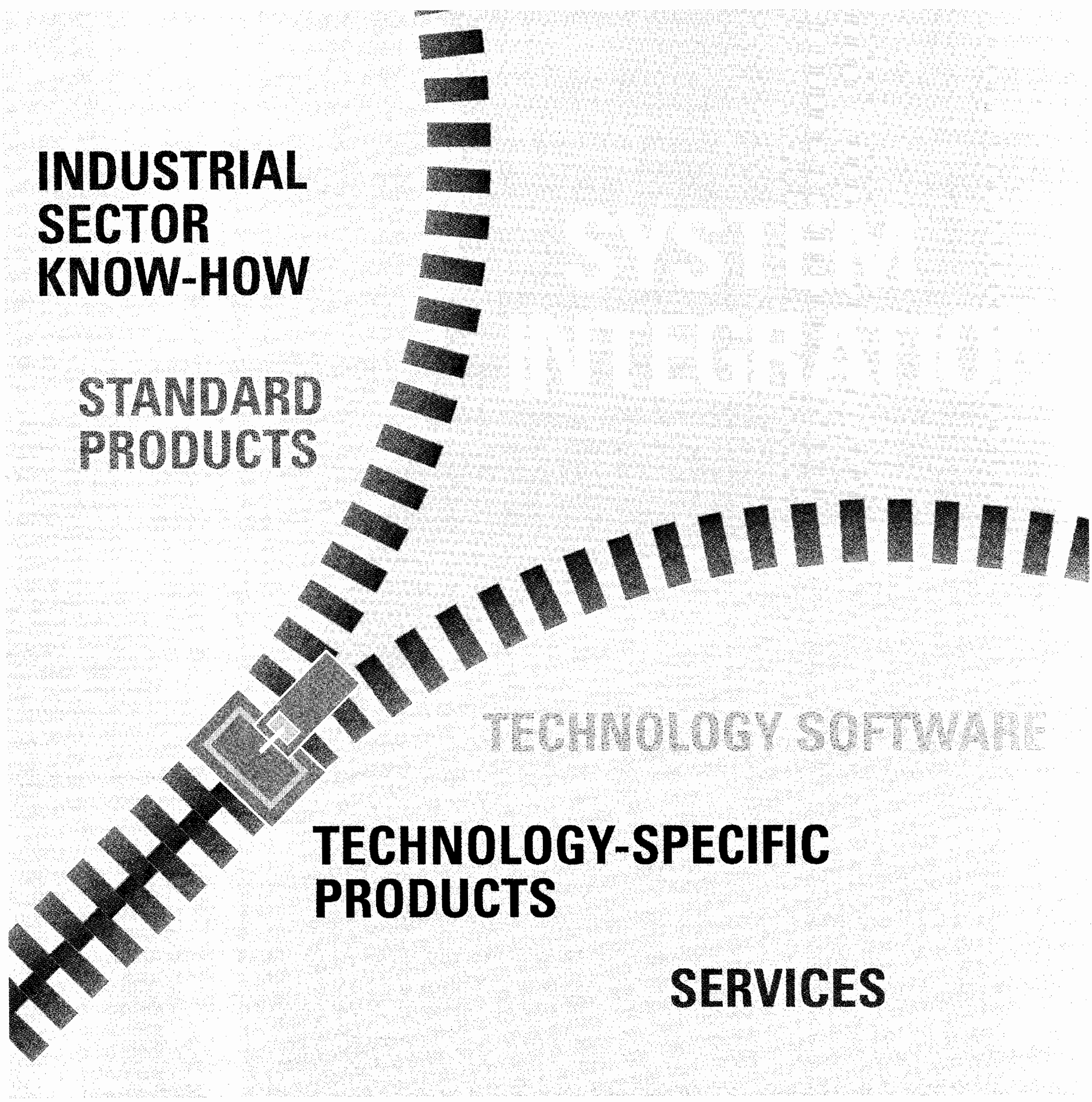
SIEMENS

System Solutions

IP 252MC / IP 252MC-DSP / IP 252MC-DP Synchronization Modules

Manual

Edition 11.98



Documentation

Circulation key

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SIEMENS

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Synchronization Modules

Manual

Valid for

Module	*Order No.*	*Version*	*Software Version*
IP 252MC	6ES5 252-5AA11	A3	2.1
IP 252MC-DSP	6ES5 252-5FA11	A0	2.0 with restriction
IP 252MC-DP	6ES5 252-5EA11	A0	2.1

Edition 11.98

Note

For reasons of clarity, this document does explain every single detail about every product type. Therefore, not all conceivable installation, operation and maintenance possibilities are taken into account.

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Table of Contents

Overview

1

Classical axis coupling

Synchronously working machine components are often required in mechanical engineering. Coupling is usually effected by various transmissions, cardan shafts, or toothed belts on a central drive.

This design can be a highly complex mechanical one, so that adaptation to a new product is only possible to a limited extent.
However, as there is a clear tendency towards smaller lot sizes and individual products, manufactured according to customer requirements, the customer also needs more flexible machines to remain competitive.

Electronic axis coupling

Due to the division of the central drive into separate drives and their flexible connection through the use of programmable electronic controls with intelligent modules, new opportunities are opening up.

The electronic solution offers the following possibilities for the machine manufacturer:

- Reduction of manufacturing costs
- Reduction of construction times through modularization
- Reduction of commissioning times
- Flexible solutions to customer requests in order to secure competitive advantages

An electronically controlled machine offers the user decisive advantages over a fully mechanical system aiding cost-effective production - today and in the future.

These advantages are as follows:

- Higher flexibility
- Wider product range
- Low wear and little maintenance
- Expandability
- Adaptations during operation

Higher flexibility

As the lot sizes become ever smaller, conversion or readjustment of the machines is more and more often necessary. Compared to the production time, the commissioning time is becoming longer and longer.

Electronic systems combined with storage media (such as programmable logic controllers - PLC) can be given new parameters in a very short period of time and the downtime can thus be reduced to a minimum.

Wider product range

Due to the possibility of storing proven values and data, these values and data can be reloaded for a new version of the product. Thus, hardly any refuse is generated by adjustment works in an electronic system.

Due to ONLINE parameter alteration, fast reaction to new influencing factors such as material characteristics, temperature, etc., is possible even while the machine is running and thus the refuse can be minimized.

Low wear and little maintenance

Mechanical systems are subject to wear and therefore require maintenance and repair. Lubricating agents, which might be necessary, can have a negative effect on the environment or the production.

With the exception of the rolling-contact bearings, electronic systems do not need any maintenance and are free of wear, thus guaranteeing constant functioning (servomotor).

Expandability

Modifications and extensions of mechanical systems - if at all possible - mean downtimes and consequently loss of production. However, with the corresponding extension, modular electronic systems can be modified with hardly any interruptions to the production.

Adaptations during operation

If systems are restarted after a standstill or if material characteristics have been changed, corrections during operation might be necessary.

This is often very difficult to realize in mechanical systems, whereas an electronic control means that only some parameters must be changed with the push of a button.

Application

2

2.1 Innovations

Trend: modular and flexible

The IP 252MC synchronization module (intelligent I/O module 252 for motion control applications) offers the following innovations:

- An electronic solution with servomotors replaces mechanical transmissions, vertical shafts, toothed belts, etc., for axis coupling.
- New axis combinations and traversing profiles can be carried out electronically at any time without mechanically adjusting the machine.
- Modular, mechanically independent axes are possible. The mechanics can be subdivided into individual function modules.
- Modular configuration, commissioning, and programming.
- Modular IP 252MC hardware, firmware and functionality.

Basic systems

Depending on the variant of the IP 252MC, the module can be plugged

- directly into SIMATIC S5
- decentralized e.g. via the drive actuator SIMODRIVE 611 analog.

The integrated functionality can be selected, combined and activated via simple SIMATIC programs.

2.2 Definitions

Internal axes

The module consists of 4 internal axes with the designation:

- Master (internal axis 0)
- Slaves 1 to 3 (internal axes 1 ... 3)

Master

- Selectable guide value provision
- Missing synchronization functions

Slaves 1 to 3

- Synchronization functions
- Guide value provision through actual value

Guide axis

- Sets the guide value for following axes
- Possible guide axes:
  - Master
  - Slaves 1 to 3

Following axis

- Adheres to the guide value of its guide axis via parameterizable synchronization functions
- Possible following axes:
  - Slaves 1 to 3
- A following axis can also be the guide axis for additional following axes.

2.3 Functions

Individual axes / synchronization

- Individual control of a maximum of 4 axes (e.g. positioner)
- Synchronization control (please see chapter 4 for definitions)
  - 1 master axis with a maximum of 3 slave axes per module
  - A maximum of 24 slave axes with 8 linked modules
  - Hierarchical structure of the slaves possible (please see chapter 4.1.2)
- Combination of
  - synchronization control and
  - single axis control
    (e.g. 1 x master, 1 x slave, 2 single axes)

Both open-loop and closed-loop control of the axes is possible.

Depending on the main function (individual axes or synchronization), additional relevant functions can be activated for:

Functions of the internal axes

- Individual axes / master axis
  - Command-value encoder for speed
    (called "Pulse generator" in the block diagrams in chapter 4)
  - Positioner
  - Cam controllers
- Slave axes
  - Pulse accuracy transmission
  - Table traversing
  - Start/stop
  - Position offset
  - Cam controllers

Flexible precision transmission

The following functions can be realized in a flexible way, which is not possible with mechanical solutions.

- Pulse accuracy transmission
  - Arbitrary combination

$$\frac{Slave}{Master} = \frac{(\pm 0...32000)}{(1...32000)}$$

  - Stable for a long period of time
  - Modifiable during operation

Electronic cam disks

Table traversing
Every angle position of the guide axis can be assigned positions of the following axis/axes.

Electronic axis coupling

- Start/stop
  Following axes can coupled / uncoupled synchronously to the guide axis in angle/position.

Slip compensation

- Position offset
  The position of the following axes can be offset during operation. Thus, synchronization in accordance with registration marks is, for instance, possible.

Position-dependent switching signals

Cam controllers

- 4 cam controllers with 2 tracks each (a maximum of 8 digital outputs)
- Application as software limit switch can be parameterized
- Free assignment of the cam controllers to the internal axes

Configuration 3

The IP 252MC, IP 252MC-DSP, IP 252MC-DP are modules which are equipped with at least one micro processor and firmware.

The data exchange or the parameterization, res., can be carried out over:

Basic controls

- SIMATIC S5, central
- SIMATIC S7-400 with adaption casing, central
- Protocol PROFIBUS-DP, decentral

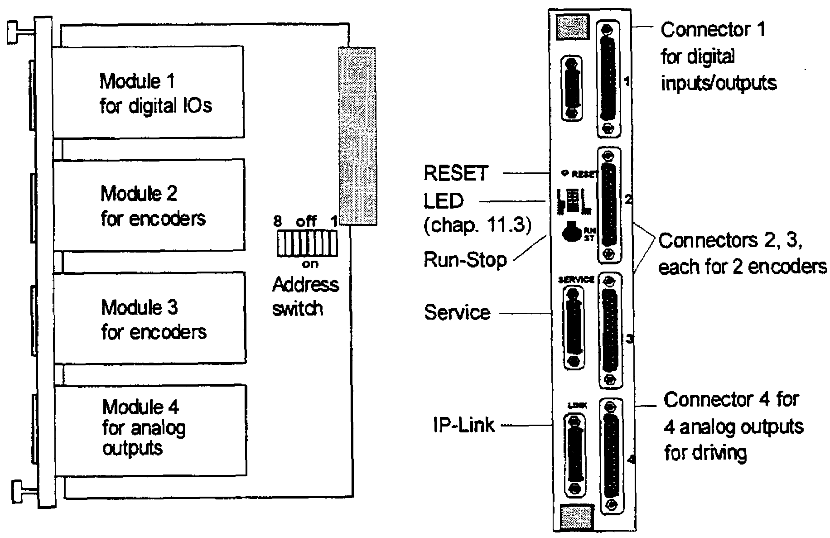


Fig. 3.1 Schemata: IP 252 variants - modules, switches, LEDs; Schemata: IP 252MC and IP 252MC-DSP connectors

The connectors 1 to 4 are attached to the modules 1 - 4.

Please see chapter 11 for the connector and address switch assignment.

3.1 Variants

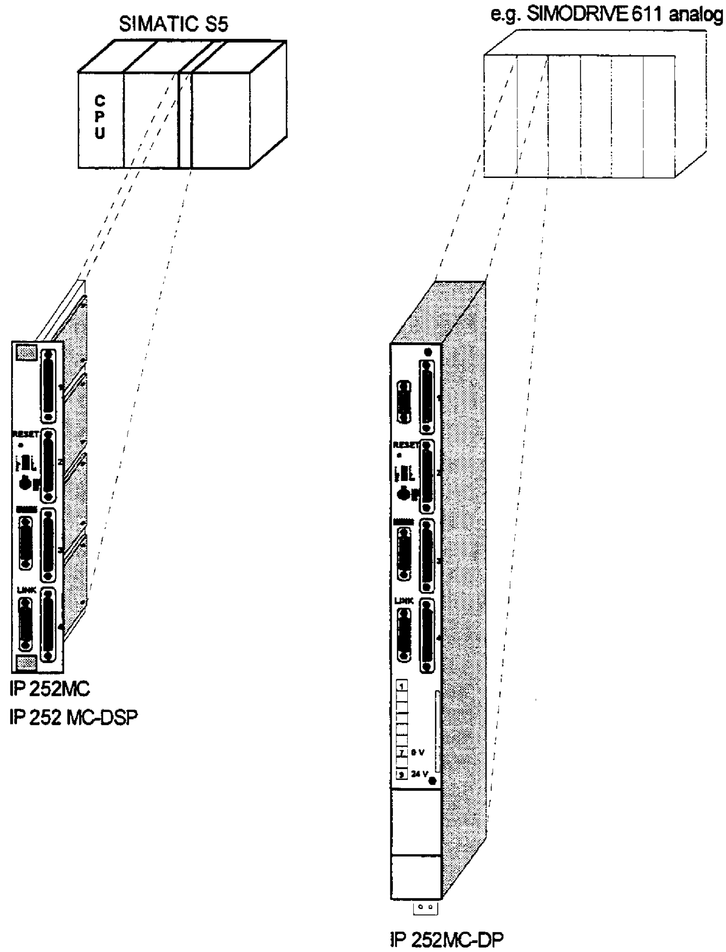


Fig. 3.2 Module variants

The module is available in 3 variants:

Standard module

- IP 252MC features:
  - Basic control: SIMATIC S5
  - Modules

Module 1	: Digital inputs/outputs
Module 2	: Encoder modules for internal axes No. 0 and 1 (master and slave 1)
Module 3	: Encoder modules for internal axes No. 2 and 3 (slaves 2 and 3)
Module 4	: Analog outputs (command values for drives)

  - Optional: Pluggable encoder modules / connectable encoders

a) Modules 2 and 3	: For 2 incremental encoders respectively
b) Modules 2 and 3	: For 2 SSI absolute encoders respectively
c) Module 2	: For 2 incremental encoders respectively
b) Module 3	: For 2 SSI absolute encoders
c) Module 2	: For 2 SSI absolute encoders
c) Module 3	: For 2 incremental encoders

  - Parallel direct coupling (IP-Link)
    A maximum of 8 modules can be linked via an IP-Link line.
    Thus, it is possible to operate up to 24 slaves on one master.
  - Cycle time 6 ms

High-speed module

- IP 252MC-DSP features (DSP: digital signal processor):
  Differs from IP 252MC in the following respects:
  - Additional digital signal processor
  - Pluggable encoder modules/connectable encoders
    a) Modules 2 and 3: For 2 incremental encoders respectively
  - Without parallel direct coupling (IP-Link)
  - Cycle time 0.5 ms

Decentral module

- IP 252MC-DP features:
  Differs from IP 252MC in the following respects:
  - Own housing (for SIMODRIVE 611 analog)
  - SIMATIC S7 basic control
  - Standard slave interface with protocol PROFIBUS-DP, 1.5 Mbit/s for connection to SIMATIC programmable controllers with PROFIBUS-DP master interface.
  - Without parallel direct coupling (IP-Link)

Interfaces

All necessary process interfaces are located on the module, enabling a highly dynamic and precise synchronization control.

