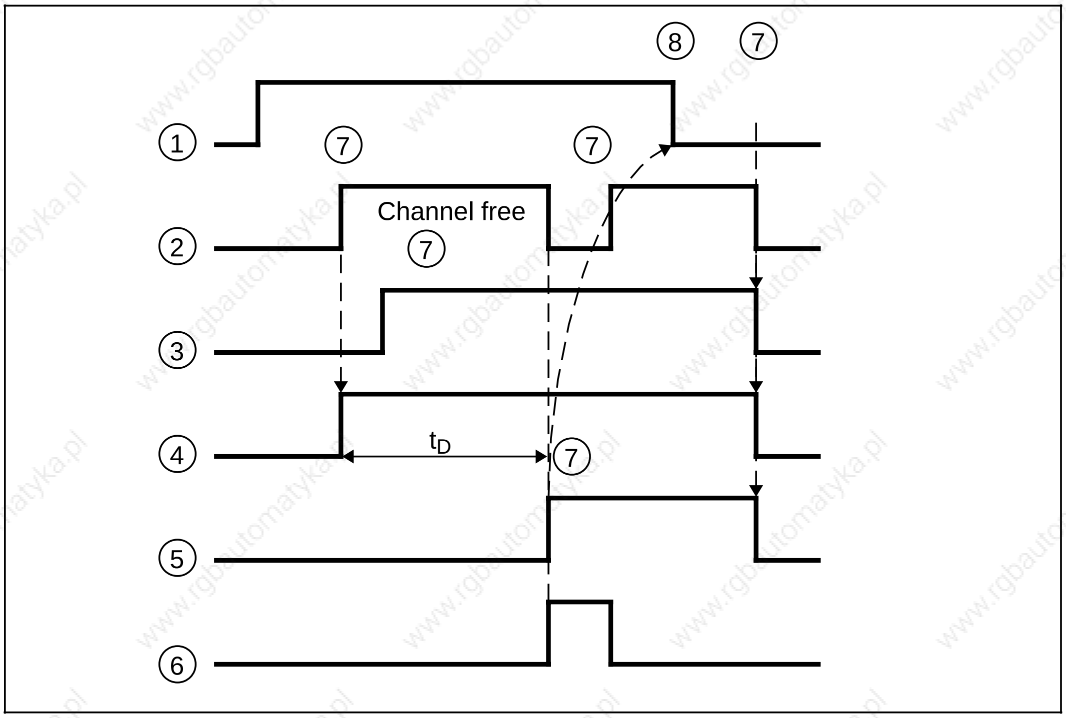
Advantage of unconditional call: Simple initialization of the FB.

Advantage of conditional call: Minimum amount of cycle time taken up in the inactive state.

If the function blocks are incorrectly parameterized (e.g. data source unknown), the PLC branches into the stop loop. The cause of the fault is contained in the interrupt stack (see "Error List with System Stop" section).

Interface signal pulse diagrams

a) Unconditional block call (processing time in inactive state approx. 0.2 ms).



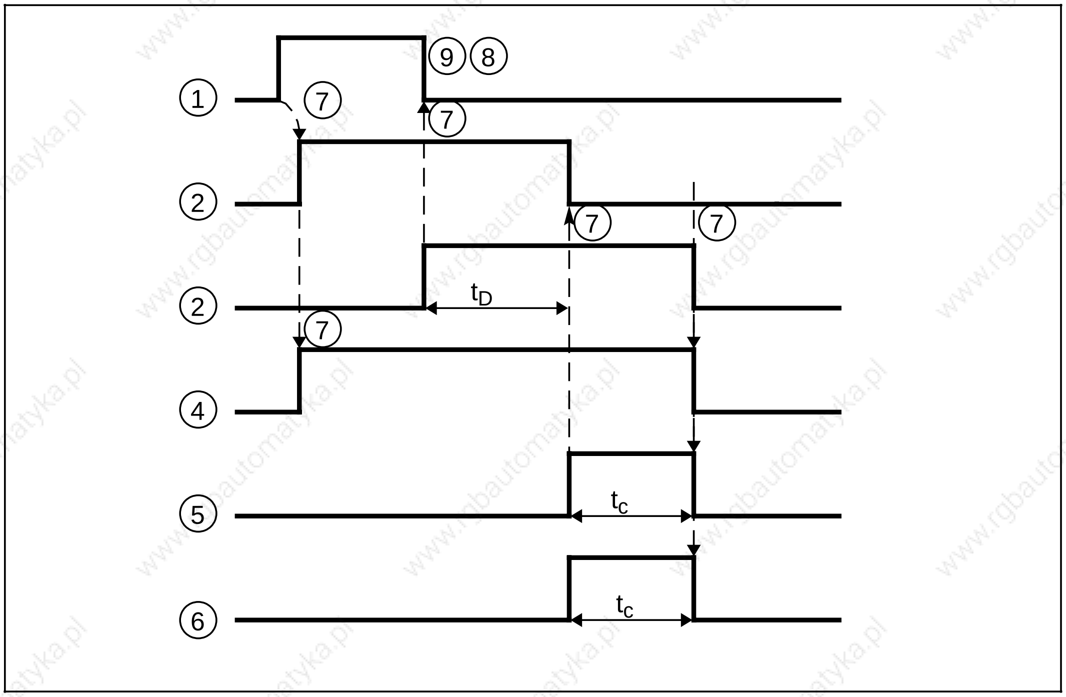
1: READ/WRITE
2 : DATA TRANSFER REQUESTED signal
3 : DATA TRANSFER BUSY signal
4 : DATA TRANSFER ASSIGNED signal
5 : DATA TRANSFER ENDED signal
6 : DATA TRANSFER EFFECTED place (to the accessed PLC)
7 : FB initiation of signal change
8 : User initiation of signal change
t_D: Internal interface assigned by data transfer

Program example for unconditional block call:

```
       :  C   DB53              DB PLC/PLC interface
       :  TB   D 25.4           Data transfer ended
                   .            job 1
       :  R  write              Reset 'SCHR'
              .                 request
       :  U condition 1
              .
              .
       :  U condition n         Condition for 'SCHR'
       :  S write
       :  JU FB64
NAME   :  PCD-SCHR
SCHR   :   - write
PCNR   :     KF+2
NSBY   :     DR 25
ANZ    :     KF+2               (2 words)
TYQU   :     KSIW               (Input word)
TYZI   :     KSDB               (Data read starting
DBNR   :     KY000,050          with input word 50)
DWQU   :     KF 50              (Data entered in DB150 starting
DWZI   :     KF10               with data word 10 )
```

The SCHR (WRITE) signal can also be used if certain functions have to be interlocked during data transfer.

b) Conditional block call (processing time in inactive state approx. 0.008 ms)



1: READ/WRITE
2 : DATA TRANSFER REQUESTED signal
3 : DATA TRANSFER BUSY signal
4 : DATA TRANSFER ASSIGNED signal
5 : DATA TRANSFER ENDED signal
6 : DATA TRANSFER EFFECTED place (to the accessed PLC)
7 : FB initiation of signal change
8 : User initiation of signal change
t_C: PLC cycle time
t_D: Internal interface assigned by data transfer

Program example for conditional block call:

(e.g. within a single run)

```
Step m      :  Data transfer started
               .
               .
            :  C   DB52         DB PLC/PLC interface
            :  TB  D 25.2       Data transfer busy
            :  U step flag
            :  R step flag m
            :  S step flag m + 1
            :  U step flag m
            :  JU FB63
NAME        :  PCD-LESE
LESE        :  F O.1            (1 signal)
PCNR        :  KF+2
NSBY        :  DR 25
ANZ         :  KF+2             (2 words)
TYQU        :  KSIW             (Input word)
TYZI        :  KSDB             (Data read starting
DBNR        :  KY000,150        with input word 50 )
DWQU        :  KF 50            (Data entered in DB150 starting
DWZI        :  KF10             with data word  10 )

Step m + 1  :  Wait until data transfer ended


            :  TB  D 25.4       Data transfer ended
            :  U step flag m + 1
            :  R step flag m + 1
            :  S step flag m + 2
```

16.3.2 Interface signals for passive PLCs (DB 50, DB 52)

DATA TRANSFER EFFECTED (DYNAMIC)	DL 25 to DL 28

1 signal: Data read or written by other PLCs. The bit is set according to the number of the allocated interface byte of the reading/writing PLC.

0 signal: After one PLC cycle.

DATA TRANSFER EFFECTED (STATIC)	DR 25 to DR 28

1 signal: Data read or written by other PLCs. The bit is set according to the number of the allocated interface byte of the reading/writing PLC.

0 signal: By the user.

16.3.3 Interface signals for active PLCs (DB 51, DB 53)

Address m depends on the number of the interface byte. Refer to the signal overview in Section 3 for the values that are valid for m.

DATA TRANSFER REQUESTED	DB m, bit 0

1 signal: READ (FB 63) or WRITE (FB 64) signal is 1

0 signal:
- With 0 1 transition of DATA TRANSFER ENDED
- READ (FB 63) or WRITE (FB 64) signal is 0

FIFO ASSIGNED	DB m, bit 1

1 signal: Entry cannot be made in FIFO at present. With READ or WRITE = 1, repeated attempts are made until the entry is enabled.

0 signal: Otherwise.

DATA TRANSFER BUSY	DB m, bit 2

1 signal: Job is entered in buffer or being executed.
0 signal: Job **not** being executed.

DATA TRANSFER ASSIGNED	**DB m, bit 3**

1 signal: 0 1 transition of DATA TRANSFER REQUESTED
0 signal: 1 0 transition of DATA TRANSFER ENDED

Example of application:

Interlocks in the PLC program during the request and execution phase of data transfer.

DATA TRANSFER ENDED	**DB m, bit 4**

1 signal: Job completed without errors.
0 signal: After 1 signal, if DATA TRANSFER REQUESTED is 0.

16.4 Central user DB (DB 59)

A central DB 59 with a length of 128 words is set up in the link RAM (not cancelled) with the "FORMAT USER M." softkey in the startup mode.

DB 59 is a user DB to which both PLCs have access with equal priority; in other words, both PLCs can access (read and write) the same DW.

The PLC user programmer is responsible for determining the access of the PLCs to DB 59. DB 59 must also be cancelled by the PLC user.

Synchronization for data access between the PLCs (if necessary) and a write interlock must also be implemented in the PLC user program.

To prevent collisions on the link bus, the hardware prevents two PLCs accessing DB 59 at exactly the same time.