3.1.1 Central use in SIMATIC S5

Layout

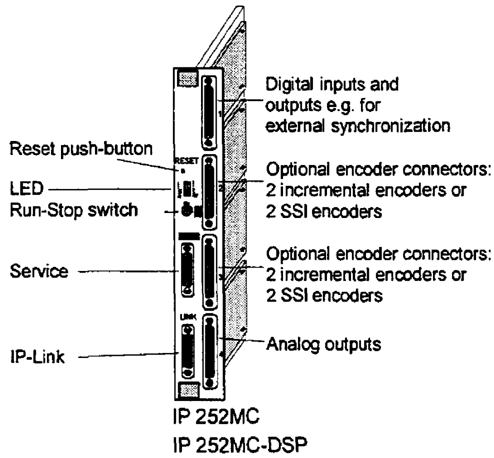


Fig. 3.3 Schemata IP 252MC, IP 252MC-DSP

Note

Please see chapter 11 for the connector assignments.

Central use in SIMATIC S5

The IP 252MC / IP 252MC-DSP can be used directly in the SIMATIC S5-115/135/155.

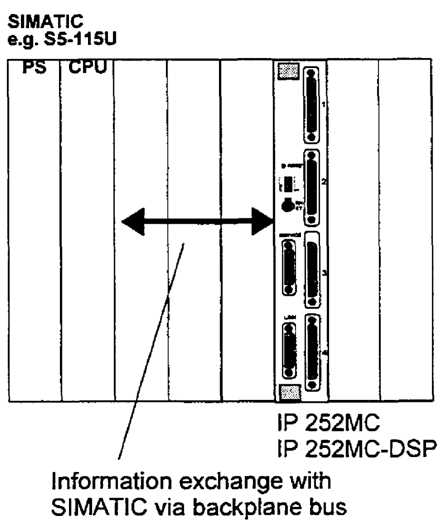


Fig. 3.4 Central use in SIMATIC S5

Note

The permissible combinations of S5-CPUs, module racks and slots are documented in chapter 11.1.

3.1.2 Distributed use

Layout

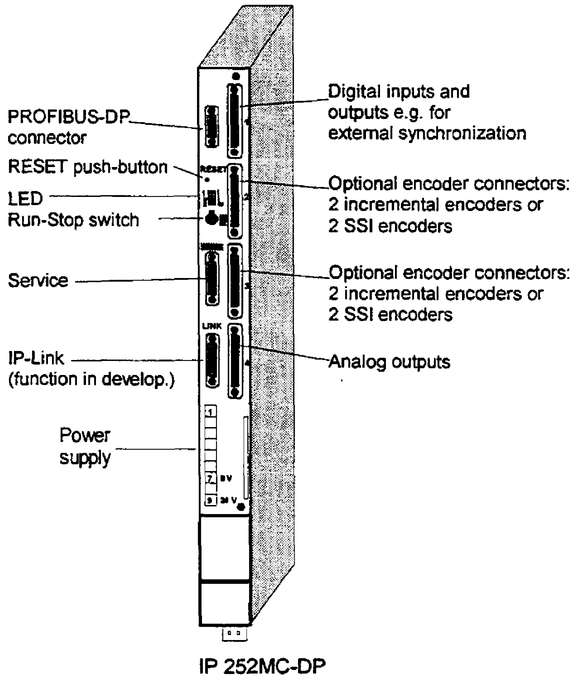


Fig. 3.5 Schemata IP 252MC-DP

IP 252MC-DP is supplied as a plug-in unit in a 50 mm wide housing. This unit can, for example, be plugged into the SIMODRIVE 611 analog.

DC 24 V / GND is supplied via the supply connector (please see chapter 11.4.4).

The module equipment can be chosen in the same way as for IP 252MC.

Module mounting

The basic module has to be pulled out of the SIMODRIVE housing cassette for module configuration with I/O modules. Two cheese heads on the upper and lower end of the front plate have to be unscrewed for this. The fastening screws do not have to be completely unscrewed for loosening the module. The module can be pulled out of the housing cassette where the screws are on the front plate.

In the vicinity of the LINK connector (26-pin high density Sub-D) there is a contact spring on the soldering side of the module. When plugged in, a conductive connection between module and housing is established by means of this spring. To guarantee problem-free insertion of the module, the contact spring must remain slightly pressed.

Distributed use

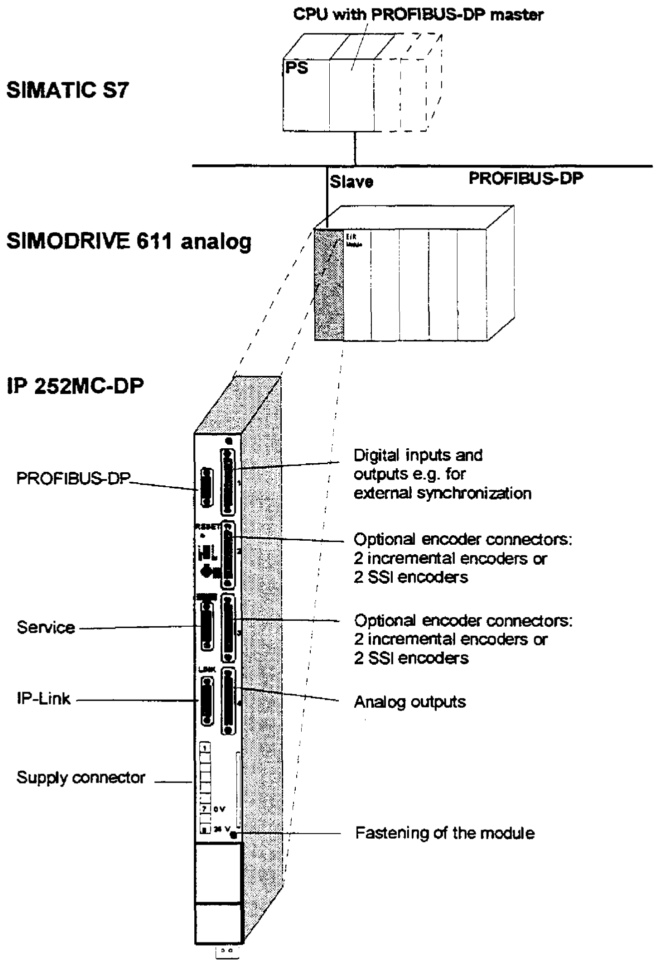


Fig. 3.6 Distributed use of the IP 252MC-DP in the servo controller SIMODRIVE 611 analog

No additional knowledge required

Coupling to the superset control unit (SIMATIC) is effected via an external bus line with the protocol PROFIBUS-DP. The data transfer rate is supported up to a maximum of 1.5 Mbaud.

The functionality and programming is similar to that of the IP 252MC.

The user does not need any PROFIBUS-DP protocol knowledge. The communications interface for the IP 252MC-DP user software corresponds to the S5 standard interface in configuration and operating principle.

The programmable controller side offers function blocks with which an information exchange via SEND / RECEIVE calls can be realized in a way similar to the S5 standard handling blocks.
All orders which can be exchanged via the page frame coupling between SIMATIC CPU and IP 252MC can also be transported via the PROFIBUS-DP coupling. The page frame interface cannot be used via PROFIBUS-DP.

3.2 Configuration examples

3.2.1 Configuration with a maximum of 3 following axes (slave axes)

Master, 3 slaves

Task:

- Guide value (master axis command value) is to supply module
- A maximum of three following axes (slave axes) are to work synchronously
- Incremental encoders are to be used

Solution:

- Basic control, e.g. SIMATIC S5
- One module IP 252MC or IP 252MC-DSP for 4 incremental axes

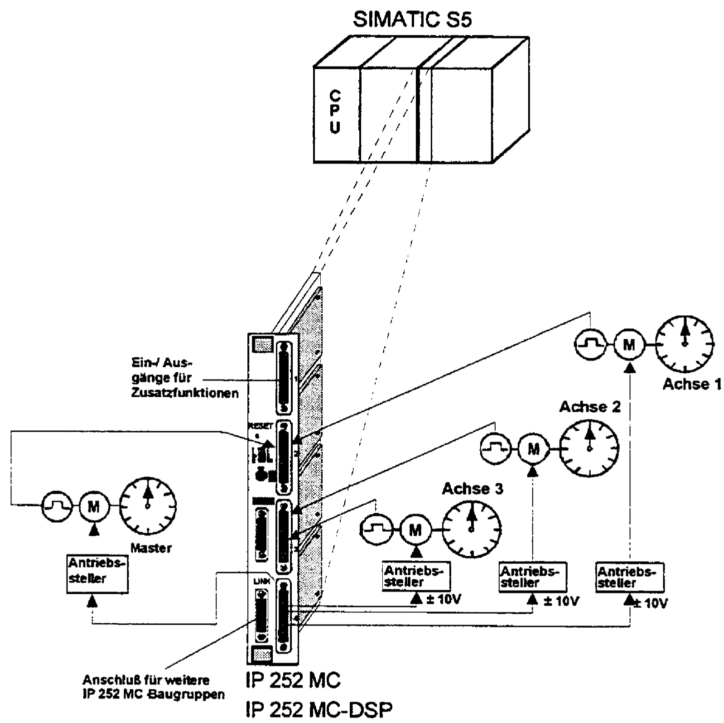


Fig. 3.7 Example: Connection of one guide axis (master axis) and 3 following axes (slave axes)

3.2.2 Configuration with more than 3 following axes (slave axes)

Master, 9 slaves

Task:

- Guide value (master axis command value) is to supply module
- 9 following axes (slave axes) are to work synchronously
- SSI absolute encoders are to be used

Solution:

- Basic control, e.g. SIMATIC S5-115U
- 3 IP 252MC modules for 4 absolute axes (SSI) respectively
- Loop guide values for following axes (slaves) 4 .. 9 via connector IP-Link

Slave coupling IP-Link

The connector IP-Link is a direct parallel interface for coupling a maximum of 8 IP 252MC modules. Thus, one master and up to 24 slaves can be operated. This function is not available for the modules IP 252MC-DSP and IP 252MC-DP for the time being.

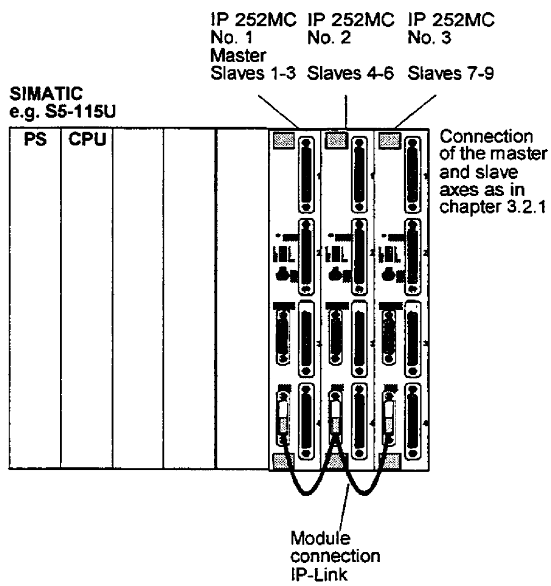


Fig. 3.8 Example: Configuration with more than three following axes (slave axes)

Operating Principles 4

4.1 Overview of the Functionality of the Modules

Functions

Each of the four internal axles (master as well as slave 1, 2, 3) can work in a self-supporting manner. For this the two functions "pulse generator" and "positioner" are available. The three internal slave axles also have the possibility of proceeding in dependency on another axle (lead axle). This function will be called "synchronous operation" in the following explanations.

Pulse generator

The drive should move itself with constant speed. For this, the desired set speed and a maximal acceleration are predefined. This function is suited for the realization of the inching.

Positioner

The drive should move itself to an absolute position (absolute dimension) or relative position (incremental dimension). For this the desired set position and speed with which this should occur, and a maximal acceleration, are predefined.

Synchronous operation

The drive (slave axle) moves itself dependent on the position of a lead axle in three different ways:

- 1:1 Synchronous
  The slave axle traverses the same as the lead axle.
- Transmission
  The slave axle traverses over a ratio the same as the lead axle.
- Travel table
  By way of a table the relation between the lead axle and the slave axle position is produced.

Additionally, coupling functions are realized via a "Start/Stop switch".

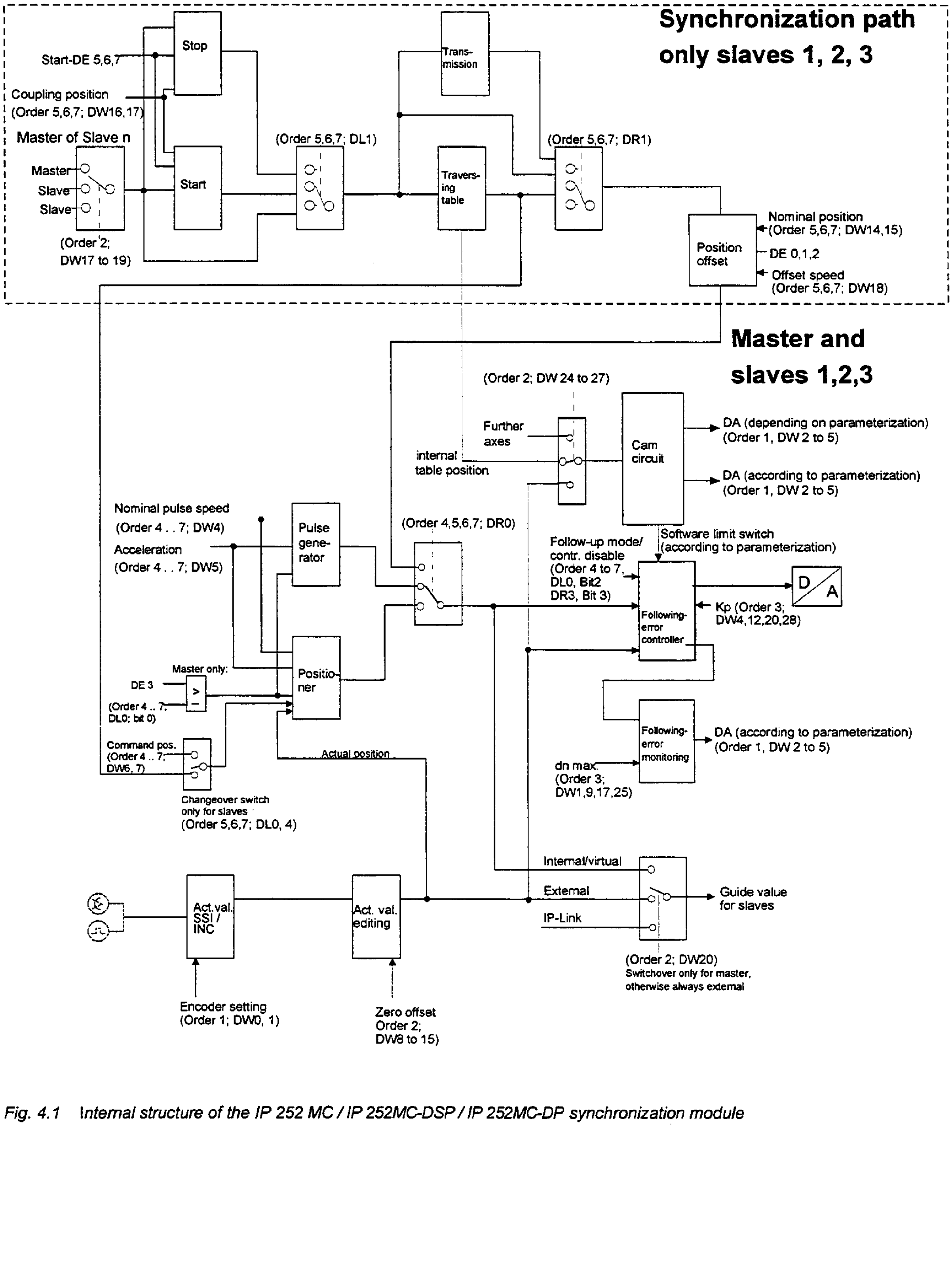


Fig. 4.1 Internal structure of the IP 252 MC / IP 252MC-DSP / IP 252MC-DP synchronization module

Units for Positions and Speed

If not otherwise stated, the following are valid::

- Increments for position value
- Increments/time unit for speed

Increments are marked with the unit “N”.