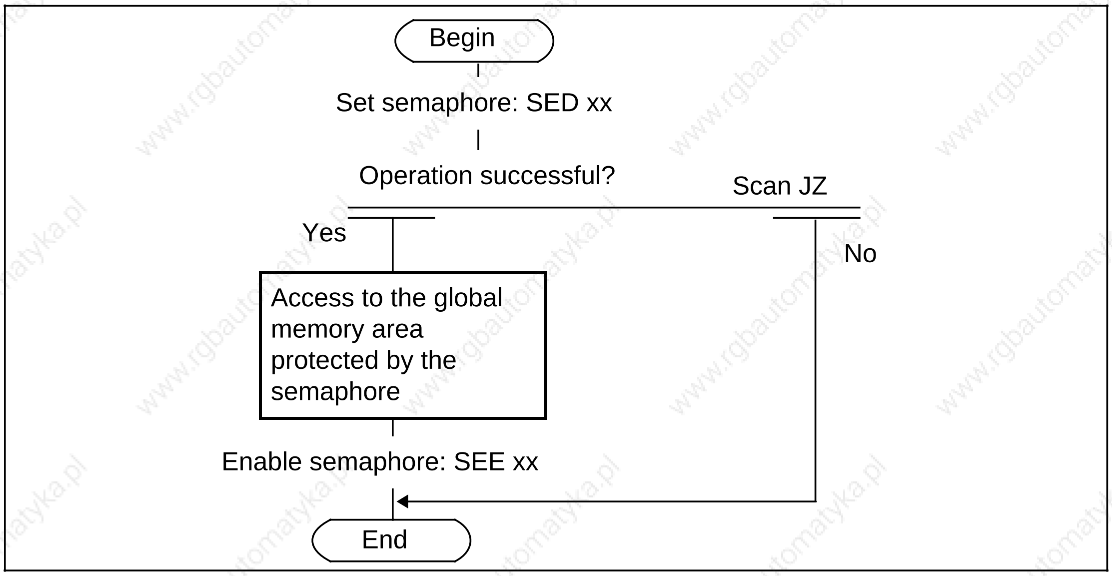
16.4.1 Semaphore technique

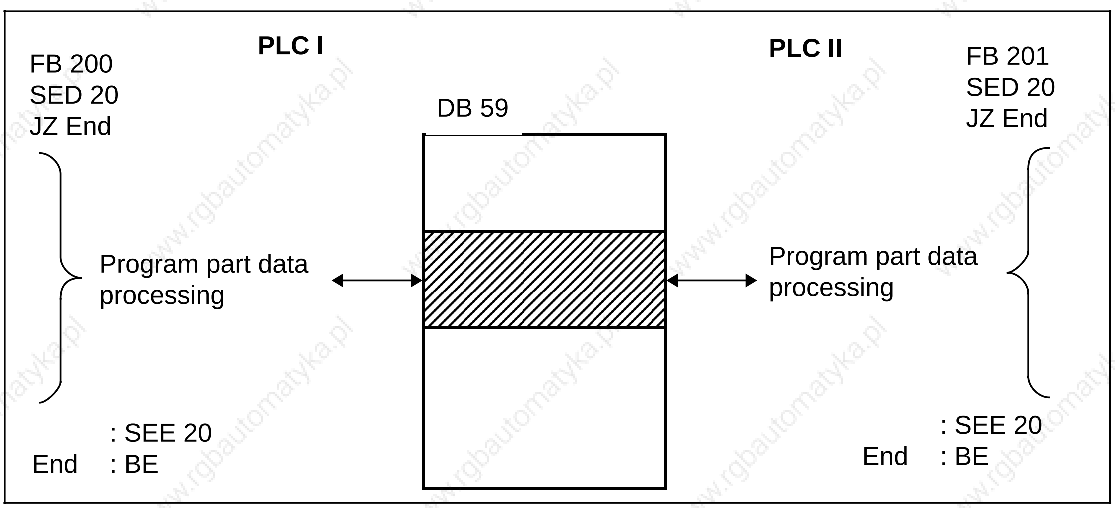
The user has 32 user semaphores at his disposal; they have the function of protecting the memory areas in the link RAM DB 59.

If two PLCs both use certain global memory areas in the link RAM, there is a danger of one PLC overwriting another's data or of invalid interim data states being read out. Access of the PLCs to the common memory areas must therefore be coordinated.

The individual PLCs can be coordinated with the semaphores and the commands SED and SEE: only after the agreed semaphore SED has been set does one of the PLCs (the one which set the semaphore) access the common memory area. A semaphore can be set by only one PLC in each case. If a PLC fails to set the semaphore, no access is possible. Similarly, a PLC must forego further access once it has enabled the semaphore again (SEE).

Both PLCs must contain a function block with the following program structure:





17 Setup DBs for User (DB 68, DB 71)

Data blocks DB 66 to 71 are reserved for user data in SINUMERIK System 800. Two of these data blocks are available on the SINUMERIK 880.

- DB 68 Data words user (64 data words)
- DB 71 Data bits user (16 data words = 256 bits)

The PLC operating system automatically sets up these data blocks in the RAM the first time the control is switched on. The user data cannot be accessed at the NC screen as standard; each user data should be supplemented with plain text in order to facilitate operation.

Images for displaying and editing the user data can be generated with the NC workstation. Users are recommended to utilize user data in cases where the data are to be used by the PLC and possibly the NC as well. The user data can also be read by NC cycles by means of CL800 language commands.

The user data are described in the Installation Guide,

Instructions for the SINUMERIK 880.

Note on application:

By means of user data the machine operator can edit the PLC program and implement branch techniques depending on the actual machine configuration.

Unlike the PLC machine data, the user data do not enable any Options; they specify actual states to the PLC program.

Examples:

1. PLC MD specify that the machine has two clamping pressures.
   The user data, for example enable the lower clamping pressure.
2. Setting the waiting time of a loader gripper after a clamping operation.

18 Decoding Lists for M Signals (DB 80 ... DB 95)

18.1 Selection of M decoding according to list

Activation of the "M decoding according to list" function for M functions with extended address is channel-specific by machine data.

M decoding according to list:

PLC I:	MD 6009.0 to MD 6010.7	for NC channels 1 to 16
PLC II:	MD 6109.0 to MD 6110.7	for NC channels 1 to 16

18.2 Channel assignment of decoding lists

For decoding M functions with extended address, the PLC user program must set up a decoding list for every NC channel in which the function is selected. Data blocks DB 80 to DB 95 are provided for the decoding lists. The decoding list for NC channel 1 must be stored in DB 80; DB 81 to DB 95 must be used for NC channels 2 to 16.

Channel	Decoding list
1	DB 80
2	DB 81
3	DB 82
4	DB 83
5	DB 84
6	DB 85
7	DB 86
8	DB 87

Channel	Decoding list
9	DB 88
10	DB 89
11	DB 90
12	DB 91
13	DB 92
14	DB 93
15	DB 94
16	DB 95

18.3 Structure of decoding lists

Size of decoding lists

A maximum of 64 M functions with extended address can be decoded per NC channel. Each M function with extended address sets a pair of bits, i.e. a static signal and the associated dynamic signal, in DB 30.

The assignment of the M functions with extended address and the pairs of bits in DB 30 is determined in the decoding lists. Each entry for an M function assigns three data words in the relevant DB.

DBs 80 to 95 can be created only with certain lengths as indicated in the following table. Fields that are not required (always at the end of the decoding lists; see below) must be preassigned with 0.

Number of M functions	Number of DWs in decoding lists
1 M function	6
2 M functions	6
4 M functions	12
8 M functions	24
16 M functions	48
32 M functions	96
64 M functions	192

Permissible decoding list sizes

Decoding list structure

Each entry in the decoding lists comprises three data words.

The extended address for the M function is specified in the first data word and the M address is stated in the second data word. The third data word determines the pair of bits in DB 30 that is to be influenced by the M function. The DR stipulates the number of the **static** bit in the specified data word. The dynamic bit is addressed automatically by the PLC operating system.

	Extended M address	M address	Definition of DW No. in DB 30	Definition of bit No. in DB 30
	0-99 (KF)	0-999 (KF)	0-63 (KY)	0-7 (KY) static bit
1st M function	DW 0	DW 1	DL 2	DR 2
2nd M function	DW 3	DW 4	DL 5	DR 5
64th M function	DW 189	DW 190	DL 191	DR 191

Structure of decoding lists

Ascending order of entries

The M addresses must be stored in the decoding lists in ascending order. In other words, all M functions with extended address 0 must be defined first, followed by all M functions with extended address 1 and so on.

The M functions must also be stated in ascending order within a group of M functions (with the same extended address).

The extended M addresses and the M addresses do not have to be allocated consecutively, however, and need not start at 0 (also see example).

Example: decoding list for channel 1

Four M functions with extended address are envisaged for NC channel 1:

M2 = 8 sets D 5.3
M2 = 15 sets D 5.5 (and the relevant dynamic bit in each case)
M3 = 10 sets D 20.5
M3 = 61 sets D 21.6

The decoding list for NC channel 1 is entered in DB 80:

Entry	DW	Parameter	Type	Value
1	0 1 2	ER-ADR M-ADR BIT-AD	KF KF KY	+ 00002 + 00008 005.003
2	3 4 5	ER-ADR M-ADR BIT-AD	KF KF KY	+ 00002 + 00015 005.005
3	6 7 8	ER-ADR M-ADR BIT-AD	KF KF KY	+ 00003 + 00010 020.005
4	9 10 11	ER-ADR M-ADR BIT-AD	KF KF KY	+ 00003 + 00061 021.006

Decoding list for the M functions stated above

Typical application of M functions with extended address:

Synchronization of machine (channel 1) and loader (channel 3) by means of M functions with extended address:

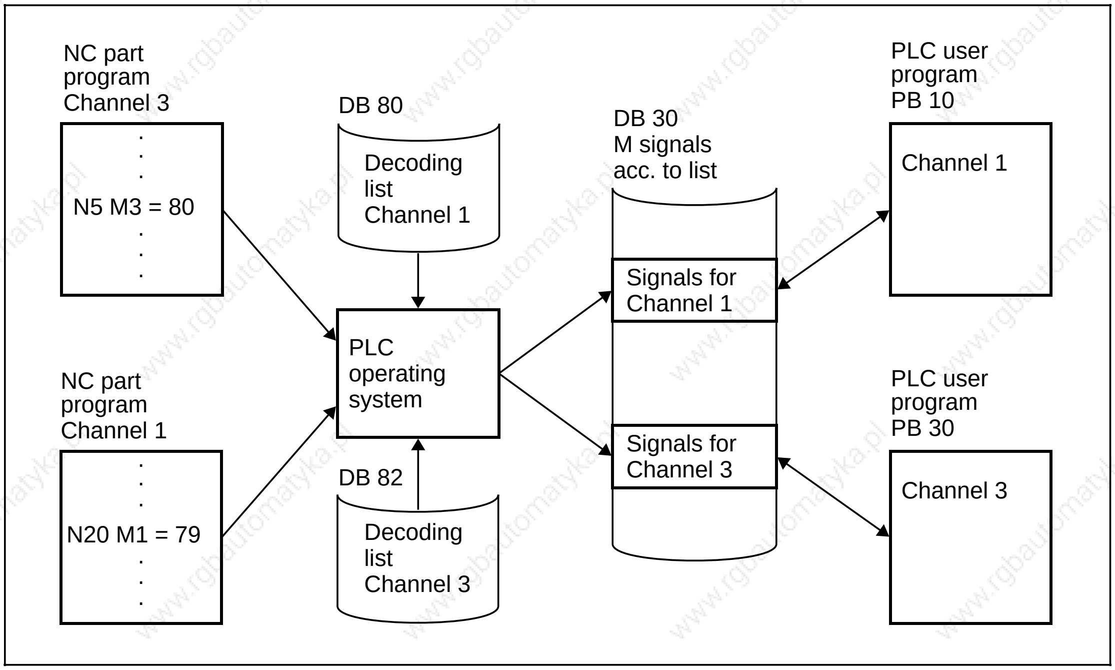
All M functions that cause a read-in disable for channel 1 are output in one byte.
All M functions that cause a read-in disable for channel 3 are output in one byte.