Definition Actual value

The value that results from the processed sensor signal is designated as the actual value. To the processing belong, among other things:

- Zero offset (offset addition at reference point approach
- Preset value (actual value setting
- Rotary axis correction (number of the increments that the axis needs for a revolution)

Definition reference value

The reference value is the immediate command value of an axis. The reference value can alternatively be made available through the:

- shaft rotation pulse transmitter
- positioner
- synchronizing function

Definition recommended value

The recommended value

- is the value that a master axis makes available for its accompanying slave axis,
- can be the actual value or the reference value (only master) of the master axis,
- is fed into the synchronization path of the slave axis, manipulated there, and then fed into the slave axis as reference value.

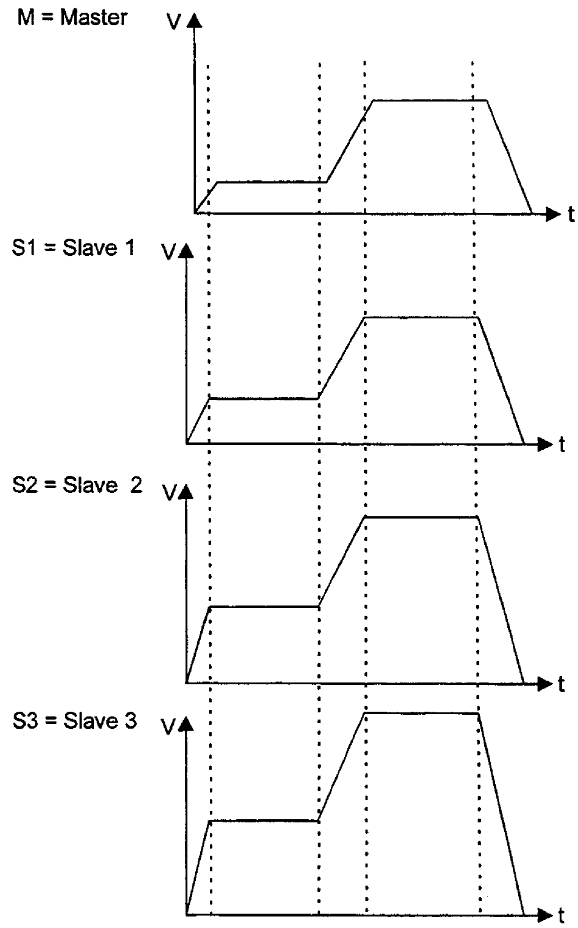


Fig. 4.2 Slave axes move at different feed rates with synchronous angles to the master

4.1.1 Guide value generation

Guide value generation slave axes

The actual value is issued as guide value for slave axes.

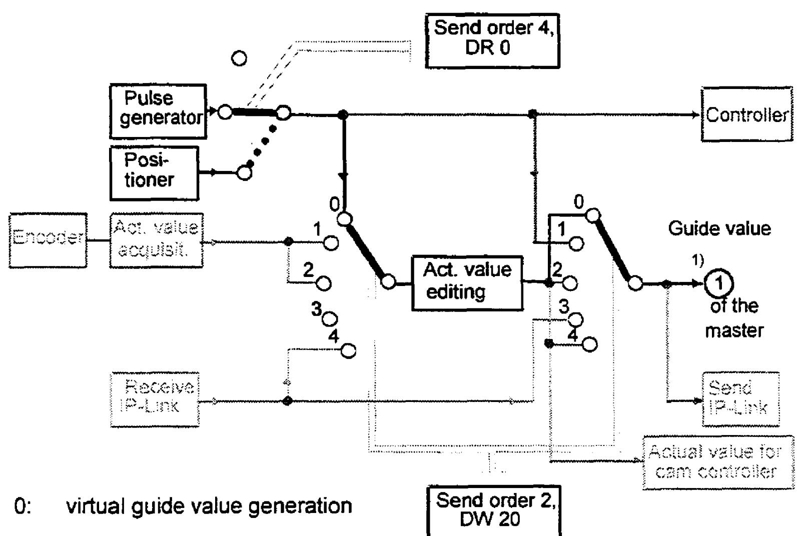
Guide value generation master axes

The master offers convenient possibilities of guide value generation via:

- Virtual master
- Command value guidance
- Actual value guidance
- IP-Link with position acceptance
- IP-Link with its own position generation

Guide value generation by means of virtual master

The master can be used as a virtual master. The SIMATIC supplies the IP 252MC module with the master command values, start-up, feed rate and, if required, the position to be approached, from which the virtual master calculates the guide value for the slave axis/axes. The position value is calculated. No closed-loop control can be implemented for the virtual positioning of the master as the master drive with axis and encoder does not actually exist.



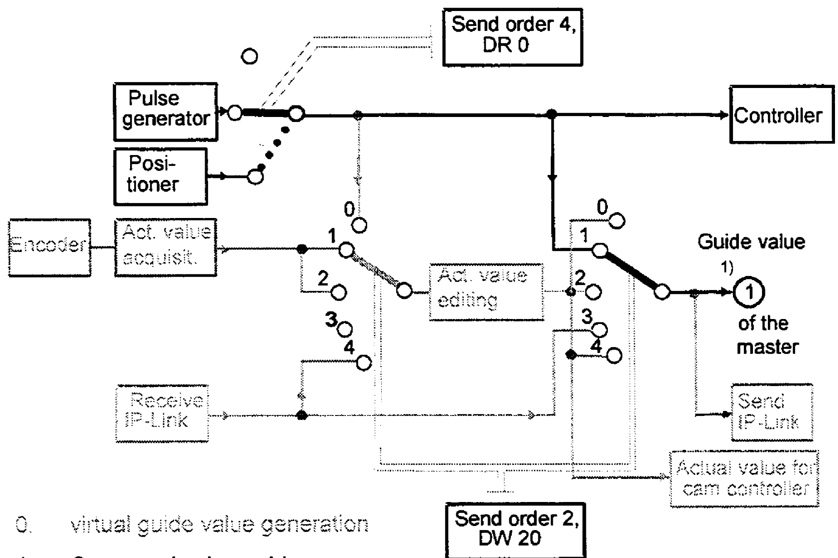
0: virtual guide value generation
1: Command value guidance
2: Actual value guidance
3: IP-Link with position acceptance
4: IP-Link with ist own position generation

1) Please see Fig. 4.10 Overview of slave synchronization functions

Fig. 4.3 Virtual guide value generation

Guide value generation by means of command value guidance

The position actual value is derived from the actual value acquisition, but the (smoother) command value is issued as a guide value for the slaves. Thus, a real master axis drive can be controlled via D/A converters and the actual values of the encoder.



0: virtual guide value generation

1: Command value guidance

2: Actual value guidance

3: IP-Link with position acceptance

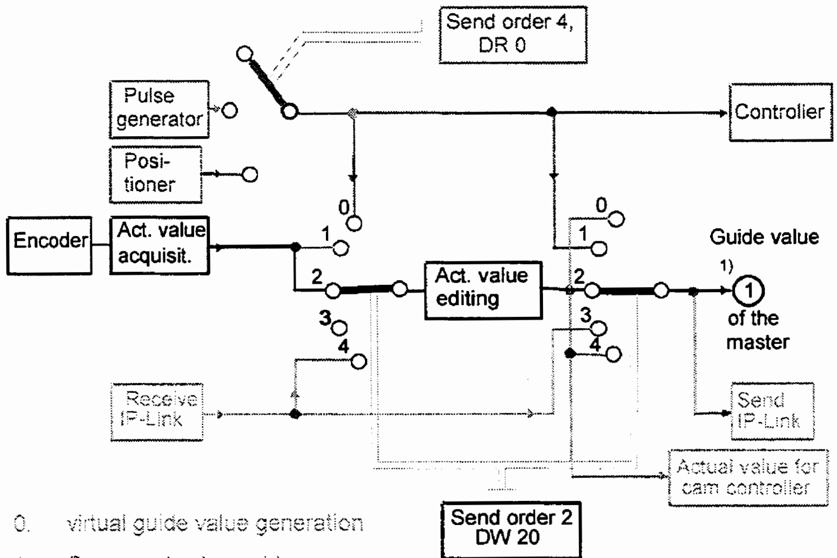
4: IP-Link with its own position generation

1) Please see Fig. 4.10 Overview of slave synchronization functions

Fig. 4.4 Guide value generation by means of command value guidance

Guide value generation by means of actual value guidance

An external encoder issues the actual value to the IP 252MC. This value is processed and issued to the slaves as a guide value.



0: virtual guide value generation

1: Command value guidance

2: Actual value guidance

3: IP-Link with position acceptance

4: IP-Link with ist own position generation

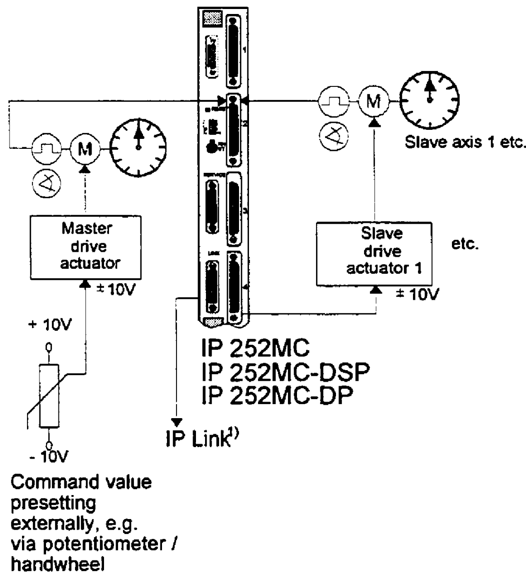
1) Please see Fig. 4.10 Overview of slave synchronization functions

Fig. 4.5 Guide value generation by means of actual value guidance

External master

Application case 1 (external master):

- IP 252MC has no influence on the external encoder
- Command value presetting is achieved
  - externally
  - by a measuring wheel and similar (please see *Fig. 4.6*)
- ⇒ Parameterization: "Controller disable" for the master axis following-error controller (please see chapter 4.4.4 Controller)



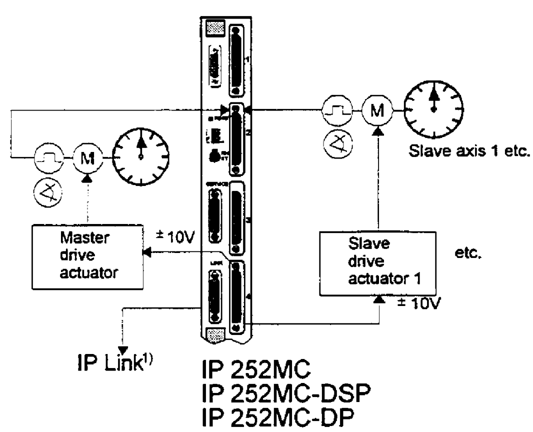
1) see Chapter 3.2.2

Fig. 4.6 IP 252MC with an external master

Internal master

Application case 2 (internal master):

- The encoder detects the actual value of an axis which is controlled by the IP 252MC.



1) see Chapter 3.2.2

Fig. 4.7 Connection example: IP 252MC with an internal master

Guide value generation by means of IP-Link

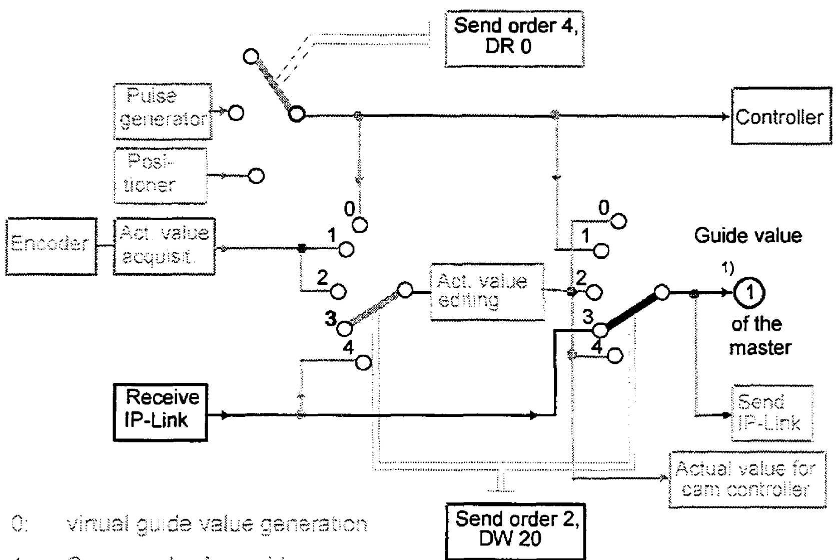
The IP-Link master module transmits the guide value of its master axis via broadcast (directly) to all connected IP-Link slave modules. In the IP-Link slave modules the received guide value replaces the own master (master guide value). In addition, the received guide value can be processed on the IP-Link slave module.

Caution

If several IP 252MC modules are parameterized as master and connected to each other, irreparable damage to the hardware cannot be excluded.

Guide value generation by means of IP-Link with position acceptance

The position actual value of the IP-Link slave module is the received position value.