Caution: The following M functions have a fixed meaning

(see Programming Guide for SINUMERIK 880):

$M_{extension}$ ***= 00, 01 ... 05, 17, 19, 30, 36, 37***

This must be taken into account when allocating new M functions.



Example for processing M functions with extended address

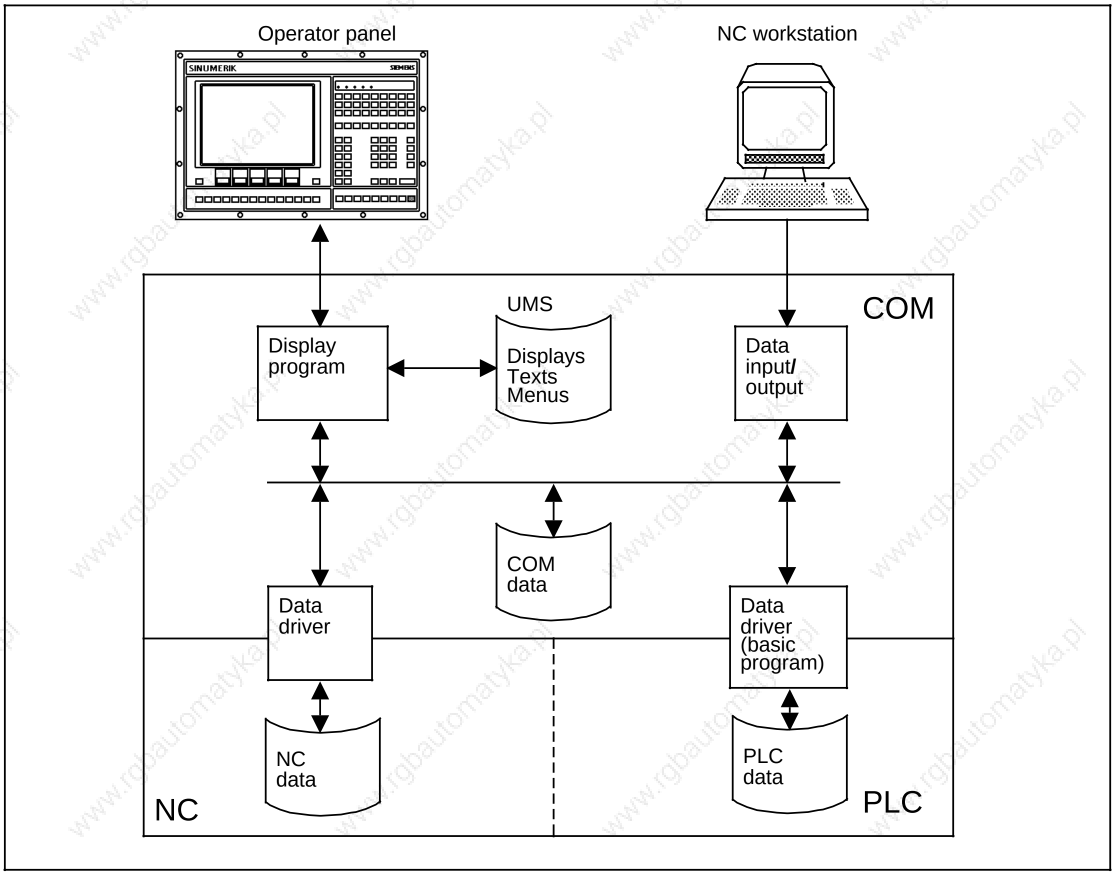
19 Display Programs for PLC Data and Messages

19.1 Structure of display programs

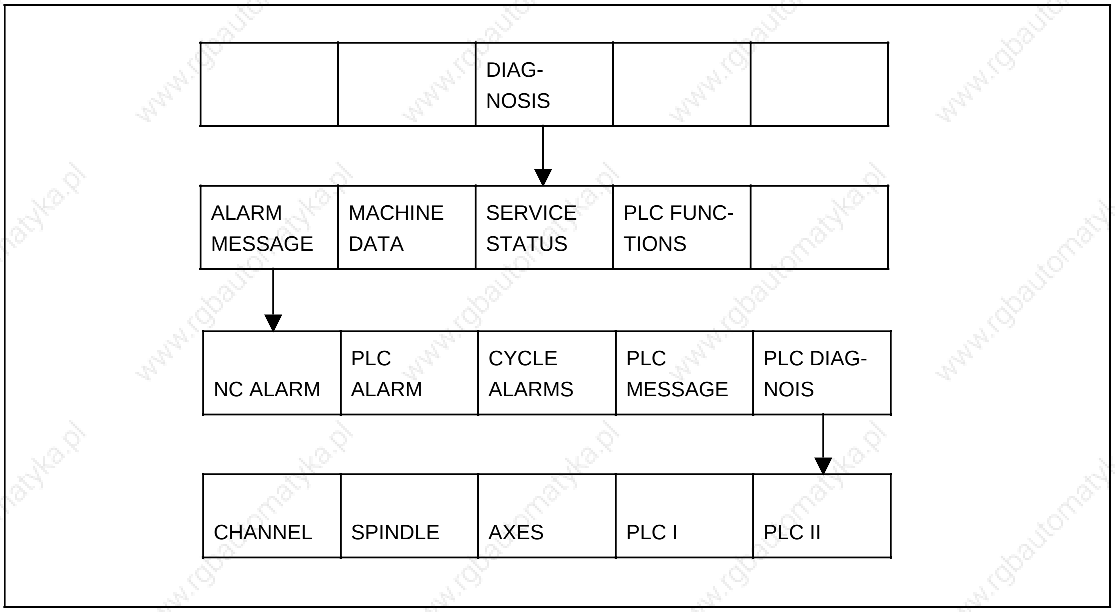
On the SINUMERIK 880, data from the NC, COM and PLC can be displayed on the screen. The display programs required for this purpose are implemented in the COM area, which has access to the relevant NC or PLC data by means of data drivers.

The following PLC displays are included in the 880 System **as standard:**

- Status display
- Error messages
- Operational messages
- Message group displays



Structure of display programs



Menu tree for display programs

The depicted menu tree shows how the standard displays can be activated.

In addition to the standard displays, **any other** displays required can be compiled on the NC workstation and added to the NC menu tree. These images can access any NC, COM or PLC data.

No function blocks have to be loaded in the PLC for the required data transfers; these are executed by the PLC operating system. However, function blocks FB 17, FB 45 - FB 51 and FB 54 - FB 59 (FB package 0) are needed for message displays. They must simply be loaded in the control and called in the user program.

The necessary "display descriptions" are stored in the **u**ser **m**emory **s**ubmodule (UMS) of the COM CPU.

19.2 PLC status display

Any PLC variables (I, Q, F, T, C, DW) can be displayed and altered with the PLC status display. Statuses can be displayed as either a word or an individual bit. In the case of word displays, the content can be displayed either bit by bit, as a fixed-point number or as a hexadecimal number. Variables to be displayed are selected on the operator panel keyboard.

Operation:

See SINUMERIK 880 Operator's Guide.

19.3 Messages

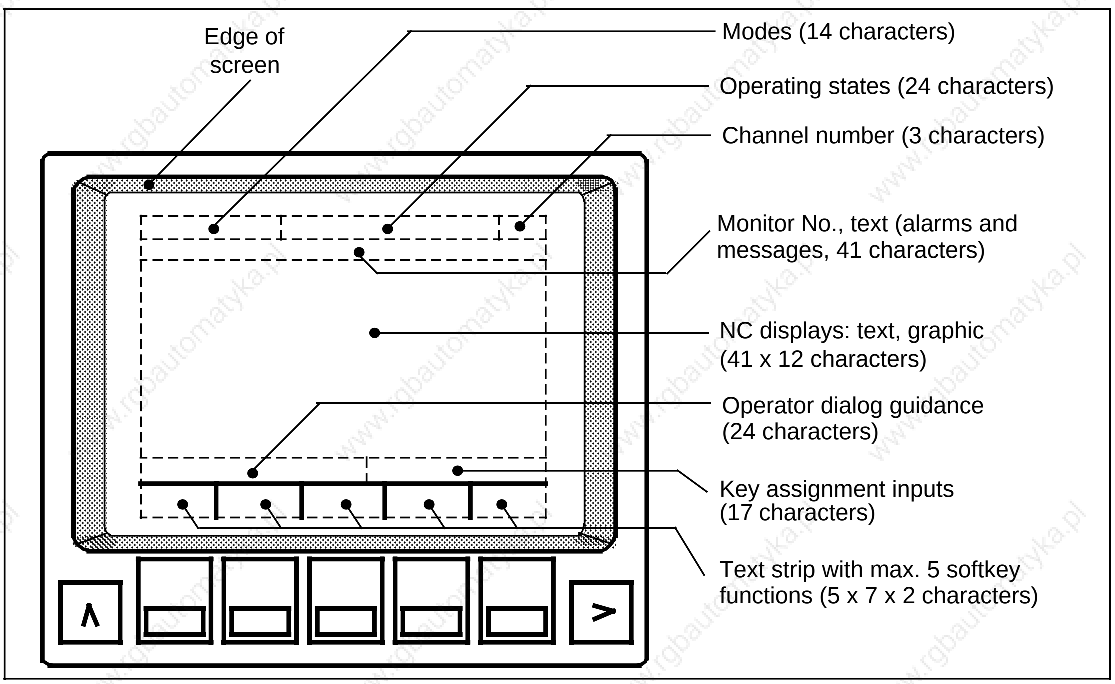
Note:

The basic principles that apply to messages are also described in the "Display of messages" Section.

To display messages on the SINUMERIK 880, the function blocks for message display (FB package 0) must be loaded in the PLC and called in the PLC user program. As they occur, NC and PLC messages are displayed in the alarm line of the NC screen (line 2) when the display is enabled by an interface signal. If several messages are present at the same time, only the one with the highest priority, according to the following list, is displayed

- NC alarm
- PLC error message
- PLC operational message
- NC message

Messages not appearing in the alarm line can be displayed on the screen by operating the appropriate softkeys or paged through in the message line by setting the PAGE DISPLAY IN MESSAGE LINE bit (in the user program, e.g. with clock frequency or keys "V" and "**/**", DB 40, DL 3).