0: virtual guide value generation

1: Command value guidance

2: Actual value guidance

3: IP-Link with position acceptance

4: IP-Link with ist own position generation

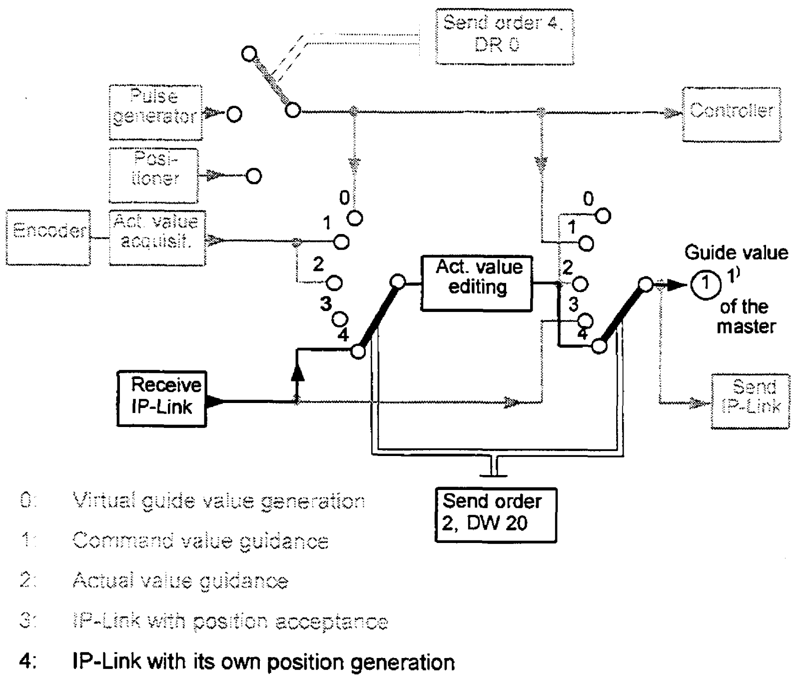
1) Please see Fig. 4.10 Overview of slave synchronization functions

Fig. 4.8 Guide value generation by means of IP-Link with position acceptance

Guide value generation by means of IP-Link with its own position generation

The position value of the IP-Link slave module is calculated from the received position actual values and can be influenced by:

- Parameters: Counting values per master cycle (SEND order 2, DW 0, 1)
- Zero offset master (SEND order 2, DW 8, 9)
- Actual value setting for the master axis (SEND order 4, DW 20, 21, DW 0, bit 15)



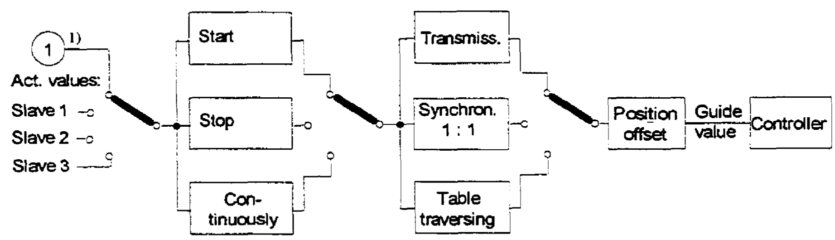
1) Please see Fig. 4.10 Overview of slave synchronization functions

Fig. 4.9 Guide value generation by means of IP-Link with its own position generation

4.1.2 Synchronization functions

Slave

The slaves receive the guide value from their respective guide axis, calculate the command value depending on the parameterized synchronization functions and transmit it to the controller.



1) *Please see Fig. 4.3, 4.4, 4.5, 4.8, 4.9*

Fig. 4.10 Overview of slave synchronization functions

Slave as guide axis

The following applies within a module:
Every slave can be parameterized as a guide axis for another slave axis. If a slave is parameterized as guide axis, then its actual value is the guide value for the following axis/axes.

4.1.3 Cam controllers

Cam controllers

Each of the four cam controllers can be assigned to any internal axis (master, slaves 1 to 3). The assignment of the digital outputs to the cam controllers can also be parameterized as required.

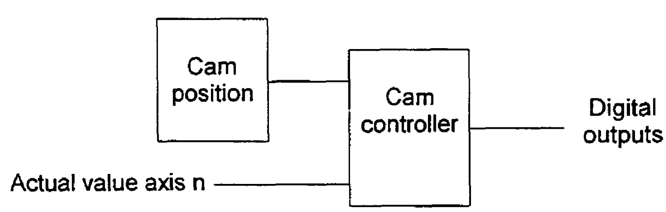


Fig. 4.11 Cam controller

4.1.4 IP-Link / networking

IP-Link master module

The IP 252MC module which is to work as the IP-Link master module has to be appropriately parameterized in SEND order 1, DW 14.

IP-Link master

The IP-Link master module transmits the guide values of its master axis (cf. Fig. 4.3, 4.4, 4.5) to all connected slave modules. The following variants are possible options for a guide value source:

- Virtual master (please see Fig. 4.3)
- Internal master (command value guidance, please see Fig. 4.4)
- External master (actual value guidance, please see Fig. 4.5)

IP-Link slave modules

The IP 252MC modules (max. 7) which are to work as IP-Link slave modules have to be appropriately parameterized in SEND order 1, DW 14.

IP-Link slave modules must be plugged:

- into the same module rack of the IP-Link master module
- in directly, right next to each other, into adjacent slots on the IP-Link master module

The IP-Link connection is made via a special line (please see ordering data, chapter 10).

Depending on the parameterization in SEND order 2, DW 20, bits 2 and 3, the internal axis 0 of the IP-Link slave module can choose to accept the IP-Link guide value as follows,:

- Acceptance of the IP-Link master module abs. position (please see Fig. 4.8)
- Acceptance of the IP-Link master module rel. position (please see Fig. 4.9)

When accepting the relative position, the steps (movements) of the IP-Link master are processed to an own position (please see Fig. 4.9).

Thus, the guide value (position) of the IP-Link slave can, for instance, be shifted by a defined value to the IP-Link master.

IP-Link slave axis

IP-Link slave can be any internal axis 1...3 which belongs to the:

- IP-Link master module
- IP-Link slave modules

The internal axis 0 is parameterized as guide value source in SEND order 2, DW 17...19 for this.

Assignment int. axes 1 ... 3

Internal axes 1...3 for which the internal axis 0 has not been parameterized as guide value source can be assigned the following as a guide value source:

- Another internal axis (1...3) which works as IP-Link or in a self-supporting manner
- SIMATIC for a self-supporting operation

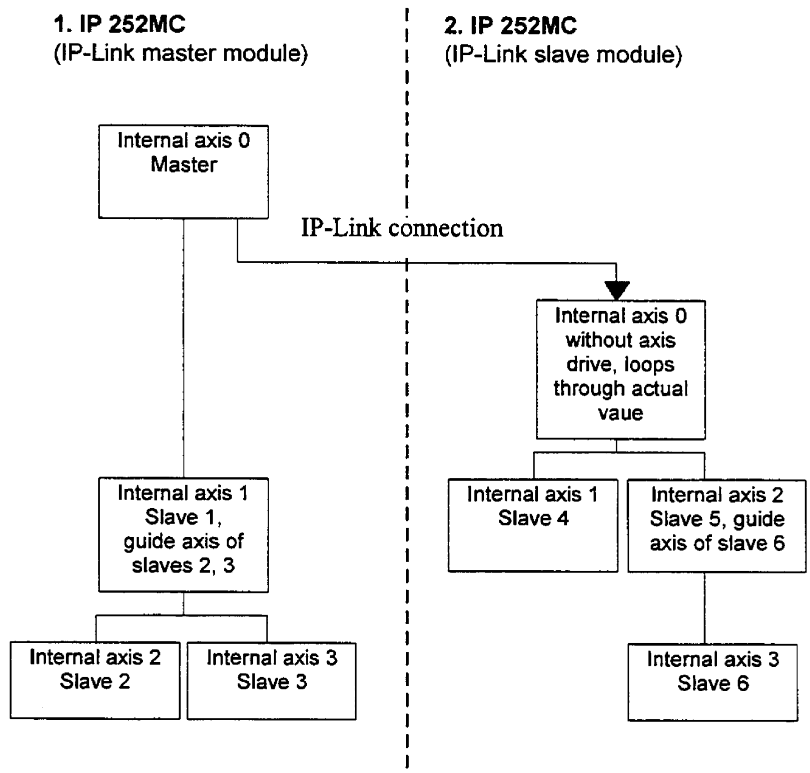


Fig. 4.12 *Example: IP-Link master and slave module*

IP-Link parameterization

Function	Order	DW	Bit	Comments
IP-Link	1	14	-	0 = Module does not transmit/receive any IP-Link guide values 1 = Module is an IP-Link master 2 = Module is an IP-Link slave
Guide value source	2	20	-	The following applies to the IP-Link master module: 0 = External master 1 = Internal master 4 = Virtual master The following applies for the IP-Link slave module: 2 = Acceptance of the absolute guide value from the IP-Link master module 3 = Acceptance of the relative guide value from the IP-Link master module with its own position generation

Table 4.1 IP-Link master/slave module parameterization

Note

The modules parameterized as slaves only start up after the first data block has been received via the IP-Link. Therefore, all slave IPs should be completely parameterized before parameterizing the master IP.

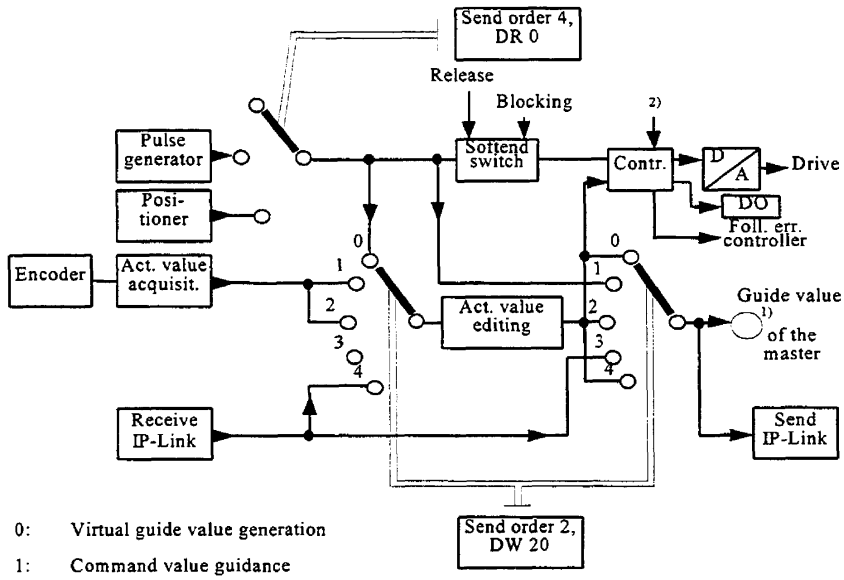
Note

A change of the parameterization master/slave IP is no longer possible after start-up of the module.

4.2 Structure

4.2.1 Command value, actual value and guide value sources

Guide value sources / master structure



0: Virtual guide value generation

1: Command value guidance

2: Actual value guidance

3: IP-Link with position acceptance

4: IP-Link with its own position generation

1) Please see Fig. 4.10 Overview of slave synchronization functions
2) Parameters: K_P, initial scaling, window width, contouring error

Fig. 4.13 Master structure

Slave structure

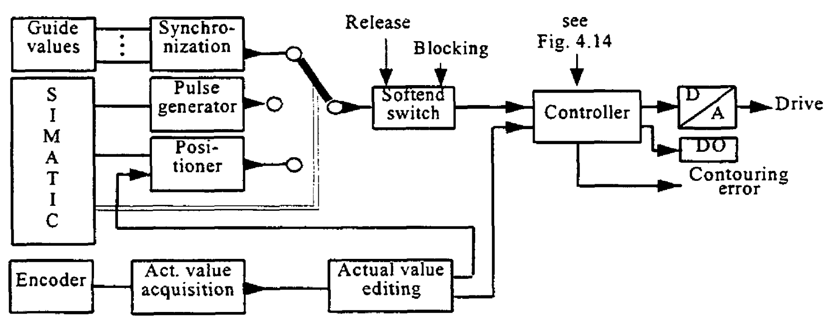
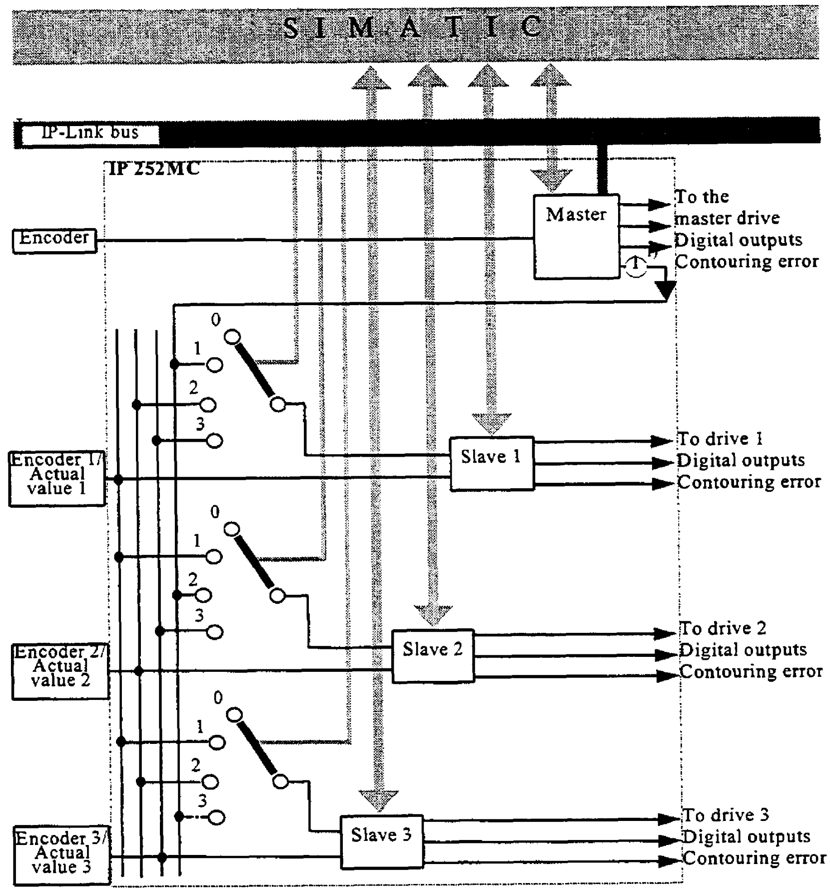


Fig. 4.14 Slave structure

The following figure shows the parameterization possibilities for:

- Command value / guide value sources
- Master-slave linkages
- Self-supporting operation

Master - slave structure



0: Slave 1...3 : Single axis operation (self-supporting operation)

1: Slave 1 : Guide value from the master
Slaves 2, 3: Guide value (actual value) from axis 1

2: Slave 2 : Guide value from the master
Slaves 1, 3: Guide value (actual value) from axis 2

3: Slave 3 : Guide value from the master
Slaves 1, 2: Guide value (actual value) from axis 3

1) Please see Fig. 4.10 Overview of slave synchronization functions
Fehler! Verweisquelle konnte nicht gefunden werden.

Fig. 4.15 Master - slave structure

Explanation of Fig. 4.16

The above figure shows:

- Single axis operation:
  - Master and slaves 1 to 3 can work in a self-supporting manner with the SIMATIC supplying the command values. The actual values are issued by the respective axis-own encoder.
- Master/slave operation:
  - The master supplies the guide value for the following axes slave 1 and/or slave 2 and/or slave 3.
  - A slave axis issues its own actual value as guide value for one of the other slave axes (following axes).

4.2.2 Cam controllers / digital outputs wiring blocks

Data cam controllers

- Number of cam controllers: 4
- Tracks per cam controller: 2
- Cams per track: 2

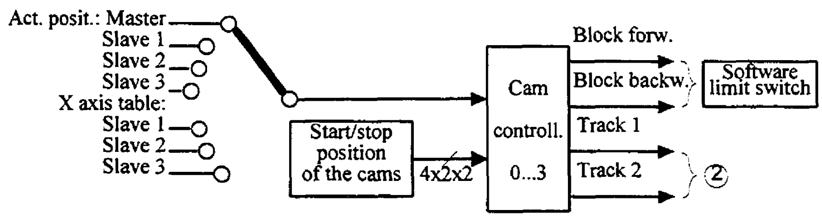


Fig. 4.16 Cam controller structure / signals

Data digital outputs

8 high-speed data outputs on the IP 252MC

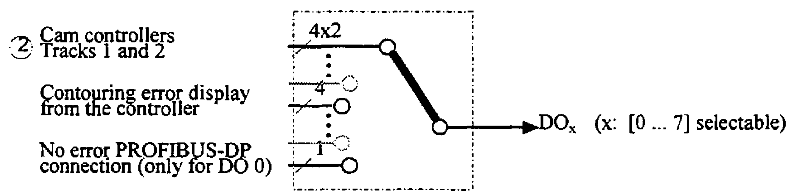


Fig. 4.17 Digital outputs structure / wiring block

4.3 Actual value editing

Actual value source/ encoder types

The actual value can be read in by:

- Incremental encoders (for all IP 252MC variants) and/or
- SSI absolute encoders (for IP 252MC, IP 252MC-DP, for format, please see table 8.1)

Cycle length rotary axis

The value of the rotary axis cycle length is the number of pulses from the encoder after a machine cycle repeats itself, e.g. pulses/360^0 for single-speed wave.

Please take the following into account:

- The hardware pulse quadruplication (multiplication of the encoder pulses by 4) for incremental encoders
- An existing transmission between axis and encoder must be included
- Value range of the cycle length: 1 ... 2^{30}

Cycle length linear axis

The value of the linear axis cycle length is parameterized "0".

Please take the following into account:

- Traversing range $\pm 2^{30}$ increments
- Two's complement representation for negative values

Status message

IP 252MC feedbacks (RECEIVE) make differentiation possible between:

- Error actual value module
  (Please see RECEIVE order 16, DW 0 ... 3, bit 12)
- Error encoder
  (Please see RECEIVE order 16, DW 0 ... 3, bit 13)

Status messages are grouped for every encoder.
(Please see RECEIVE order 13, DW 0 ... 3)

SSI module features

When using modules for SSI absolute encoders, the following must be taken into account:

- Read absolute value:
  - Once in the first controller cycle after start-up
  - Only actual value changes addition during operation
- Synchronization variations
  The following times are received:
  - Encoder scanning time: 0.5 ms, i.e. the actual values of SSI absolute encoders are available with an accuracy of 0.5 ms
  - Controller cycle time for IP 252MC and IP 252MC-DP: 6 ms.
    The following is calculated:

$$\text{Synchronization variation} = \frac{0.5\text{ ms}}{6\text{ ms}} \cdot 100\% \approx 10\%$$

- Actual value setting
  The parameterizable preset value (SEND order 4 .. 7, DW 20, 21) can also overwrite the actual value when using SSI absolute encoders. The function is activated with SEND order 4 .. 7, DW 0, bit 8.
- Preset input at SSI absolute encoders
  - The machine should be at standstill when activating this function (controller disable)
  - The axes should be in follow-up mode (without actual value calculation)
  - Afterwards, actual value setting from the SIMATIC to the module is required
  - When activating the preset input at the SSI absolute encoder, no axis is allowed to be in synchronization to this encoder. Tables should be deselected.

Note

The preset value affects the module like an actual value change as it cannot recognize if the axis is actually moving or not.

4.3.1 Zero offset

(manual position offset)

Zero point definition

The zero point of the respective axis is fixed for:

- SSI absolute encoders via
  - mechanical encoder coupling
- Incremental encoders via
  - mechanical encoder coupling
  - reference point approach

Zero offset definition

The zero offset (ZO) is the difference between

- the zero point of the axis and the required zero point, or
- the current actual value and the required actual value

This difference has a sign and can be calculated with a SIMATIC computation if a known command position is approached.

Computation: required actual position
– current actual position
+ old zero offset
= new zero offset

The current actual position can be read out in RECEIVE order 16.

Activation / effect

In SEND order 2, DW 8 .. 15, two data words are designated for the zero offset of each internal axis. The zero offset is effective in the following way straight after description and data word transfer:

- A signed zero offset is added to the encoder actual value:
  $Act_{internal} = Act_{current} + ZO$
- Consequence depending on the shifting direction:
  - Positive offset → Backward shifting of the axis
  - Negative offset → Forward shifting of the axis

⚠ **Caution**

A change of the zero offset becomes effective immediately. Therefore, large offset changes may result in jumpy compensation movements. This can be avoided by several transmissions increasing step by step up to the command value.

It is usually recommended switching off the following-error controller, i.e. parameterizing the follow-up mode.

Applications

It usually makes sense using the zero offset for setting up the axis (machine) - e.g.:

- Shifting/adaptation of electronically linked axes
- Change of tool/work piece
- Zero point adjustment for encoder installation

4.3.2 Actual value setting (PRESET)

Actual value setting means that the actual value numerator is overwritten with the PRESET value by the software.

Prerequisite

An actual position must be known by:

- value
- mechanical position.

This actual position must be stored in SEND order 4 .. 7, DW 20, 21, depending on the axis, as "PRESET actual value setting".

Note

The axis must be at standstill!

Procedure

The following steps must be made:

- Reset synchronization (if required)
- Traverse the axis with the help of the pulse generator to a known position (PRESET position) such as:
  - Fixed stop
  - Acceptance point
  - Mark etc.
- Send SEND order 4 .. 7, DW 0, bit 15 = 1. Consequence:
  - The actual value is overwritten by the value "PRESET actual value setting"
  - The synchronization bit RECEIVE order 16, DW 27 is set

Parameters for actual value setting

Function	Order	DW	Byte/ Bit	Comments
Reset synchro-nization	4 .. 7	0	/14	1 = Reset the incremental encoder synchronization
Actual value setting	4 .. 7	0	/15	1 = Value of DW 20, 21 is accepted as actual value
PRESET actual value setting	4 .. 7	20, 21	-	Value which is accepted into the actual value numerator at DW 0, bit 15 = 1
Status synchro-nization	16	27	8 ... 11	1 = Respective axis is synchronized This state is undefined if "Reset syn-chronization" and "Actual value setting" are triggered in the same order.

Table 4-2 Parameters for actual value setting

Note

In contrast to the zero offset, there is no compensation movement with actual value setting.

4.3.3 Reference point approach

Synchronization of the incremental encoder

If an incremental encoder has been parameterized to an axis, there is no defined connection between mechanical axis position and encoder position after start-up. To establish this connection a synchronization must be made and only then can a defined axis position be approached in the operating modes/functions:

- Positioner
- Synchronization with defined master-slave positions (e.g. traversing table)
- Cam signals
- Electronic coupling

Variants

The incremental encoder synchronization can be carried out via two methods:

- Reference point approach (mechanical synchronization)
- Actual value setting (software synchronization)
  (Please see chapter 4.3.2 Actual value setting (PRESET))

Mechanical prerequisites

Mechanically, a cam should be mounted at one end of the axis so that it can be easily and rapidly accelerated after start-up.

This cam operates a reference switch. The cam length must be selected so as to ensure that only one encoder zero pulse is in the cam overmove range (please see Fig. 4.18). The reference switch is connected to the incremental encoder module pin GSYNC1(2) (please see chapter 10.4.2.2).

Electronical prerequisites

In RECEIVE order 16, DW 27, the corresponding axis should be checked to see if it has already been synchronized. If yes, activate "Reset synchronization" via SEND order 4 ... 7 (depending on the axis), DW 0, bit 14. The status bits in RECEIVE order 16, DW 27 are reset with this.

Axis synchronized

Regardless of the operating mode, the bit "Axis synchronized" in RECEIVE order 16, DW 27 is set if the following AND condition is fulfilled the first time:

- Reference switch signals "1" to GSYNC1 (GSYNC2)
- Zero pulse (0 - 1 - edge) is signaled by the incremental encoder

Simultaneously, the zero offset is accepted by SEND order 2, DW 8 ... 16 into the actual value indication.

Note

The axis does not stop on its own after the zero pulse has been received.

Zero pulse reference point switch

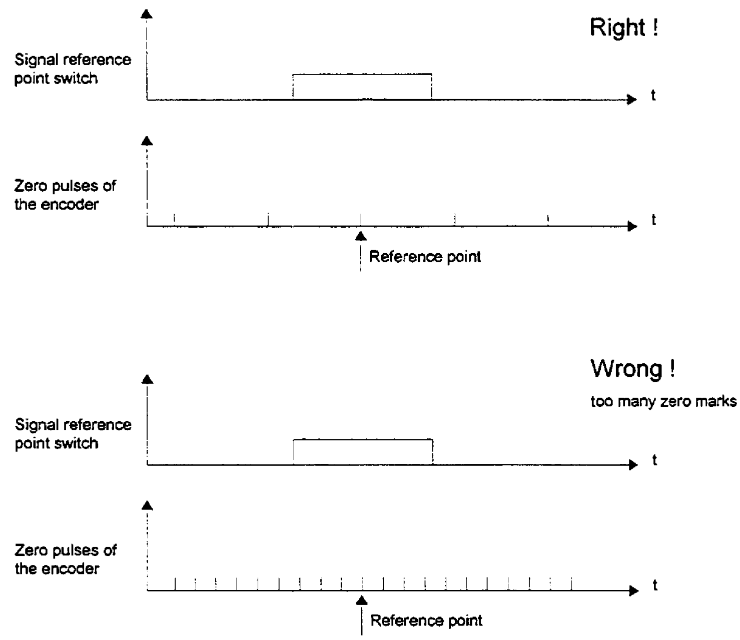


Fig. 4.18 Position of the encoder zero mark in relation to the reference signal

---

Note

The reference point can be approached with one or several axes simultaneously.

4.3.4 Reference Point/Zero Offsets IP 252MC/IP 252MC-DSP

> **Note**
>
> The procedures described in this chapter are valid only for customers who jointly replace or employ the IP 252MC modules (Ordering no.: 6ES5 252-5AA11, release A3, software version 2.1) with the IP 252MC-DSP module (Ordering no.: 6ES5 252-5FA11, release 0 or 1).

Why this chapter?

An incompatibility exists between the IP 252MC-DSP and the IP 252MC regarding:

Reference point search with the incremental encoder and

Change of the zero offsets after start-up

Behavior during reference point search

Differences:

- IP 252 MC

  analyzes the 1. event "GSYNC and N - track only

  sets the bit "axle synchronized"

  suppresses further reference events until the acknowledgement command (in SEND task 4 ... 7, DW 27, bit 8 ... 11)

- IP 252 MC-DSP

  evaluates all reference eve3nts independently of the bit "axis synchronized" (RECEIVE job 16, DW 27 bit 8...11)

Consequences:

- None, when the length of the rotary axis is so parameterized that the same zero point is always set.
- None, when the IP 252MC-DSP with the release 0 is replaced through a module with the release 1 and the compatibility bits are not set thereby.

If the same behavior is demanded from the IP 252MC-DSP as from the IP 252MC, then please proceed as in **case 1** or **case 2.**

Zero offset after start-up

If the zero offset is changed **after** start-up, then the sign for the changing of the zero offset of the IP 252MC-DSP works in the opposite manner as it would with the IP 252MC.

Numerical example

for an IP 252MC-DSP release 0 and release 1 without a set compatibility bit (SEND task 1, DW 31 bit 0=0):

- SEND task 2, DW 8, 12, 14 = 2000 (old)
- After start-up change e. g. to 3000
- Calculation: change new - old = 3000 - 2000 = +1000
- Following error **reduces** itself by +1000 and is possibly broken down by the error controller, if the axle is released
- The same development leads with an IP 252MC to an **increase** in the following error of +1000

Consequences:

- None for customers who don't change a zero offset after start-up
- None for customers who, for example, use the zero offset to realize operator adjustments

If the same behavior is demanded from the IP 252MC-DSP as from the IP 252MC, then please proceed as in **case 1** or **case 2**.

Case 1

You have an IP 252MC-DSP module, ordering no. 6ES5 252-5FA11, release A0:

- Upgrade of the IP 252MC-DSP module to the release A! in the Siemens branch office Cologne

  Address: Siemens AG
  Dept.: ANL TD
  Mr. Niederpruem
  Franz-Geuer-Strasse 10

  50823 Cologne

  Ordering no. for the upgrade: G26004-A3118-A045, release A3

  Mr. Niederpruem's tel. no.: 0221-576-2471

- Parameterization of the IP 252MC-DSP module

  SEND task 1, DW 31 bit 0 = 1 (for compatibility of the zero offset)

  SEND task 1, DW 31 bit 1 =1 (for compatibility of the reference point events)

Case 2

You have an IP 252MC-DSP module, ordering no. 6ES5 252-5FA11, release A1:

- Parameterization of the IP 252MC-DSP module

  SEND task 1, DW 31 bit 0= 1 (for compatibility of the zero offset)

  SEND task 1, DW 31 bit 1 =1 (for compatibility of the reference point events)

4.4 Description of the function blocks

4.4.1 Pulse generator

Task

Pulse generator and following-error controller produce a speed/feed rate control.

Selection pulse generator

SEND order 4 ... 7 (depending on the axis), DW 0

Traversing order

Sequence:

- Start with rising edge of the start/stop signal, direction presetting
- Acceleration of the axis after parameterized ramp up to $n_{command}$ or $v_{command}$
- Constant speed/feed rate traverse via pulse generator (speed/feed rate control with following-error control)
- Stop with falling edge of the start/stop signal
- Braking with the parameterized acceleration ramp (negative)

Parameter change with operational axis

The following changes can be made when an axis is operational:

- Command feed rate
- Acceleration
- Direction of rotation

In case of changes of speed and direction, the respective ramp steepness is active (acceleration).

Start/stop signals

In SEND order 4 .. 7, DW 0, the respective axis can be started with bit 8 = 1, stopped with bit 8 = 0.

Ext. start/stop for master

At the master it is additionally possible to react to the process via a start/stop pulse at the high-speed digital input DI 3.

The start signal of the interface (via SEND order 4, DW 0, bit 8) is linked with DI 3 via OR:

Order 4 DW 0, bit 8	Digital input DI 3	Effect
0	0	Stop
1	0	Start
1	1	Start
0	1	Start

Caution

The start/stop signals must not be used for EMERGENCY STOP but the standard electromechanical circuits such as the safety switchgear (Catalog AR80, Chapter Accessories).

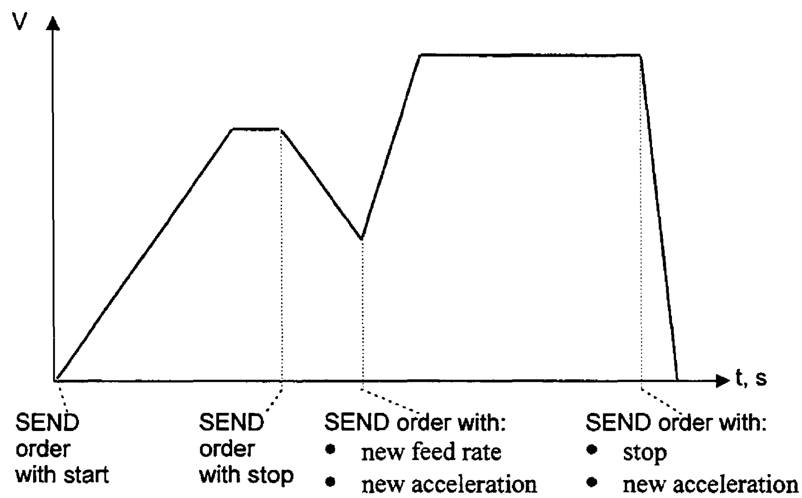


Fig. 4.19 Traversing profile of pulse generator with temporary removal of the start signal

Parameterization pulse generator

Function	Order	DW	Byte/ Bit	Comments
Activation pulse encoder	4 .. 7	0	Low/	01 = Pulse generator active
Start/stop	4 .. 7	0	High/0	0 = Stop pulse generator 1 = Start pulse generator
Direction	4 .. 7	0	High/1	0 = Positive (forwards) 1 = Negative (backwards)
Command pulse speed	4 .. 7	4	-	Traversing speed in pulses per 16 ms
Acceleration	4 .. 7	5	-	Steepness start and braking ramp Pulses / (16 ms)^2
Status	16	0 .. 3	/7 /9	Command feed rate = 0 Speed reached

Table 4-3 Parameters for pulse generator

Caution

Even with command feed rate = 0 the axis itself can still be in motion to close a pending contouring error.