NC display layout

As far as the display concept is concerned, a differentiation is made between three types of display:

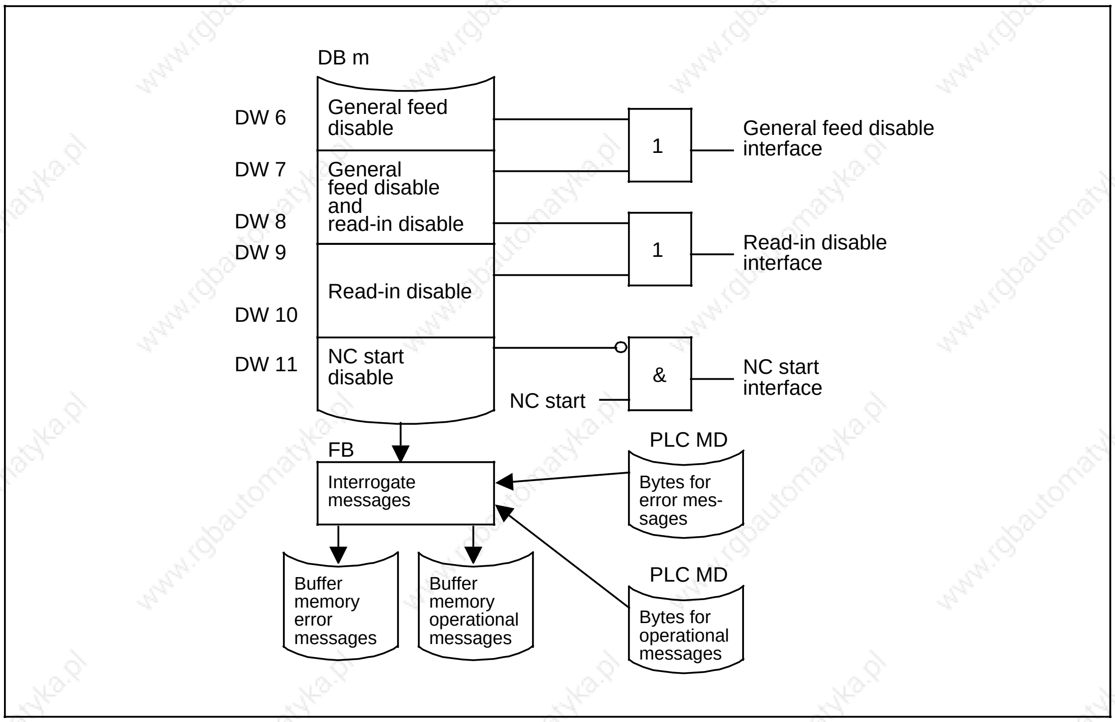
- PLC error messages
- PLC operational messages
- PLC message groups

Several bit fields are available to detect the messages (Section 19.3.4):

- Channel-specific message bits (DB 10 to DB 25, DW 6 to DW 11, active channels only)
- Spindle-specific message bits (DB 31, DW K+3)
- Axis-specific message bits (DB 32, DW K+3)
- PLC-specific message bits (DB 58, DW 1 to DW 32)

The bit fields are allocated a dual function:

a) Actuation of NC functions (e.g. feed disable)
b) Actuation of messages



Channel-specific messages, dual function of message bits

The bit fields of inactive channels can also be used to initiate error or operational messages. The channels that are to be used additionally must be defined by the user by means of the PLC MD 6030 ... 6031.

Allocations to the group of

PLC error messages
PLC MD 6032 ... 6039 and 6080 ... 6083 (Option) for PLC I
PLC MD 6132 ... 6139 and 6180 ... 6183 (Option) for PLC II

or

PLC operational messages
PLC MD 6040 ... 6047 and 6084 ... 6087 (Option) for PLC I
PLC MD 6140 ... 6147 and 6184 ... 6187 (Option) for PLC II

can be made **byte by byte** in the bit fields by means of PLC machine data.

In addition, all the set bits of a bit field can be displayed by means of the bit field-specific message group display.

The bits of the bit fields that have **not** been declared as error or operational messages by the PLC machine data can also be shown in plain text in these displays.

The message texts must be made up with the NC workstation. They are stored in the user memory submodule of the COM CPU.

19.3.1 Error messages

On the SINUMERIK 880 a differentiation is made between error and operational messages.

The following figure shows the program and data structure for detecting and displaying error messages. In the user program the criteria representing a machine error, for example, are tested. The results of this "error detection" are stored in data blocks at defined locations; i.e. the bit permanently allocated to an error remains set for as long as the error exists.

Which bytes within the

• channel-specific	(DB 10 to 25,	DW 6 to 11)
• spindle-specific	(DB 31,	DW K+3)
• axis-specific	(DB 32,	DW K+3)
• PLC-specific	(DB 58,	DW 1 to 32)

bit fields of the ERROR MESSAGES INTERROGATION function block (FB 57, FB package 0) are to be analyzed for the occurrence of a new error is determined with the PLC machine data (example for PLC I):

6032 to 33	(error messages to NC channel)
6034	(error messages to spindle)
6035	(error message to axis)
6036 to 39	(error messages DB 58)
6080 to 83	(error messages DB 58, Option)

If a bit changes from 0 to 1, the corresponding message number (each bitis **explicitly** allocated a number) is entered in the buffer memory for error messages.

The buffer memory is common to PLC I and PLC II, a **total** of 44 entries can be made. An internal record is also kept of the fact that the error has been detected and entered in the buffer memory (DB acknowledgement signals).

Error messages are retained in the buffer memory until cancelled by ACKNOWLEDGE PLC ERROR MESSAGE (DB 58 DW 0, bit 9) (by the user program) or until the next warm restart.

19.3.2 Operational messages

The program and data structure is identical to that for error messages (see figure).

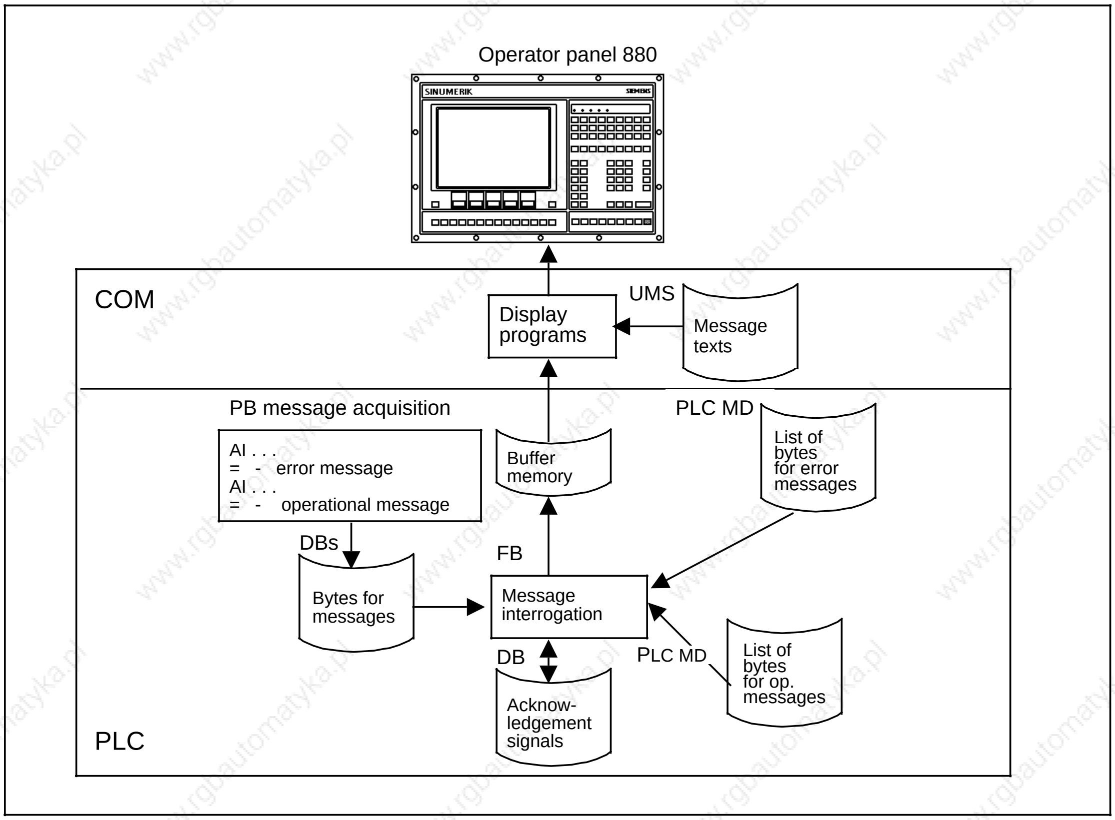
Which bytes within the

- channel-specific message bits (DB 10 to 25, DW 6 to11)
- spindle-specific message bits (DB 31 DW K+3)
- axis-specific message bits (DB 32 DW K+3)
- PLC-specific message bits (DB 58 DW 1 to 32)

bit fields of the OPERATIONAL MESSAGES INTERROGATION function block (FB 58, FB package 0) are to be analyzed for the occurrence of a new error is determined with the PLC machine data (example for PLC I):

6040 to 41	(operational messages to NC channel)
6042	(operational messages to spindle)
6043	(operational messages to axis)
6044 to 47	(operational messages DB 58)
6084 to 87	(operational messages DB 58, Option)

If a bit changes from 0 to 1, the corresponding numbers are entered in a separate buffer memory (44 entries for PLC I and PLC II together). In contrast to the error messages, however, not only the incoming but also the outgoing messages are detected, so that only current messages are entered in the buffer memory.



Detection and display of messages

19.3.3 Message groups

As well as error and operational messages, operator message groups can also be displayed. All the bits of the listed bit field are designated as message groups. To activate the display of message groups, FB 56 and FB 59 (FB package 0) have to be loaded in the control.

The following message groups are available on the SINUMERIK 880:

Message group	Message number	Bit field
Channels	6000 to 7595	DB 10, DW 6 to 11 DB 25, DW 6 to 11
Spindles	8000 to 8115	DB 31, DW 3, 7, 11, 15, 19, 23
Axes	8200 to 8675	DB 32, DW 3,7,11,15,19, 23, 27, DW 31, 35, 39, 43, 47, DW 51, 55, 59, 63, 67, DW 71, 75, 79, 83, 87, DW 91, 95
PLC I	9000 to 9997[1)]	DB 58 DW 1 to DL 32
PLC II	9000 to 9997[1)]	DB 58 DW 1 to DL 32

If the display of a message group is selected, **each** set bit is allocated a message irrespective of whether the MD error message, the MD operational message or neither of the two is set.

Example of application:

Display of operational messages that are not to be displayed in the message line (line 2 of the screen), e.g. GENERAL FEED DISABLE during a tool change.

This results in the following scope of displays:

PLC MD	Shown in mess. line	Shown in display		
		PLC alarm	PLC message	PLC message group
Error message	x	x		x
Operational message	x		x	x
–				x

Selection of message areas

The two PLC message groups PLC I and PLC II comprise a total of 4 message groups of 248 messages each. The 4 message areas are defined by parameterizing the PLC machine data bits 7044.0 to 3 (PLC I) and 7294.0 to 3 (PLC II). A maximum of 2 message areas can be selected per PLC. The message areas are freely assignable to the PLCs.