Speed reached

The status bit 9 in RECEIVE order 16, DW ... 3 is set also if the command feed rate 0 has been issued and the axis is at standstill. Within the acceleration and braking ramps, bit 9 = 0.

4.4.2 Positioner

Task

The positioner compares the command position with the actual position and from this calculates a pulse sequence which traverses the axis to the command position.

Selection positioner

SEND order 4 ... 7 (depending on the axis), DW 0

Operations

Rotary axis:

- Absolute dimension
  Approach to absolute angular position
  - using the shortest distance
  - with direction presetting
- Incremental dimension

Linear axis:

Every position can be approached in the:

- absolute dimension (approach to absolute position)
- incremental dimension (relative part of distance)

Traversing order

Normal sequence:

- Start with rising edge of the start/stop signal
- Acceleration of the axis after parameterized ramp up to a maximum of $v_{command}$
- Position and following-error control until parameterized braking ramp (negative acceleration ramp) starts because:
  - braking starting point for command position has been reached
  - stop with falling edge of the start/stop signal has been recognized
  - intermediate stop has been recognized
- Standstill
  - Actual position = command position

Ext. start/stop for master

Please see page 4-29 and note on page 4-30

Parameter changes

Parameter changes during a running positioning operation do not have any effect. Changes are only recognized and evaluated with a rising edge of the start signal.

A running positioning operation can be influenced by:

- premature resetting of the start signal
- intermediate stop

Intermediate stop

The application of the parameter bit "intermediate stop" is only useful in the incremental dimension.

Sequence:

- "Intermediate stop" bit is set
- Braking ramp starts, axis stops
- "Intermediate stop" bit is reset later
- Axis accelerates over ramp to $v_{command}$ again and traverses the remaining path, the traversing order has not been restarted

Intermediate stop divides incremental dimension or absolute dimension

Fig. 4.20 shows the effect of "intermediate stop", Fig. 4.21 shows the effect of "stop" on the target position.

Sequence:

- Start with incremental / absolute dimension
  - Axis traverses over ramp to command feed rate
- "Intermediate stop = 1"
  - Axis reaches 60 % of the incremental / absolute dimension, for example, and stops
- "Intermediate stop = 0"
  - Axis traverses remaining incremental / absolute dimension of 40 % until the target position is reached

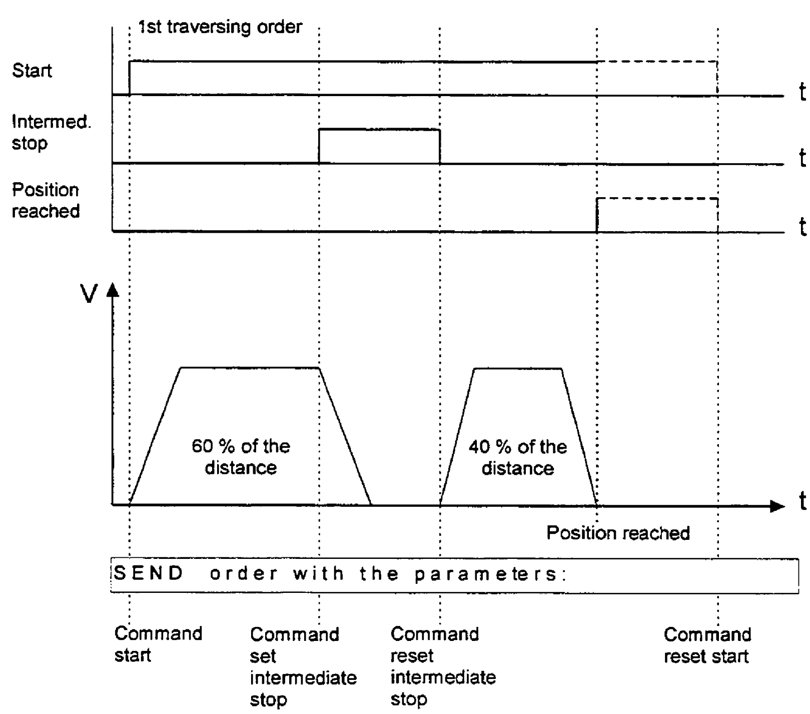


Fig. 4.20 Relative / absolute positioning travel with intermediate stop after 60 % of the distance

Premature Stop ends incremental dimension

In Fig. 4.21 the order is interrupted by stop and start and is restarted:

Sequence:

- Start with incremental dimension
  - Axis traverses over ramp to command feed rate
- Stop with falling start/stop bit edge
  - Traversing order is ended
  - Axis reaches e.g. 60 % of the incremental dimension
- Start with incremental dimension (here without changing the incremental dimension)
  - Axis traverses over ramp to command feed rate
- Position reached
  - Axis stops over braking ramp after 100 % of the 2nd traversing order have been processed
- Total path compared to the application of "intermediate stop": 160 %

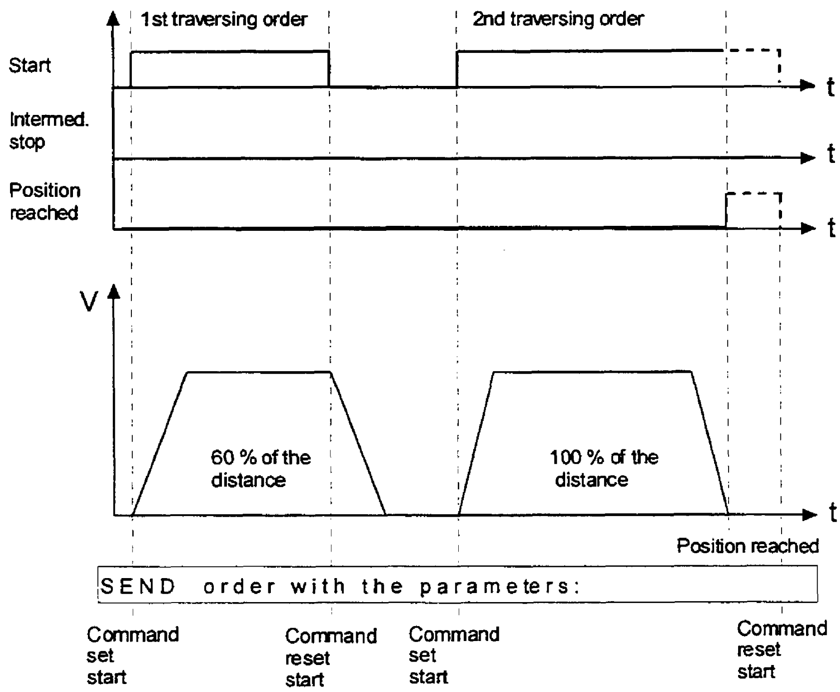


Fig. 4.21 Relative positioning travel with stop and start after 60 % of the distance

Premature Stop divides absolute dimension

In Fig. 4.22 the absolute dimension order is interrupted by start and stop and is restarted:

Sequence:

- Start in absolute dimension
- Premature stop due to falling start/stop bit edge
- Start in the absolute dimension, e.g. without target position
- Position reached
- Reset end of the traversing order with the command start

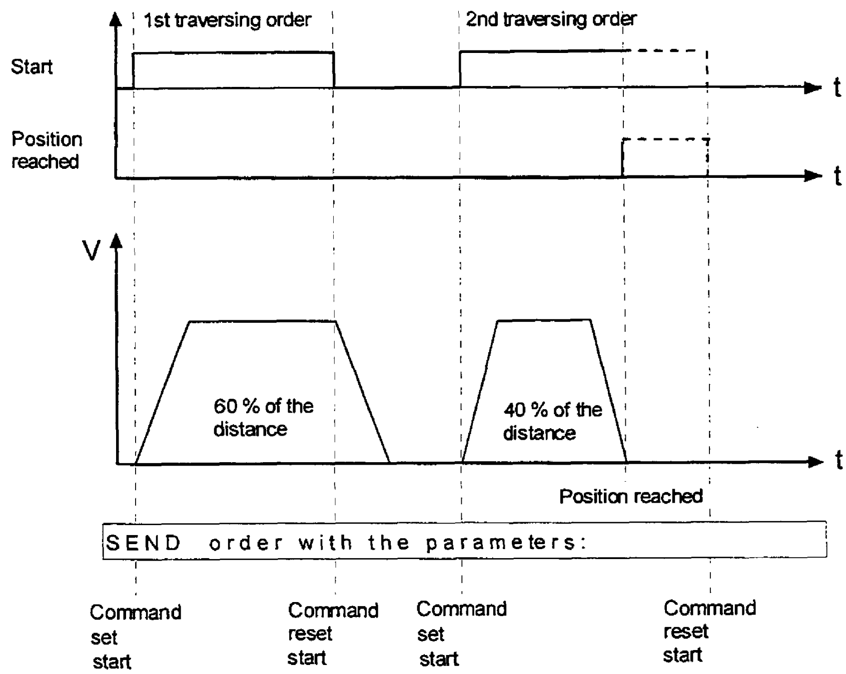


Fig. 4.22 Absolute positioning travel with stop and start after 60 % of the distance

Table 4-3 Parameters for pulse generator expanded by the following parameters/status messages applies for the parameterization of the positioner:

Parameterization positioner

Function	Order	DW	Byte/ Bit	Comments
Activation positioner	4 .. 7	0	Low/	02 = Absolute dimension, for rotary axis: shortest path 03 = Same as 02, for rotary axis with direction presetting in DW 0, high byte, bit 1 04 = Incremental dimension (relative), the direction is stated in the sign of the command position
Command position	4 .. 7	6,7	-	Target position for positioner in pulses in the absolute dimension or incremental dimension depending on DW 0, low byte: • For SIMATIC interface • New acceptance with rising start/stop bit regardless of whether the value has changed or if the old position has been reached.
Nominal pulse speed	4 .. 7	4	-	Traversing speed in pulses per 16 ms
Acceleration	4 .. 7	5	-	Steepness start and braking ramp pulses / $(16\ ms)^2$
Direction	4 .. 7	0	High/1	0 = Positive (forwards) 1 = Negative (backwards)
Start/stop	4 .. 7	0	High/0	0 = Stop positioner 1 = Start positioner
Intermediate stop	4 .. 7	0	High/5	0 = No intermediate stop 1 = Intermediate stop: Interruption of the running traversing order, remaining path is processed after resetting the parameter
Status	16	0 .. 3	/7 /8 /10	1 = Command feed rate = 0 1 = Following error > Window 1 = Position reached

Table 4-4 Parameters for positioner

4.4.3 Position-dependent switching signals

The IP 252MC offers the possibility of generating position-dependent switching signals with the aid of cam controllers. These can either be used internally or switched to the high-speed outputs of the module.

Application

This function can be used for:

- Simple cam controllers
- Software limit switches

Prerequisite

It might be necessary to traverse to the reference point before issuing the position-dependent switching signals.

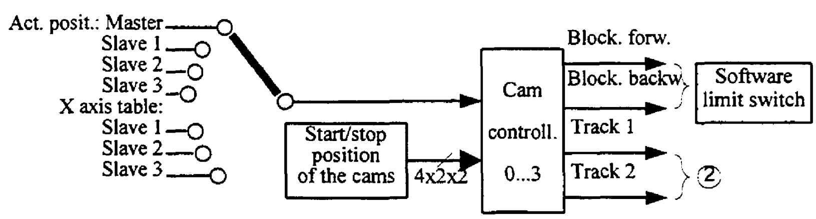
Features

The switching signals have the following features:

- Assignment to the actual values of an internal axis (can be changed online)
- Switch-on and switch-off position is parameterized (can be changed online)

This means that when the axis is at standstill (e.g. intermittent operation), the actual values and therefore the switching signals also stay in the current state.

Cam controller



② see *Fig. 4.17*

Fig. 4.23 Structure / signals of a cam controller

Axle assignment

Cam groups can be assigned freely to the individual axles. With the use of a software limit switch a definite assignment must be maintained:

- Master: cam group 0, track 1
- Slave 1: cam group 1, track 1
- Slave 2 cam group 2, track 1
- Slave 3 cam group 3, track 1

Furthermore, the cam groups must be assigned to the internal axles (SEND task 2, DW 24 ... 27).

Cam examples

Here are three cam controller examples:

- DO1: Cam 2 is in front of cam 1, i.e. the sequence is arbitrary
- DO2: Cam 2 starts in the area of cam 1, i.e. cams can overlap
- DO3: Cam 2
  Cam beginning > Cam end
  Consequence: Cam 2 traverses over the zero point.

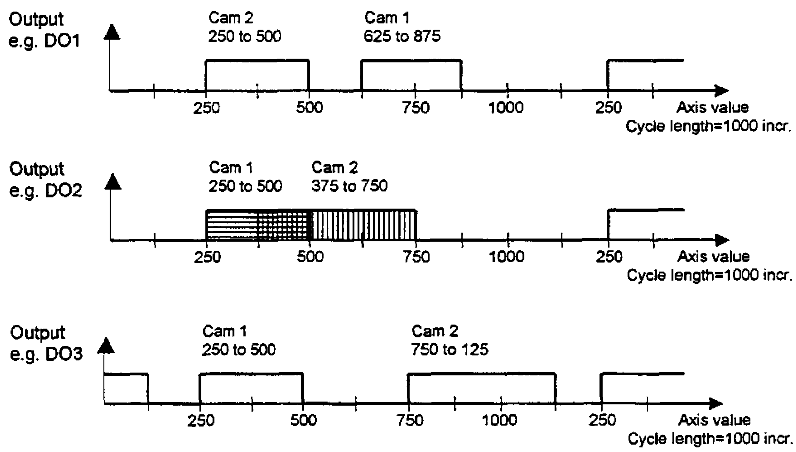


Fig. 4.24 Diagram - Switching signal output

Software limit switch

With the aid of the software limit switch an axis can be prevented from moving in the forbidden area. The area is marked by cam 1 or 2 of the first track of a cam controller.

Effective direction

The following cam assignment is valid:

- Cam 1 inhibits the direction forwards
- Cam 2 inhibits the direction backwards

Axis-specific release

The function of the software limit switches of the axes is activated or blocked per pair in SEND order 2, DW 21, bit 0 ... 3.

Software limit switch range

The valid traversing range is between cams 1 and 2.

As a cam has a range (between start and stop position of the cams) this also applies to the software limit switches (please see note).