1) *The 496 messages available per PLC are divided into 4 message areas by PLC MD.*

PLC MD DW No.	Bit No.							
	7	6	5	4	3	2	1	0
7044 DL 37					Message area 4	Message area 3	Message area 2	Message area 1

With these bits the offset signal numbers are assigned to the message areas of DB 58.

Bit 0=1: Offset signal number m=9000
Bit 1=1: Offset signal number m=9250
Bit 2=1: Offset signal number m=9500
Bit 3=1: Offset signal number m=9750

Up to two message areas can be activated per PLC. The lower offset numbers are always assigned to message area DW 0 ... DW 16 first of all and the higher offset numbers to the message area DW 17 ... DW 32.

PLC I	PLC II
PLC-MD-Nr. 7044	PLC-MD-Nr. 7294

Example:

Message area	Message No.	PLC I	PLC II
1	9000...9247	X	
2	9250...9497		X
3	9500...9747	X	
4	9750...9997		X

The PLC machine data bits 7044 bits 0 and 2, and 7294 bits 1 and 3, must be set.

19.3.4 Bit fields for messages

With the detection of error and operational messages by

- FB 57 (interrogate error messages)
- FB 58 (interrogate operational messages)
- FB 59 (interrogate message groups)

the following data words of the interface DBs are interpreted. Each bit is explicitly allocated an error number which is shown in the corresponding displays in addition to the message text. The texts have to be input at the NC workstation. If no text has been entered, only the message number is displayed.

Table of error numbers and bit fields:

	Message number	Bit field	Address K
Channel 1	6000...6095	DB 10, DW 6...DW 11	
Channel 2	6100...6195	DB 11, DW 6...DW 11	
Channel 3	6200...6295	DB 12, DW 6...DW 11	
Channel 4	6300...6395	DB 13, DW 6...DW 11	
Channel 5	6400...6495	DB 14, DW 6...DW 11	
Channel 6	6500...6595	DB 15, DW 6...DW 11	
Channel 7	6600...6695	DB 16, DW 6...DW 11	
Channel 8	6700...6795	DB 17, DW 6...DW 11	
Channel 9	6800...6895	DB 18, DW 6...DW 11	
Channel 10	6900...6995	DB 19, DW 6...DW 11	
Channel 11	7000...7095	DB 20, DW 6...DW 11	
Channel 12	7100...6715	DB 21, DW 6...DW 11	
Channel 13	7200...7295	DB 22, DW 6...DW 11	
Channel 14	7300...7395	DB 23, DW 6...DW 11	
Channel 15	7400...7495	DB 24, DW 6...DW 11	
Channel 16	7500...7595	DB 25, DW 6...DW 11	
Spindle 1	8000...8015	DB 31, DW 3	0
Spindle 2	8020...8035	DB 31, DW 7	4
Spindle 3	8040...8055	DB 31, DW 11	8
Spindle 4	8060...8075	DB 31, DW 15	12
Spindle 5	8080...8095	DB 31, DW 19	16
Spindle 6	8100...8115	DB 31, DW 23	20
Axis 1	8200...8215	DB 32, DW 3	0
Axis 2	8220...8235	DB 32, DW 7	4
Axis 3	8240...8255	DB 32, DW 11	8
Axis 4	8260...8275	DB 32, DW 15	12
Axis 5	8280...8295	DB 32, DW 19	16
Axis 6	8300...8315	DB 32, DW 23	20
Axis 7	8320...8335	DB 32, DW 27	24
Axis 8	8340...8355	DB 32, DW 31	28
Axis 9	8360...8375	DB 32, DW 35	32
Axis 10	8380...8395	DB 32, DW 39	36
Axis 11	8400...8415	DB 32, DW 43	40
Axis 12	8420...8435	DB 32, DW 47	44
Axis 13	8440...8455	DB 32, DW 51	48
Axis 14	8460...8475	DB 32, DW 55	52
Axis 15	8480...8495	DB 32, DW 59	56
Axis 16	8500...8515	DB 32, DW 63	60
Axis 17	8520...8535	DB 32, DW 67	64
Axis 18	8540...8555	DB 32, DW 71	68
Axis 19	8560...8575	DB 32, DW 75	72
Axis 20	8580...8595	DB 32, DW 79	76
Axis 21	8600...8615	DB 32, DW 83	80
Axis 22	8620...8635	DB 32, DW 87	84
Axis 23	8640...8655	DB 32, DW 91	88
Axis 24	8660...8675	DB 32, DW 95	92
PLC I PLC II	9000...9997	DB 58, DW 1...DL 32 DB 58, DW 1...DL 32	

Structure of bit fields

General feed disable and read-in disable

Byte No.	15 / 7	14 / 6	13 / 5	12 / 4	11 / 3	10 / 2	9 / 1	8 / 0
	Bit No.							
DL 6	General feed disable							
	m+7	m+6	m+5	m+4	m+3	m+2	m+1	m+0
DR 6	General feed disable							
	m+15	m+14	m+13	m+12	m+11	m+10	m+9	m+8
DL 7	General feed disable and read-in disable							
	m+23	m+22	m+21	m+20	m+19	m+18	m+17	m+16
DR 7	General feed disable and read-in disable							
	m+31	m+30	m+29	m+28	m+27	m+26	m+25	m+24
DL 8	General feed disable and read-in disable							
	m+39	m+38	m+37	m+36	m+35	m+34	m+33	m+32
DR 8	General feed disable and read-in disable							
	m+47	m+46	m+45	m+44	m+43	m+42	m+41	m+40
DL 9	Read-in disable							
	m+55	m+54	m+53	m+52	m+51	m+50	m+49	m+48
DR 9	Read-in disable							
	m+63	m+62	m+61	m+60	m+59	m+58	m+57	m+56
DL 10	Read-in disable							
	m+71	m+70	m+69	m+68	m+67	m+66	m+65	m+64
DR 10	Read-in disable							
	m+79	m+78	m+77	m+76	m+75	m+74	m+73	m+72
DL 11	NC start disable							
	m+87	m+86	m+85	m+84	m+83	m+82	m+81	m+80
DR 11	NC start disable							
	m+95	m+94	m+93	m+92	m+91	m+90	m+89	m+88

Bit field for channel-specific messages (DB 10 to DB 25)

Message number m = 6000 + (channel number - 1) * 100.

Signals from spindle								
Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL K+3	Spindle disable							
	n+7	n+6	n+5	n+4	n+3	n+2	n+1	n+0
DR K+3	Spindle disable							
	n+15	n+14	n+13	n+12	n+11	n+10	n+9	n+8

Bit field for spindle-specific messages (DB 31)

Signals to axis								
Byte No.	15	14	13	12	11	10	9	8
	Bit No.							
	7	6	5	4	3	2	1	0
DL K+3	Feed disable							
	n+7	n+6	n+5	n+4	n+3	n+2	n+1	n+0
DR K+3	Feed disable							
	n+15	n+14	n+13	n+12	n+11	n+10	n+9	n+8

Bit field for axis-specific messages (DB 32)

Refer to the table of error numbers for the value of "K".

19.3.5 Assigned areas for messages

Emergency stop to NC

Byte No.	Bit No. 7	6	5	4	3	2	1	0
DL 1	Message m+ 7	6	5	4	3	2	1	0
DR 1	Message m+ 15	14	13	12	11	10	9	8
DL 2	Message m+ 23	22	21	20	19	18	17	16
DR 2	Message m+ 31	30	29	28	27	26	25	24

General messages

Byte No.	Bit No. 7	6	5	4	3	2	1	0
DL 3	Message m+ 39	38	37	36	35	34	33	32
DR 3	Message m+ 47	46	45	44	43	42	41	40
DL 4	Message m+ 55	54	53	52	51	50	49	48
. . .								
DL 31	Message m+ 481	480	479	478	477	476	475	474
DR 31	Message m+ 489	488	487	486	485	484	483	482
DL 32	Message m+ 497	496	495	494	493	492	491	490

Bit field for general messages (DB 58)

19.3.6 PLC machine data for messages

PLC machine data are used to determine whether a message byte of the stated bit fields is to be treated as an error or operational message. If a message is not to be displayed as either an error or operational message, display is still possible via PLC MESSAGE GROUP. Message bytes can be treated in accordance with the following settings:

	PLC machine data for error messages	
	PLC I	PLC II
Channels	6032 6033	6132 6133
Spindles	6034	6134
Axes	6035	6135
General messages	6036 to 6039, 6080 to 6083	6136 to 6139, 6180 to 6183

	PLC machine data for operational messages	
	PLC I	PLC II
Channels	6040 6041	6140 6141
Spindles	6042	6142
Axes	6043	6143
General messages	6044 to 6047, 6084 to 6087	6144 to 6147, 6184 to 6187

The machine data for messages can be determined differently in PLC I and PLC II.

Example:

Setting channel-specific messages for NC channels (DB 10 ... DB 25) of PLC I.

Interface byte	Functions	Message No.	Message type	PLC MD
DL 6	General feed disable	6000...6007	Error messages	6032.0
DR 6		6008...6015		
DL 7	General feed disable and read-in disable	6016...6023	Operational message	6040.2
DR 7		6024...6031		
DL 8		6032...6039	Error messages	6032.4
DR 8		6040...6047		
DL 9	Read-in disable	6048...6055		
DR 9		6056...6063	Operational message	6040.7
DL 10		6064...6071		
DR 10		6072...6079	Error messages	6033.1
DL 11	NC start disable	6080...6087	Error messages	6033.2
DR 11		6086...6095		

19.3.7 Message texts

Each message number can be allocated a text with the NC workstation for display in the alarm line of the NC screen or in the PLC alarm, PLC message and PLC message group displays when the relevant error occurs.

Texts are stored in the user memory submodule of the COM CPU.

MODE: ALARM TEXTS FILE: ALARMT1. B
MASK: INPUT IDENT: XXX MACH1..880T 01

ALARM CLASS : 11 INPUT RANGE : 9000 - 9247

TEXT NUMBER : 9032
TEXT : START.COND.F.SEQ.CASC.MISSING

f1
HELP

f1	f2	f3	f4	f5	f6	f7	f8 END

Example of error text compilation with NC workstation

19.4 Message signals interface (DB 58)

ACKNOWLEDGE NC EMERGENCY	**DW 0, bit 15**

1 signal: EMERGENCY STOP acknowledged to the NC
0 signal: No effect

Note:

- ACKNOWLEDGE NC EMERGENCY STOP affects **all** NC channels when NC IN EMERGENCY STOP STATE is present.
- ACKNOWLEDGE NC EMERGENCY STOP can generally be effected with the RESET key (must be implemented by user).
- The signal is static. If this signal is set while you are remedying the cause of error the EMERGENCY OFF state of the control is acknowledged.

DISPLAY IN MESSAGE LINE ERROR MESSAGES	**DW 0, bit 13**

1 signal: The first error message of the buffer memory for error messages is entered in the message line (line 2 of the screen).
0 signal: No error messages are entered in the message line (line 2 of the screen).

Note:

The bit is interpreted in PLC I only.

DISPLAY IN MESSAGE LINE OPERATIONAL MESSAGES	**DW 0, bit 12**

1 signal: The first operational message of the buffer memory for operational messages is entered in the message line (line 2 of the screen).
0 signal: No operational messages are entered in the message line (line 2 of the screen).

Note:

- The bit is interpreted in PLC I only.
- If the display bits for error and operational messages are set, the error messages have a higher priority. Even if the display in the message line is not selected, current error and operational messages are still shown in the displays selected by softkeys.

PAGE DISPLAY IN MESSAGE LINE	**DW 0, bit 11**

1 signal: With each 0 1 transition, the address of the buffer memory for the display in the message line is increased by 1. This enables all current messages to be displayed in the message line as well.

If the DISPLAY IN MESSAGE LINE: ERROR MESSAGES and DISPLAY IN MESSAGE LINE: OPERATIONAL MESSAGES signals are set, only error messages are displayed.

A 1 0 transition of these signals resets the pointer.

0 signal: No paging in the message line.

Note:

The bit is interpreted in PLC I only.

ACKNOWLEDGE PLC ERROR MESSAGE	**DW 0, bit 9**

1 signal: On every 0 1 transition, the buffer memory for PLC error messages is erased. The dynamic signal of the ACKNOWLEDGE ALARMS key (DB 40, D4.10) can be used to do this.

0 signal: No effect.

Note:

The bit is interpreted in PLC I only.

NC IN EMERGENCY STOP STATE	**DW 0, bit 7**

1 signal: After EMERGENCY STOP TO NC.

0 signal: After ACKNOWLEDGE EMERGENCY STOP.

PLC EMERGENCY STOP MESSAGE	**DW 0, bit 2**

1 signal: At least one EMERGENCY STOP TO NC signal is present.

0 signal: No EMERGENCY STOP TO NC signal is present.

Note:

The bit is output separately for PLC I and PLC II.

PLC ERROR MESSAGE	DW 0, bit 1

1 signal: At least one error message is entered in the buffer memory.
0 signal: No error number in buffer memory.

Note:

The buffer memory is common to PLC I and PLC II. Several PLC cycles (max. 31) can be executed between the bit that triggers a message being set and entry being made in the buffer memory. The duration depends on how many bytes have been defined as error messages by PLC machine data.

PLC OPERATIONAL MESSAGE	DW 0, bit 0

1 signal: At least one operational message is entered in the buffer memory.
0 signal: No operational message signal is entered in the buffer memory.

Note:

The buffer memory is common to PLC I and PLC II. Several PLC cycles (max. 31) can be executed between the bit that triggers a message being set and entry being made in the buffer memory. The duration depends on how many bytes have been defined as operational messages by PLC machine data.

Examples of application:

- Activation of an indicator lamp in the event of EMERGENCY STOP or errors.
- Interlocks in the PLC should an error occur.

EMERGENCY STOP TO NC — DW 1, DW 2

1 signal:
a) EMERGENCY STOP reported to the NC. The removal of all signals must be reported to the NC with ACKNOWLEDGE EMERGENCY STOP.
b) Entry in the buffer memory for error and/or operational messages if the relevant PLC machine data is set.

0 signal:
a) No EMERGENCY STOP reported to the NC.
b) Removal from the buffer memory for messages if the relevant PLC machine data is set.

Notes:

- The 1 signal effects rapid braking of the feed drives and spindle drive with max. braking current. After expiry of the time set by machine data, the position control loop is opened and the NC assumes follow-up operation. This ensures that the actual position values are retained even in the EMERGENCY STOP state of the control.
- The controllers for the feed and spindle drives should remain connected to the power until the braking procedure has been completed.
- If the NC was not disconnected from the power supply in the EMERGENCY STOP state, the axes do **not** have to be resynchronized (no approach to reference point) after the EMERGENCY STOP state has been removed.

MESSAGES — DW 3 to DW 32

1 signal: Entry in the buffer memory for error and/or operational messages if the relevant PLC machine data is set.

0 signal: Removal from the buffer memory for operational messages if the relevant PLC machine data is set. The buffer memory for error messages is erased by ACKNOWLEDGE PLC ERROR MESSAGES.

20 Error List with System Stop

The parameters for the PLC operating system (PLC machine data) and the direct parameters of the function blocks are checked for their admissibility in the function blocks for the SINUMERIK 880 - in particular when switching on. In the event of serious errors being identified that would lead to improper control reactions, the PLC assumes the STOP state with STS (system stop).

In the stop state the INTERRUPT STACK can be read out using the PG 685/750. The user can identify the cause of the error from the second interrupt stack display.

If STS is stated in the interrupt stack display as the cause of the fault and the block number is the same as ACCU 1, the STOP has been caused by a parameterization error.

Interrupt stack 1)

```
PLC INFORMATION ISTACK

DEPTH:      01

BEF-REG:   3D0B    SAZ (new):32AD1   DB-ADR:    00000   BR-ADR:  32ABD
BST-STP:  00009    OB-NR.r:     20   DB-NR.:            FB-NR.:    254
AKT                REL-SAZ:  00001   DBL-REG:       0   BEF-Z:
OB-NR.:      20    BEF-Z:

ACCU1:  0000 0011  ACCU2:  0000 0004  ERRCODE:  00FF 0000 1400 0000

RESULT CON. CODES:  CC1     CC0     OVFL    OVFLS   ODER    ERAB
                                                              X
                    STATUS  VKE


CAUSES OF FAULT:    KB      KDB     TRAF    SUF     STUEB   STUEU

                    NAU     QVZ     ADF     ZYK     WEFE    PEU
```

Example of interrupt stack display

In the example, error 04 is set in FB 11. As described in the following table, this error indicates that the length of the data block being set up does not correspond to the length of the data block that already exists in the PLC.

The following table lists the currently available error messages. Note that the list is comprehensive only for the function macros of the PLC operating system (FB overview). If accumulator identifiers are found in the interrupt stack that are not listed in the table, the relevant error descriptions can be found in the data sheets of the block.

Also note that the BLOCK STACK is often required for a comprehensive error analysis.

If advice is needed in the event of errors being found, e.g. in consultation with a branch office, all the data of the INTERRUPT STACK and, where possible of the BLOCK STACK, will be required.

1) *If using a SIMATIC S5-155U, refer to SINUMERIK 880 with S5-155U, Difference Description to PLC 135 WB in this context.*

Accu 1 (FB No.)	Accu 2 (E No.)	Error locat. Error description
11		Setting up data blocks
	1	DB 2, 3, 4 already in KOPSEG
	2	DB No. > 255
	3	Stated DW No. < 0
	4	Length of DB being set up not same as length of DB already in programmable controller
	5	Inadequate memory space in programmable controller
	6	Stated DW No. > 2042
	7	DB 0 cannot be set up
	8	Data block type different from DB or DX
60		Block transfer
	1	No. of DWs to be transferred > 127
	2	No. of DWs to be transferred = 0
	3	Source DB/DX missing
	4	Destination DB/DX missing
	5	Destination DB/DX too short
	6	Destination DB/DX in EPROM
	7	Source DB/DX too short
	8	Parameter TYQU incorrect
	9	Parameter TYZ1 incorrect
61/62		Reading/writing NC data
	v0	NO. > 1 is inadmissible
	v1	Interface byte inadmissible
	v2	Addressed data word missing DB/DX miss. or DB No./DX No. in link RAM or FW No. inadmissible
	v3	Data type inadmissible
	v4	NO. < 0 or > 128
	v5	Reading inadmissible/writing inadmissible
	v6	Number format inadmissible
	v7	Val. 3 for ZOA or ZOFA not equal to 0 or 1 respectively
	v8	Type of data dest. or data source in the PLC inadmissible
63/64		Reading/writing PLC data
	v1	Non-compliance with parameter limits
	v2	Destination DB/DX too short (FB 63) or source DB/DX too short (FB 64) or DB/DX missing or in link RAM
	v3	Parameter limit of input or output area exceeded
		Parameter limit of flag area exceeded
	v4	Incorrect interface byte (accu 2 high-order byte = 0)
	v5	Incorrect data type of source
	v6	Number < 0 or > 256
	v7	Source DB/DX too short (FB 63) or destination DB/DX
	v8	too short (FB 64) or DB/DX missing or in link RAM
		Incorrect data type of destination
	v9	Incorrect PCNO
	v12	

v: The high-order byte of accumulator 2 contains the job number in which the error occurred.

Accu1 (FB No.)	Accu2 (E No.)	Error locat. Error description
65		Transfer flag to flag stack
	1	Stack point overflow on flag entry
66		Flag stack to transfer flag
	1	Stack point overflow on flag removal
67		Transfer machine control panel signals > DB axes
	1	"Signals from/to axis" PLC machine data not set
	2	Axis number > 24
68		Aperiodic program call
	1	Tool parameter is less than 0
69		G decoding
	1	Channel number inadmissible
	2	Incorrect G group
	3	PLC MD signals from/to NC channel or signals from NC channel not set
70/71		Transfer interface DB to I/Q/F (FB 70) or transfer I/Q/F to interface DB (FB 71)
	1	Incorrect source or destination type (inadmissible ASCII character)
	2	Source DB not in programmable controller
	3	Non-compliance with parameter limits
	4	Source or destination DB too short
	5	Parameter limit of flag area exceeded (No. of DWs too great)
	6	Limit of input or output process image exceeded
	7	Source or destination parameter type inadmissible (not I/Q/F)
72		Transfer NC channel to DB channel-specific signals
	1	Channel address inadmissible
73		Transfer DB channel-specific signals to NC channel
	1	Channel address inadmissible
74		Transfer spindle to DB spindle-specific signals
	1	Spindle address inadmissible
75		Transfer DB spindle-specific signals to spindle
	1	Spindle address inadmissible
76		Transfer axis to DB axis-specific signals
	1	Axis address inadmissible
77		Transfer DB axis-specific signals to axis
	1	Axis address inadmissible

Accu1 (FB No.)	Accu2 (E No.)	Error locat. Error description
78		Transfer softkey selection and machine control panel signals to channels/spindles
	1	PLC machine data for signals from/to channel not set
	2	PLC machine data for signals from/to spindle not set
	3	Parameterized channel No. > 16 or spindle No. > 6
79		Transfer machine control panel signals DB axes
	1	Transfer machine control panel signals DB axes
	2	PLC machine data for signals from/to axis not set No. of parameterized axes > 24
89		Reading block initial address
	1	Designation of block type not known
	2	Address list not available
	3	Address list not sufficient
91		Sequential controller forwards/backwards
	1	SB or error step number not in PLC (i.e. branch to impermissible sequence)
92		Sequential controller automatic
	1	SB or error step number not in PLC (i.e. branch to impermissible sequence)
93		Sequential controller forwards/backwards Graph 5
	1	Sequential controller forwards/backwards Graph 5 No. of parameterized SB outside permissible range (range 150 SB No. 255)
	2	Parameterized SB not in PLC
	3	Parameterized SB not compiled with Graph 5
	4	INIT step definition not step 1
	5	DB (SB No. + 1) missing in PLC
	6	No. of parameterized diagnostics DB outside permissible range (range 150 SB No. 255)
	7	Diagnostics DB missing in PLC
94		Sequential controller automatic Graph 5
	1	No. of parameterized SB outside permissible range (range 150 SB No. 255)
	2	Parameterized SB not in PLC
	3	Parameterized SB not compiled with Graph 5
	4	Step 1 not defined as INIT sequence
	5	INIT step definition not sequence 1
	6	No. of parameterized diagnostics DB outside permissible range (range 150 SB No. 255)
	7	Diagnostics DB missing in PLC