Note

To prevent penetration of the software limit switch range due to the mass inertia of the drives, the following parameterization is recommended:

Cam 1 :	Beginning:	-2^{30}
	End:	Beginning software limit switch min.
Cam 2 :	Beginning:	Beginning software limit switch max.
	End:	2^{30}

Note

Plausibility of values for the software limit switches is not checked by the IP!

When a software limit switch is reached, the following happens:

- Feed rate (pulse) in the direction of the software limit switch is set to zero.
- Synchronization is lost.

The cam signals of the software limit switches can be assigned digital outputs and/or scanned via status displays (RECEIVE order 16).

Parameters for switching signals

Function	Order	DW	Byte/ Bit	Comments
Cam beginning	9, 10	0,1 4,5 8,9 etc.	- - -	Position at which the switching signal starts when moving in a positive direction or ends when moving in a negative direction.
Cam end	9,10	2,3 6,7 10,11 etc.	- - -	Position at which the switching signal ends when moving in a positive direction or starts when moving in a negative direction.
Software limit switch	2	21	/0 ... /3	Release of the software limit switches for: Internal axis 0 ⇒ Bit 0=1 Internal axis 1 ⇒ Bit 1=1 Internal axis 2 ⇒ Bit 2=1 Internal axis 3 ⇒ Bit 3=1
Assignment cam controller 0 .. 3	2	24...27	-	Each cam controller can optionally be assigned one of the 7 possible actual value (position) sources. Example for DW 25: 0 = Actual position slave 1 1 = Actual position master 2 = Actual position slave 2 3 = Actual position slave 3 5 = Internal table position (x axis) slave 1 6 = Internal table position (x axis) slave 2 7 = Internal table position (x axis) slave 3
Function digital outputs	1	2...5	-	Here, the cam controllers and the tracks are assigned to the digital outputs.
Status cams	16	0...3	/0 ... /3	Display of all cam statuses of the 4 cam controllers

Table 4-5 Parameters for "position-dependent switching signals"

4.4.4 Controller

Principle circuit diagram

The controller of the IP 252MC is designed as P-controller with pilot control.

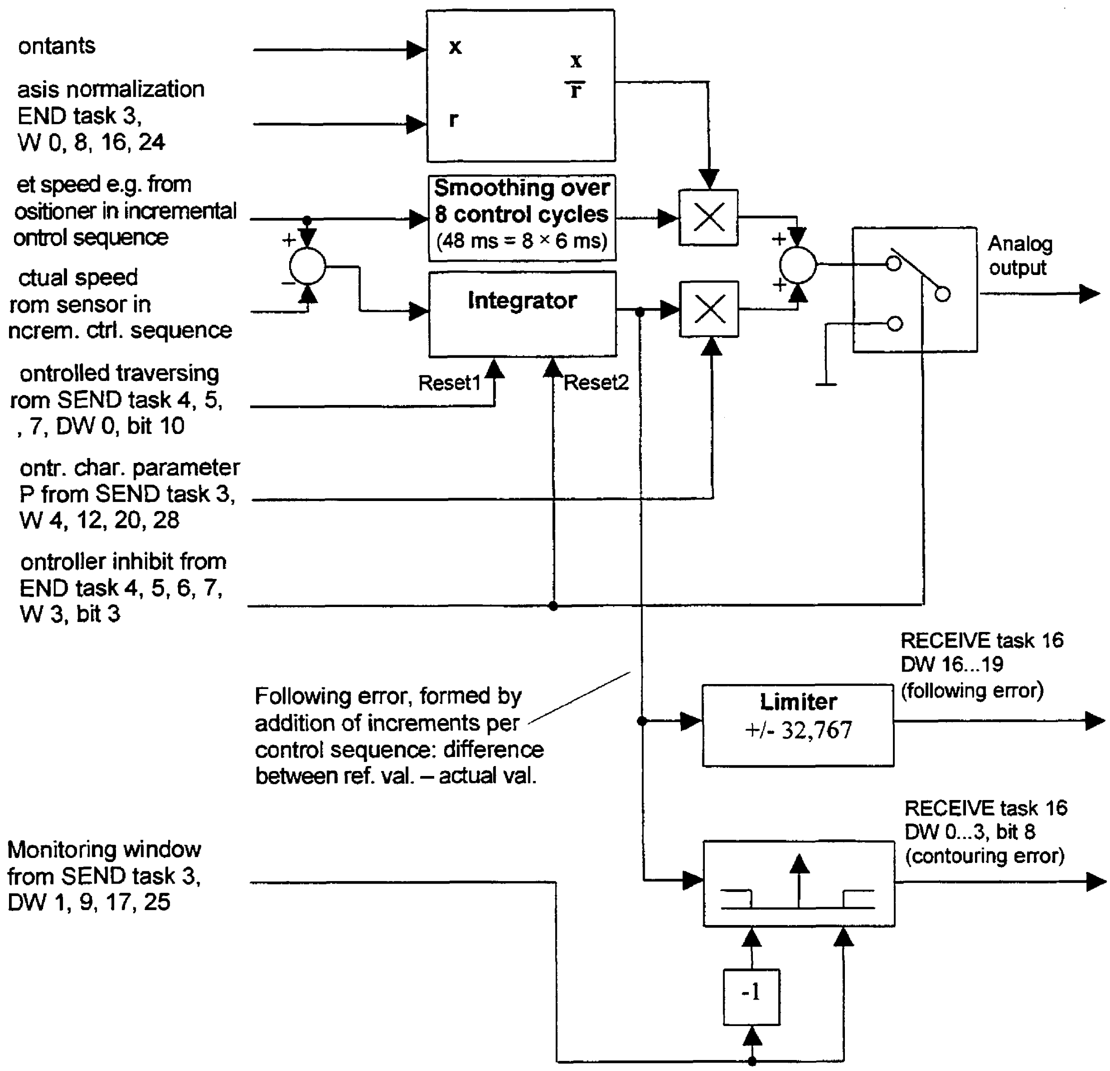


Fig. 4-25 Function diagram controller IP 252MC (schematic drawing)

Pilot control

The pilot control and a short closed-loop position controller clock pulse guarantee that the slave axes can follow the master (command value) with a following error which is almost negligible. With the suitable parameterization (please see chapter 7.2) the following error is not dependent on the feed rate.

Following error

Definition:
Difference between momentary command position and actual position of an axis.

The following error is kept to zero by selecting:

- Follow-up mode
- Controller disable

Monitoring following error

The following error is monitored with the help of a window. If the window is exited, a contouring error is **signaled** (RECEIVE order 16, DW 0 ... 3, bit 8 = 1). The module does not react on its own to a contouring error but stays in the position/feed rate control. Additionally, this signal can be assigned to the high-speed digital outputs via parameterization.

Follow-up mode

Application reasons:

- During operation, an axis must, for example, be:
  - traversed against a fixed stop,
  - linked mechanically with a second axis,
  - braked to a stop.
- E.g. fault rectification after blockage of an axis

Activation:

The control loop of the following-error controller must be opened for the respective internal axis via SEND order 4 .. 7, DW 0, high byte, bit 2 = 1.

With this, controlled (follow-up) traversing is possible.

Effects:

- The existing following error is:
  - set to and kept at zero
  - not displayed
  - not evaluated
  - not controlled
- The positioning control loop is opened.
- The axis traverses "blindly" with the help of the pilot control and the calculated command feed rate.
- The following is not recognized:
  - Feed rate reductions due to load variations
  - Standstill in the case of a blocked axis
- Precise (angle) synchronization is not guaranteed.
- There is a drift.

Controller disable

Activation:

In SEND order 4 ... 7, DW 3, bit 3 = 1 is to be set for the respective internal axis.

Effects:

- The control loop of the following-error controller is opened and thus follow-up mode is activated.
- Analog command value output for the axis drive is instantly set to "0" and leads to instantaneous braking until axis standstill is met.

Applications:

- Axis clamping
- Reaction to severe error messages
- Suppression of undesired analog outputs for axes not used.

Note

Drift might arise at the axes due to:

- Pick-up of an interference voltage
- Low offset of the analog outputs

Solution: Remove drive release

Parameters for controller

Function	Order	DW	Byte/ Bit	Comments
Initial scaling	3	0, 8, 16, 24	- -	Number of pulses N per millisecond which is generated by an analog command value of 10 V.
Window following error	3	1, 9, 17, 25	- -	Entry in pulses
Controller parameter K_p	3	4, 12, 20, 28	- -	The larger K_P, the larger the activity of the controller with fixed following error.
Follow-up mode	4 ... 7	0	High/2	0 = Following-error controller active 1 = Open-loop controlled traversing
Controller disable	4 ... 7	3	/3	0 = No controller disable 1 = Controller disable (command value output = 0)
Display following error	16	16...19		Current following error in pulses
Display contouring error	16	0...3	/8	0 = Following error ≤ Window 1 = Following error > Window
Display command feed rate = 0	16	0 ... 3	/7	0 = Command feed rate ≤ 0 1 = Command feed rate = 0
Function of the digital outputs	1	2 ... 5	-	Assignment to: • No. cam controller/track • Error messages: – Contouring error axis-specific – PROFIBUS-DB error

Table 4-6 Parameters for "position-dependent switching signals"

4.4.5 Synchronization

Definition

One or several following axes are dependent on one guide axis.

The dependency refers to:

- Start/stop
- Speed
- Position

The guide axis can be moved arbitrarily; the following axes follow their guide value. All sorts of cascading are possible in a module so that a following axis can also be the guide axis for another internal axis.

Synchronization variants

The following axes move in synchronization with the guide axis. The following modifications influence the synchronization:

- Electronic transmission
- Electronic cam disk (traversing table)
- Electronic coupling (start/stop)

Guide value generation

Function	Order	DW	Byte/ Bit	Comments
Guide value generation master	2	20	Low/	00= Actual value guidance 01= Command value guidance 02= IP-Link absolute position acceptance 03= IP-Link relative position acceptance 04= Virtual master
Guide axis of following axis n	2	17...19	-	Selection of the internal axis which is to be the guide axis for following axis n [1 ... 3]
Operating mode synchro-nization	5 ... 7	0	Low/	00= Synchronization

Table 4-7 Parameters for guide value generation / call operating mode synchronization

Details for guide value generation:
Please see chapter 4.1.1 Guide value generation

Synchronization variants: Please see the following sub-chapter, 4.4.5.1.

4.4.5.1. Synchronization 1:1

Synchronization 1:1 The following axis traverses the same number of increments as the guide axis.

Application example Portal with identical left- and right-hand side

Function	Order	DW	Byte/ Bit	Comments
Operating mode synchro-nization	5 ... 7	0	Low/	00 = Synchronization
Synchroni-zation 1 : 1	5 ... 7	1	Low/	00 = Synchronization 1:1

Table 4-8 Parameters for the synchronization of the portal drives

4.4.5.2. Electronic transmission

Transmission ratios between the following axis and the master axis can be predefined and adapted with the IP 252MC. The transmission function acts like a mechanically toothed transmission.

Transmission ratio The factor i is usually calculated as follows:

$$i = \frac{\text{Increments following axis}}{\text{Increments guide axis}}$$

Application examples Several drives are to work in synchronization with each other but traverse at different feed rates. This is necessary if, for example, a belt is to be driven over rollers of different diameters (D1, D2). The factor i of the transmission ratio is calculated under the condition that the peripheral speed of the rollers is the same. The speed (increments/time) is inversely proportional to the roller diameter. Assuming that the axes are mechanically identical, the following applies:

$$i = \frac{\text{Increments following axis}}{\text{Increments guide axis}} = \frac{\varnothing\text{ Master roller}}{\varnothing\text{ Slave roller}} = \frac{D1}{D2}$$

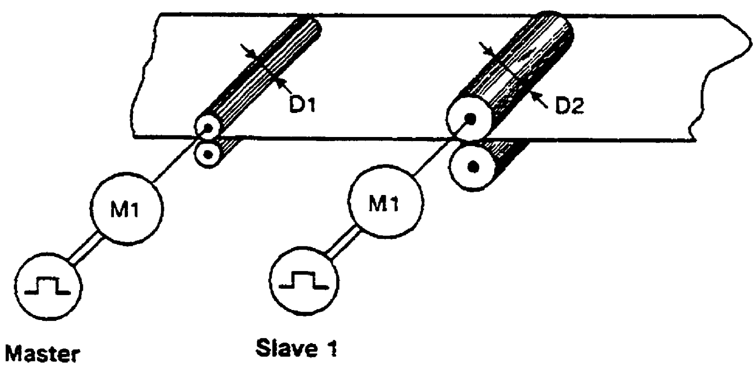


Fig. 4.26 Transmission with different roller diameters

Limits

The following is permissible as a transmission ratio:

$$i = \frac{\text{Increments following axis}}{\text{Increments guide axis}} = \frac{0 \ldots \pm 32000}{1 \ldots 32000} \leq \frac{5}{1}$$

The restriction following axis : guide axis ≤ 5 : 1 (feed rate of the following axis ≤ 5 x feed rate of the guide axis) is a limit due to mechanics not to the module. Higher ratios lead to "chattering" following axes when the master traverses slowly. "i" can be set separately for every following axis.

Examples

i = 1 : 2 ⇒ Guide axis traverses twice as many increments as the following axis

i = 2 : 1 ⇒ Following axis traverses twice as many increments as the guide axis

i = 9998:9999 ⇒ Very fine transmission adaptation (application e.g.: roller wear)

Dynamic transmission

The transmission ratio i can also be changed/adapted during the operating phase.

Note

Every change instantly influences the following axis.

Reversal of direction of rotation

The numerator of the transmission ratio i can also be set negative (please see SEND order 5...7, DW 8), e.g. i = -1:2

Function	Order	DW	Byte/ Bit	Comments
Operating mode synchro-nization	5 ... 7	0	Low/	00= Synchronization
Synchro-nization 1 : 1	5 ... 7	1	Low/	01= Electronic transmission
Numerator scaling factor i	5 ... 7	8		0 ... ± 32 000
Denominator scaling factor i	5 ... 7	9		1 ... 32 000

Table 4-9 Parameters for synchronization with electronic transmission

4.4.5.3. Traversing table

Description

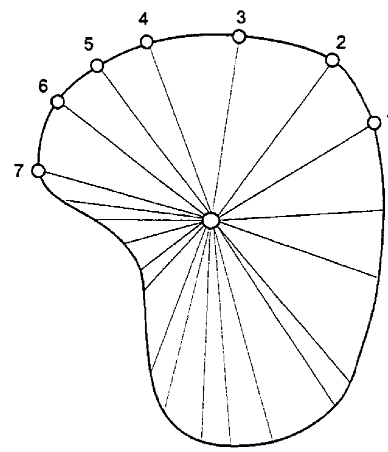
A traversing table states the nodes (position value pairs) with which a relationship between a guide axis position (entered along the x axis) and a slave axis position (entered along the y axis) is made. A linear interpolation determining the value of a constant feed rate between two nodes for the slave axis is made. The nodes (position value pairs) determine the movement profile of the slave axis contingent upon the movement of the guide axis.

Function principle

When switching over to table synchronization (SEND order 5 ... 7, DW 1, low byte = 02) this movement profile is traversed, starting from the current position of the guide axis and the slave axis. To establish an absolute relation between the positions of the axes and the values in the table, the position of the guide axis must be transferred explicitly into the position of the x axis (SEND order 4 ... 7, DW 0, high byte, bit 3 = 1 ⇒ Synchronize table). Subsequently, the slave axis must be positioned to the position according to the table (please see chapter 6, sub-chapter "Sequence descriptions").

Cam disk example

A possibility of using the traversing table is the electronic simulation of a cam disk.