21 Terms and Abbreviations

880M	SINUMERIK 880 version for milling
880N	SINUMERIK 880 version for nibbling
880T	SINUMERIK 880 version for turning
@	See Programming Guide for SINUMERIK 880, own documentation
*****	A signal marked with on asterisk (*) is 0 active.
Alarm byte	Input byte whose signals (bits) are monitored specifically for edge changes. Edge changes in alarm bytes can trigger program interrupts (see Section 1).
AUT	NC mode
Axis-specific	Separate for each axis of the machine
Basic signals	Selection of signals in the flag area; see Sections 3.1 and 4
BCD	Abbreviation for binary coded decimal; data format for storing decimal numbers
Binary	Binary data format
Block	Software unit in the NC part program
Block preparation function	Prepares the part program blocks for interpretation by the block decoding logic in the NC channel
Cancel	Clearing function (operation)
CC	Abbreviation for central controller
Central controller	Subrack for the printed circuit boards of the SINUMERIK 880; available in various sizes. Generally accommodates link RAM, NC, servo, COM and PLC CPUs with the I/Os required in each case (e.g. memory modules, I/O modules, interface for distributed I/Os etc.).
Central I/Os	I/Os in the central controller
Channel-specific	Separate for each NC channel of the control
CL 800	Programming language for cycles
Cold restart	PLC startup with system reinitialization, e.g. after overall reset of machine data. Different from warm restart.

COM	Communication, communication area or communication CPU of the SINUMERIK 880
Command channel	Interface between the PLC and NC; here the PLC can initiate functions on the NC and transfer user data (parameters) at the same time. The command channel comprises 8 user interfaces so that a maximum of 8 functions can be initiated on the NC more or less simultaneously (see Section 1 UI).
Communication area	Area of the SINUMERIK 880 responsible for communication of the control with the user, host computer etc. (see Section 1)
Configuration	Compilation of user-specific operations or cycles for a control with the WS 800 workstation. The configured operation (e.g. messages, menus) or cycles are stored in the UMS.
CPU	Central processing unit, the actual computer for a specific area. Example: NC CPU.
CU	Abbreviation for copper cable
Cycles	Parameterizable subroutines for NC part programs
DAC	Abbreviation for digital-analog converter
Data block	Block of data and/or signals. The data blocks are numbered as a means of differentiation. There are two equivalent categories of data blocks: DB and DX. See "PLC 135 WB Planning Guide", own documentation, for further details.
DB	Abbreviation for data block
DEC	Abbreviation for block decoding in an NC channel
Def.	Abbreviation for definition
DL	Abbreviation for the left data byte of a data word; this is the higher-order data byte of the data word
DMP	Abbreviation for distributed machine peripherals (I/Os), designates signals connected directly to the machine by means of special I/O modules (EU, DMP submodu-le). Counterparts: central machine I/Os, connected directly to the central controller by I/O modules.
DMP submodule	Module for connecting machine signals. DMP submodules have their own MPC interface that allows them to be con-nected directly together and to the central controller. Counterparts: I/O modules in the central controller or in EUs, I/O submodules at the operator panel (see Section 1).

DR	Abbreviation for the right data byte of a data word; this is the lower-order data byte of the data word.
DRF	Abbreviation for differential resolver function, interface for handwheels
DW	Abbreviation for data word
DX	Category of data block
Dynamic signal	Signal that is reset by the PLC operating system at the end of the cycle
ELG	Abbreviation for electronic gearbox
EM	Abbreviation for entry menu
Emergency stop	Deactivation of all NC functions by the user in an emergency by means of a special EMERGENCY STOP switch
EU	Abbreviation for expansion unit
Expansion unit	Subrack for I/O modules that are not inserted in the central controller. SINUMERIK expansion units (EUs) have a serial interface to the central controller, SIMATIC EUs can be interfaced to the central controller with a parallel port subject to certain preconditions (see Section 1).
F word	Word (parameter) in the part program that specifies a feedrate
FB	Abbreviation for function block
FB package	Package of function blocks. Contains several preconfigured function blocks with associated functions. The FBs from FB packages are loaded in the PLC when required and can then be called by the PLC program.
Feedrate override	Change of specified feedrate
FIFO	First in, first out; designates a software queue for jobs or data
File transfer (FTR)	Data transfer between host computer and NC
Fixed-point number	Number format; see "PLC 135 WB Planning Guide", own documentation
Flag area	Bit-addressable memory area used for temporary (dynamic) and retentive flags. Parts of the memory area are saved in a kind of stack in the event of program interrupts.
Flag word	Two consecutive bytes in the flag area, starting at an even address

Function block	Parameterizable program block of the PLC program. The FBs which the user can compile himself are complemented by preconfigured FBs which are either already integrated in the PLC operating system as function macros or can be downloaded from FB packages.
Function macro	Function block integrated in the PLC operating system. Separate documentation is available for the function macros.
FW	Abbreviation for flag word
FY	Abbreviation for flag byte, a byte in the flag area that can be addressed bit by bit (see Section 1)
G functions	Functions in the part program that specify preparatory functions for workpiece machining
G33	Thread cutting, constant lead (preparatory function)
General reset	Overall reset
Global I/Os	I/Os accessible to both PLCs (indirectly where applicable); see Section 1
Handwheel	Operator device for manual input of axis movements
I stack	Interrupt stack used, among other things, for analyzing malfunctions; can be evaluated by a programmer
I submodule	Input submodule, for connecting input signals to the operator panel, e.g. for signals from the machine control panel and its expansions
I/O group	8 bytes of the I/O address area
I/O modules	Modules for connecting machine signals to the operator panel
I/O submodule	Submodule for connecting input and output signals to the operator panel (I submodule; see Section 1)
I/Os	General term for machine signals or I/O modules, EUs, DMPs, I/O submodules for connecting machine signals
I/Q/F area	Combination of input area, output area and flag area. They share the characteristic of being addressable bit by bit and not located in data blocks.
IAR	German abbreviation for integrated drive control
IB	Input byte, byte in input area, in which input signals are depicted. Can be addressed bit by bit.

INCR NC mode

INT-EU/MPC Interface module for MPC bus, inserted in the central controller

Interface signal Individual bit or data that can be evaluated or modified by the PLC user program. Serves as a user interface to a separate SINUMERIK 880 unit, e.g. an NC channel, the operator panel or another PLC CPU. The interface signals are located in data blocks or the I/Q/F areas.

Interpolator The interpolator calculates the path points for machining the workpiece until the destination point programmed in the part program. The programmed preparatory functions are taken into account. Each NC channel has its own interpolator.

JOG NC mode

KF Number format, decimal fixed-point number (binary signed)

$K_Ü$ factor Speed ratio

K_V factor Servo gain factor

KY Number format, byte

Link bus Bus in the central controller which links the individual CPUs of the separate areas (NC, PLC, COM) to the link RAM

Link RAM Memory area used for communication between the NC, COM and PLC areas. Located on a memory module on the link bus which can be accessed by the CPUs of the NC, COM and PLC areas (dualport or multiport RAM).

Local bus Bus in the central controller which links the individual CPUs to the modules to which only the CPU concerned has access

Local I/Os I/Os accessible via the local bus of the PLC; see Section 1

Logical partner; peer See Computer Link documentation

M decoding PLC mechanism which influences the M signals in the PLC according to the M functions contained in the part program

M function Miscellaneous function for NC part programs. Some M functions have fixed meanings, others can be freely defined.

M signal Signal in data blocks which is influenced by M functions contained in the NC part program

M word Word (parameter) in the part program for a miscellaneous function

m, n, x	These letters are often used in tables as block indices. They indicate an address offset that depends on the axis or spindle number, for example. The values for the applicable address offsets are generally stated underneath the relevant table or at the end of the Section concerned.
M00	Miscellaneous function in the part program; program stop (unconditional)
M01	Miscellaneous function in the part program; optional stop (conditional)
M02	Miscellaneous function in the part program; end of program
M03	Miscellaneous function in the part program; spindle rotation clockwise
M04	Miscellaneous function in the part program; spindle rotation counter-clockwise
M05	Miscellaneous function in the part program; spindle off (without orientation)
M17	End of subroutine
M19	Miscellaneous function in the part program; oriented spindle stop (M19 can also effect an oriented spindle stop over several revolutions; incremental positioning)
M30	End of program
M36	Feedrate ratio 1:100
M37	Feedrate 1:1 (initial setting)
Main block	Program block in the NC part program. The program blocks in the part program are classified hierarchically as main blocks and subblocks.
MD	Abbreviation for machine data
MD 123*	General notation for machine data available separately for each axis or spindle, for example. The asterisk " * " stands for the number of the axis or spindle concerned.
MDA	NC mode
Measuring circuit	Unit in the NC area; obtains partial setpoints from the interpolator and supplies the interpolator with partial actual values for one drive (axis or spindle)
Menu	Function or data-related structure of screen representation
Mini EU	Small version of an expansion unit
Mode	Abbreviation for operating mode
Mode group	Combination of NC channels that always operate in the same mode (also see Section 1)

MPC	Abbreviation for multipoint controller, interface to a serial (MPC) bus. Used in the SINUMERIK 880, for instance, to connect the operator panel to the COM CPU and for linking EUs to the central controller.
MPF	Abbreviation for main program file, designates a memory area in the NC for part programs
Multiport RAM	A type of memory module with the link RAM
NC	Numerical control. Often used in this publication to refer to the NC area (or the NC CPU) of the SINUMERIK 880 (see Section 1, General Overview).
NC channel	The NC area of the SINUMERIK 880 comprises NC channels. The principal components of each NC channel are a block preparation function for part programs, an interpolator and an interface to the PLC
NC part program	Part program
Normal mode	Mode of the PLC CPU in which the PLC program can be interrupted only at block limits. For this reason hardware interrupts, for example, cannot be processed in the normal mode (see "PLC 135 WB Planning Guide", own documentation)
OB	Abbreviation for organization block
Operator panel I/Os	Machine signals connected to the operator panel by I/O submodules (see Section 1)
Option	Supplement to the standard functionality of the SINUMERIK 880
Overall reset	Reset of all editable memory areas, combined with the entry of fixed initial values where applicable (also "general reset")
Part program	Program for the numerical control, for machining the workpiece with the controlled machine
PB	Abbreviation for program block
PCB	Module for installation in the central controller or in an expansion unit
Peripheral byte	A byte of the I/O address area. The I/O address area accommodates the input and output signals; also see PII, PIQ
Peripheral word	A word (two consecutive bytes, starting with an even address) in the I/O area; see peripheral byte
PII	Abbreviation for process input image (see Section 1)

PIQ	Abbreviation for process output image (see Section 1)
PLC	Programmable logic control, the interface control of the SINUMERIK to the machine in question (see Section 1, General Overview)
PLC user program	Program for the PLC which adapts the SINUMERIK 880 to the machine concerned. It is compiled by the user (= machine manufacturer); see Section 1. Programming languages: Step 5 (in various forms of representation) or a high-level language of the HLL interface (see "PLC 135 WB Planning Guide", "HLL Programming", own documentation)
Power Off	Switching off the NC, especially power failure
Power On	Switching on the NC, especially return of supply after a power failure
PP	Abbreviation for part program
PRESET	NC mode
Process alarm byte	Alarm byte
Process image	Depiction of the machine signals in the bit-serial addressable I/O area (see Section 1)
PW	Abbreviation for peripheral word
QB	Output byte, byte in output area, in which output signals are depicted. Can be addressed bit by bit (see Section 1).
QW	Output word, 2 consecutive QBs, starting at an even address
R parameter	Parameter (variable) in the part program
RAM	Random access memory from which data can be read and into which data can be written
Rapid (traverse) override	Change of feedrate specified for rapid traverse
Rapid traverse	Accelerated travel movement of an axis
REF	NC mode
Reference point	Reference point on the machine for the measuring system

Reorg	Abbreviation for the function that reorganizes the part program memory
REPOS	NC mode
RESET	NC mode
RPA	Abbreviation for R parameter active, designates a memory area in the NC for R parameter numbers (value assignment)
RS 232 C	Serial interface according to RS 232 C standard
RS 422 C	Serial interface according to RS 422 C standard
SB	Abbreviation for sequence block
SEA	Abbreviation for setting data active, designates the memory area for setting data in the NC
Sequence block	Program block with specified structure; especially suitable for programming sequence-oriented procedures (see "PLC 135 WB Planning Guide" and "Step 5 Language Description")
Setting data	Setting data determine operating states (like machine data). Unlike machine data, however, setting data are not protected by codewords. They can be changed by the operator. Examples: setting data for zero offsets, scalings, speed limitations.
SI	Abbreviation for self-installation (with IAR)
Signal	Often used as an equivalent term for bit
SIMATIC	Siemens process control system
SINEC H1	Registered designation for an industrial LAN for linking computers, e.g. a host computer and an NC
Softkey	Key underneath the operator panel screen with programmable assignment
Special mode	Mode of the PLC CPU in which hardware interrupts can be processed. The current program can generally be interrupted after every Step 5 command (see "PLC 135 WB Planning Guide", own documentation).
Speed override	Change of specified speed
SPF	Abbreviation for subprogram file, designates a memory area in the NC for part program subroutines
Spindle-specific	Separate for each spindle of the machine

Static signal	A signal that cannot be influenced, especially not reset, by the PLC operating system during normal operation (see dynamic signal)
STEP 5	Programming language
STL	Abbreviation for statement list, a form of representing Step 5 programs
Strobe	Signal (bit) that indicates the occurrence of an event
Subblock	Program block in the NC part program; see main block
T signal	Tool signal
TEA	Abbreviation for testing data active; refers to the machine data
Teach-in/playback	Input and execution mode for part programs
TO	Abbreviation for tool offset
TOA	Tool offset active, designates a memory area for tool offsets in the NC
T_C	Abbreviation for cycle time
UI	Abbreviation for user interface of the command channel
UMS	User memory submodule, for storing operations (e.g. menus, messages) and cycles configured by the user of the control for one specific machine (or machine type) or customer. Also see WS 800, CL 800, Section 1, General Overview.
User	Generally refers to the PLC user program or the machine manufacturer who compiles it
V.24	Serial interface standard, often used to designate the serial interface itself (same as RS 232 C)
Warm restart	When the power supply is connected, the PLC resumes the PLC user program at the point at which it was interrupted when switched off
WS 800	NC workstation for compiling user-specific operations or cycles for the SINUMERIK 880
XM	Abbreviation for exit menu
ZOA	Zero offset active, designates a memory area for zero offsets in the NC

22 Alphabetical List of Signal Names

Signal name	Signal	Description
ACCELERATION LIMITATION SYNCHRONOUS	3.6.2	7.3
ACCELERATION LIMITATION SYNCHRONOUS ACTIVE	3.6.2	7.2
ACCELERATION WARNING THRESHOLD REACHED	3.6.3.2	8.4
ACCELERATION WARNING THRESHOLD REACHED	3.6.2	7.2
ACCESS DISABLED	3.7	11.2.2
ACCU 1/2, LOW WORD[d)]	3.5	5.6
ACKNOWLEDGE ALARMS	3.9.1	13.2
ACKNOWLEDGE M19	3.6.3.1	8.3
ACKNOWLEDGE NC EMERGENCY STOP	3.13	19.4
ACKNOWLEDGE PLC ERROR MESSAGE	3.13	19.4
ACKNOWLEDGEMENT, FUNCTION RESULT VALID	3.9.3	13.3
ACTIVE MESSAGE OPERATOR PANEL	3.9.2	13.3
ACTIVATE NEW SPEED RATIO ($K_Ü$)	3.6.2 3.6.3.2	7.3 8.5
ACTUAL DIRECTION OF SPINDLE ROTATION CW	3.6.3.1	8.2
ACTUAL GEAR STAGE	3.6.3.1	8.3
ACTUAL VALUE DISPLAY	3.9.1	13.2
ACTUATE C AXIS OPERATION	3.6.3.1	8.3
ADDITIONAL ERROR DATA 1ST TO 4TH WORD	3.5	5.6
ADDITIONAL TIMEOUT IN OB 2 TO OB 7[d)]	3.5	5.6
ADDRESSING ERROR RECOGNITION	3.4	5.1
AUTOMATIC SI	3.4	5.4
AUTOMATICALLY CONTROLLED CORRECTION	3.6.3.2	8.4
AUTOMATICALLY CONTROLLED CORRECTION OF FA	3.6.2	7.2
AXIS DISABLE	3.6.4	9.3
AXIS SELECTION SWITCH	3.3.3	4.4
AXIS SELECTION SWITCH	3.3.2	4.2
BASIC SPEED	3.6.3.1	8.3
BATTERY FAULT	3.4	5.5

Signal name	Signal	Description
BLOCK NUMBER	3.9.5	13.5
BLOCK SEARCH ACTIVE	3.6.1.2	6.5.1
BLOCK SEARCH WITH CALCULATION	3.6.1.1	6.4.4
BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK	3.6.1.1	6.4.4
BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK SELECTED	3.6.1.2	6.5.2
BLOCK SEARCH WITH CALCULATION FROM LAST MAIN BLOCK WITHOUT ERROR	3.6.1.2	6.5.3
BLOCK SEARCH WITH CALCULATION SELECTED	3.6.1.2	6.5.2
BLOCK SEARCH WITH CALCULATION WITHOUT ERROR	3.6.1.2	6.5.3
CALCULATE NEW $K_{Ü}$	3.6.3.2	8.5
CALCULATE NEW $K_{Ü}$	3.6.2	7.3
CANCEL	3.9.1	13.2
CENTRE POSITION REACHED	3.6.2	7.2
CHANGE GEAR	3.6.3.1	8.2
CHANNEL NUMBER	3.9.4	13.4
CHANNEL NUMBER	3.6.3.1	8.3
CHANNEL NUMBER	3.8	12.1
CLEAR	3.9.1	13.2
COLD RESTART (OB 1...OB 7, OB 20)	3.4	5.1
COM CPU READY	3.4	5.4
COMPENSATING CONTROLLER ACTIVE	3.6.2	7.2
COMPENSATING CONTROLLER ON/OFF	3.6.2	7.3
CONTROL WITHOUT OPERATOR PANEL	3.11	15.1
COORDINATION ERROR	3.6.1.3	6.6.4
COUPLE MOTIN ACTIVE[d)]	3.6.1.2	6.5.1
CPU FAILURE	3.4	5.5
CURRENT OB NO.	3.4	5.1
CURRENT STROKE RATE	3.6.5	10.6
CYCLE DISABLE	3.11	15.1
CYCLIC SIGNALS FROM PLC	3.12.1	16.2
CYCLIC SIGNALS TO PLC	3.12.2	16.2

Signal name	Signal	Description
D MODIFICATION	3.6.1.3	6.3.3
D WORD	3.6.1.3	6.3.3
DATA GROUP BASE	3.9.5	13.5
DATA START INPUT	3.8	12.1
DATA START OUTPUT	3.8	12.1
DATA TRANSFER ASSIGNED	3.12.2	16.3.3
DATA TRANSFER ASSIGNED	3.7	11.2.2
DATA TRANSFER BUSY	3.12.2	16.3.3
DATA TRANSFER BUSY	3.7	11.2.2
DATA TRANSFER EFFECTED	3.12.1	16.3.2
DATA TRANSFER ENDED	3.12.2	16.3.3
DATA TRANSFER ENDED	3.7	11.2.2
DATA TRANSFER ENDED	3.8	12.1
DATA TRANSFER REQUESTED	3.7	11.2.2
DATA TRANSFER REQUESTED	3.12.2	16.3.3
DATA TYPE BASE	3.9.5	13.5
DATA TYPE CURSOR	3.9.5	13.5
DATA TYPE FOR DATA OUTPUT	3.8	12.1
DATA TYPE POINTER	3.9.5	13.5
DATA WORD NUMBER IN TARGET DB/DX[d)]	3.10	14.3
DATA WORD NUMBER IN USEFUL DATA DB/DX	3.10	14.3
DB/DX	3.10	14.3
DB/DX NUMBER BASE	3.9.5	13.5
DB/DX NUMBER POINTER	3.9.5	13.5
DECELERATION REFERENCE POINT APPROACH	3.6.4	9.3
DECODING SINGLE BLOCK	3.6.1.1	6.4.2
DECODING SINGLE BLOCK SELECTED	3.6.1.2	6.5.2
DEFINED ANGULAR OFFSET REACHED	3.6.3.2	8.4
DELETE DISTANCE TO GO	3.6.1.1	6.4.4
DELETE NUMBER OF SUBROUTINE PASSES	3.6.1.1	6.4.4
DIALOG TEXT NUMBER	3.9.3	13.3
DIRECTION KEYS	3.3.3	4.4

Signal name	Signal	Description
DIRECTION KEYS (X, Z, C)	3.3.1 3.3.3	4.1 4.3
DIRECTION KEYS 1	3.3.2	4.2
DISPLAY IN MESSAGE LINE ERROR MESSAGES	3.13	19.4
DISPLAY IN MESSAGE LINE OPERATIONAL MESSAGES	3.13	19.4
DISPLAYED CHANNEL FROM NC	3.9.4	13.4
DRF ACTIVE	3.6.1.1	6.4.1
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c) up to and including software version 6
d) with GA2, software version 1 and higher

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