Position master	Position slave
0°	100 mm
30°	95 mm
60°	90 mm
90°	95 mm
.	.
.	.
.	.

Fig. 4.27 Cam disk and corresponding table

Due to the linear interpolation, corners arise at the transitions. To keep these low, the appropriate number of nodes must be parameterized.

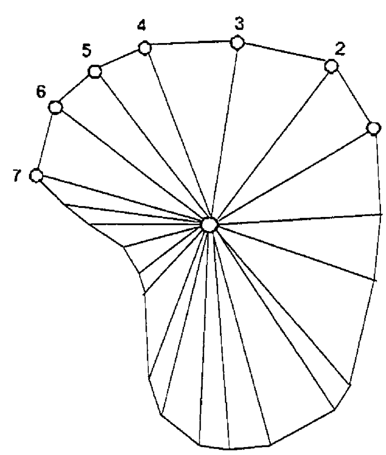


Fig. 4.28 Cam disk after processing

Configuration table

At start-up of the module the available number of tables and the maximum number of nodes can be determined (SEND order 1, DW 15).

DW 15	Number of tables	Table numbers	Max. number of nodes	Node numbers
00 00h	8	0 ... 7	1022	0 ...1021
00 01h	16	0 ... 15	510	0 ... 509
00 02h	32	0 ... 31	254	0 ... 253

Table 4-10 Possible traversing table configurations

Table width/ valid nodes

When the table is transferred to the module, a width of the table (along the x axis) is stated. All table nodes have x coordinates in the range 0 ... table width. Nodes not within this range are ignored.

Sorting sequence of the nodes

Nodes are sorted out from the left to the right along the x axis and transferred to the module. Infringement of the sorting sequence terminates the acceptance of the nodes.

Horizontal perpendicular

Table beginning:
If no y value is predefined for $x = 0$, i.e. the first node (x_0, y_0) is predefined with $x_0 > 0$, then the value y_1 is calculated in the range $x = 0 \ldots x_1$.

The same applies at the table end:
If the last node (x_m, y_m) with $x_m <$ table width, then the value y_m is calculated in the range $x = x_m$ ... table width.

Table transmission

With SEND order 15, nodes and table width for all tables are transferred to the module.

A maximum of 7 nodes can be transferred per order, consisting of:

- 2 DW with a value for guide axis (x position)
- 2 DW with a value for slave axis (y position)

Tables with more than 7 nodes must be transferred as a sequence of different SEND orders 15 (please see chapter 6, sub-chapter "Sequence descriptions").

The table width is also transferred in SEND order 15, DW 4 and 5 if DW 2 = 0 is set.

Table status

Feedbacks on the table statuses can be seen in RECEIVE order 16, DW 28 ... 31 or in RECEIVE order 14. The update of the status information is made during table acceptance or reset of the status information via command (SEND order 15, DW 0 = -4).

Flexible use of tables

- Every table can be assigned in SEND order 5 ... 7, high byte:
  - to any slave axis
  - to several slave axes simultaneously
- Scaling
  Slave positions in a table can be multiplied with a scaling factor.
  This factor is:
- To be transferred as ratio numerator/denominator in SEND order 5 ... 7, DW 8, 9.
- To be activated in SEND order 5 ... 7, DW 2, bit 3 = 1

Note

The scaling does not affect the x axis but the y axis.

Processing modes / table functions

In SEND order 5 ... 7, DW 2, bits 0 and 1, the behavior of the table can be parameterized at:

- reaching the table edge
  - continuous output
  - stop at table end
- jump at table end/beginning
  - relative output
  - absolute output

Continuous output

When the current x value reaches the table end, it is once more jumped to the table beginning. Prerequisite is the parameterization "continuous output" in SEND order 5 ... 7, DW 2, bit 1 = 0. In the same way it is jumped to the table end in case it falls below "0" (left table edge).

Example: Continuous output

In the following example, the guide axis traverses at a constant feed rate. Continuous output is selected.

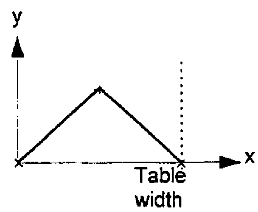


Fig. 4.29 Nodes (slave position y, guide axis position x)

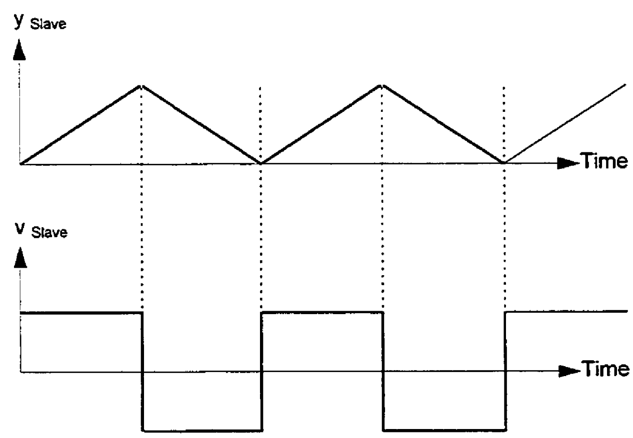


Fig. 4.30 Time sequence of position y and feed rate v of the slave axis

This setting is especially useful if the guide axis is a rotary axis. The table width usually then corresponds to the size of the guide axis (increments per guide axis revolution).

Stop at table end

"Stop at table end" is selected via SEND order 5 ... 7, DW 2, bit 1 = 1. When the x value reaches the table end:

- the movement of the guide axis is traced along the x axis
- the y value for the position of the slave axis is kept on the last value

The same applies when the x value falls below the table beginning.

Example: Stop at table end

In the following example, the guide axis traverses at a constant feed rate.

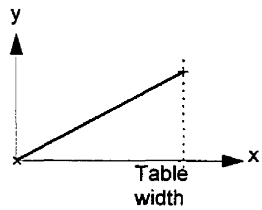


Fig. 4.31 Nodes (slave position y, guide axis position x)

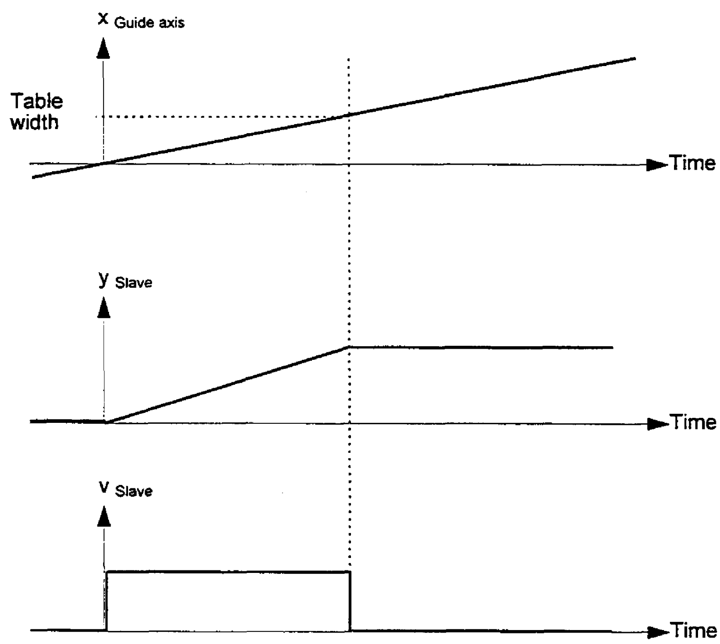


Fig. 4.32 Time sequence of: Position x of the guide axis
Position y and feed rate v of the slave axis

When the guide axis reaches the table position x = table width, the slave axis stops.

This setting is especially useful if:

- the guide axis is a linear axis and
- dynamic performance of the slave axis is only necessary in a certain range (e.g. 0 ... table width).

Note

Please make sure that the x position is not exceeded (31 bit + sign) because then it will be jumped to x = - ∞, i.e. - 2^{30}. It can be ascertained via RECEIVE order 16, DW 1... 3, where the table is currently being interpolated/ processed.

Relative output

"Relative output" is selected via SEND order 5 ... 7, DW 2, bit 0 = 1. The relative output can be used to ensure that a possible jump is "deducted" and thus **continuous** connection is ensured.

Example: Relative output

A foil strip is to be cut while moving with a rotating blade.

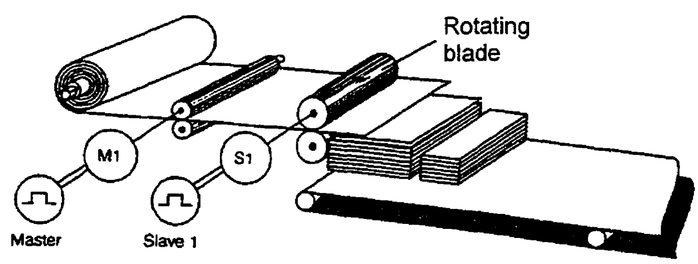


Fig. 4.33 Cutting a moving foil with a rotating blade

The axes work as follows:

- Guide axis
  - Continuous axis (pulse generator parameterized ⇒ constant speed)
- Slave axis
  - Traversing table with 4 nodes
  - Relative output of the slave table values
  - Continuous output of the table values

During the cutting process the peripheral speed of the blade must be similar to the foil feed rate, i.e. synchronization between guide axis and slave axis.

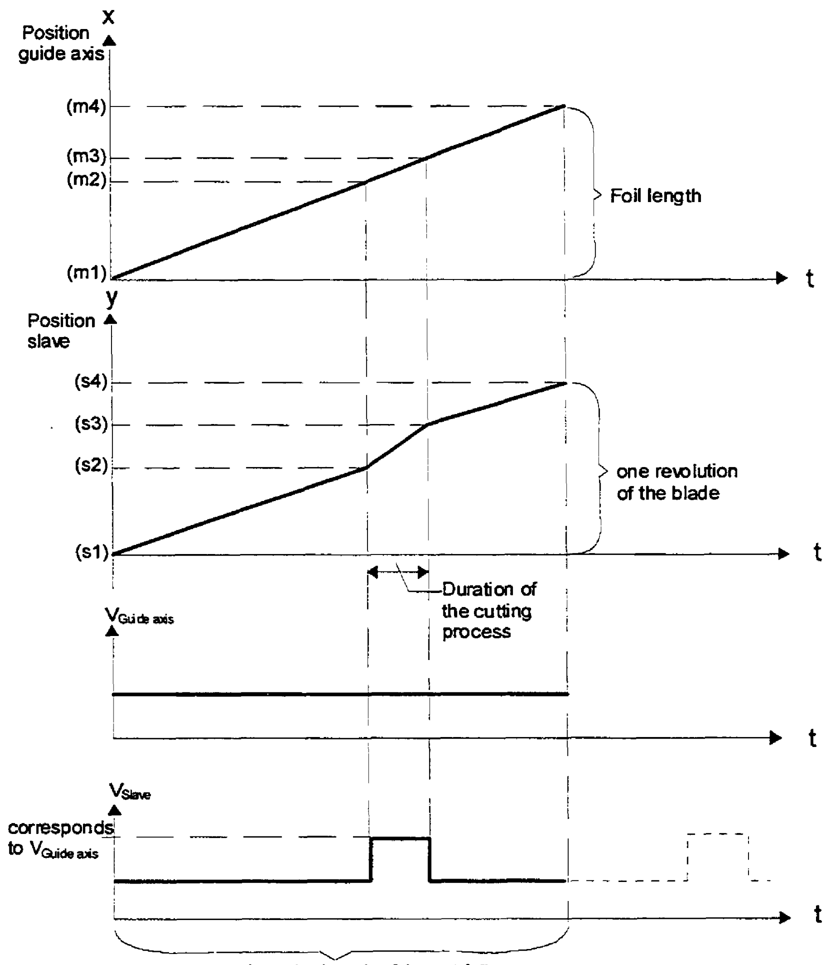


Fig. 4.34 Movement diagrams for Fig. 4.33

Nodes / value pairs

The guide value positions m_1 .. m_4 are assigned the slave positions s_1 .. s_4. This results in 4 value pairs $m_{1;}s_1$ .. $m_{4;}s_4$ which are called nodes.

Absolute output

When selecting "absolute output" via SEND order 5 ... 7, DW 2, bit 0 = 0, position jumps which occur at the table end are not "deducted", as in "relative output", but transferred to the position encoder without interruption.

The application of "absolute output" is only useful when the table data ensure that there cannot be any jumps as, for instance, with $y_{End} = y_{Beginning}$.

Example: Absolute output

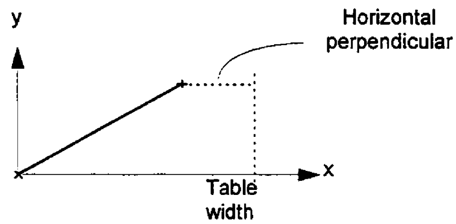


Fig. 4.35 Nodes (slave position y, guide axis position x)

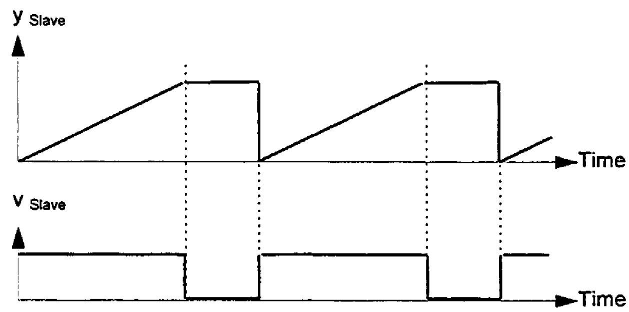


Fig. 4.36 Time sequence of position y and feed rate v of the slave axis

Operating mode synchronization: traversing table

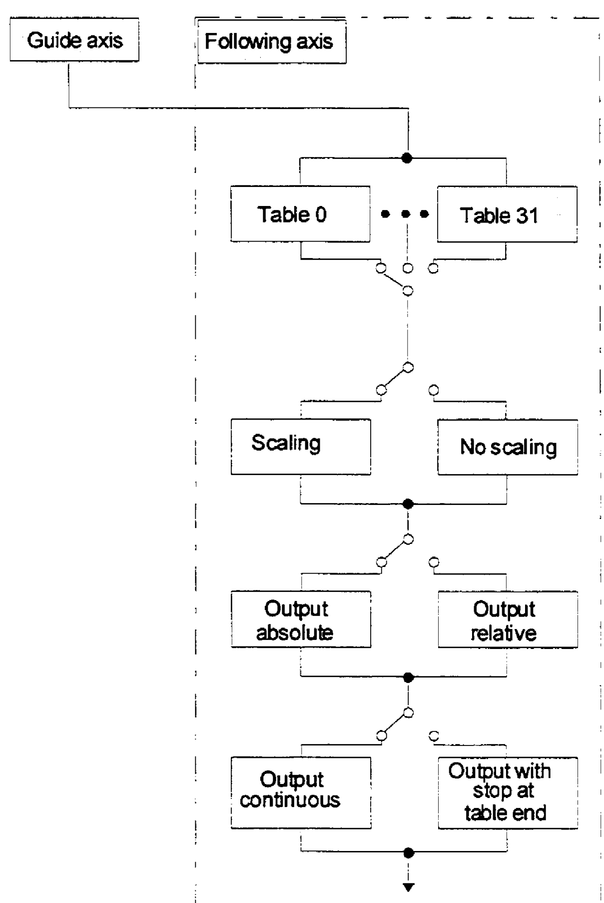


Fig. 4.37 Overview: Operating modes traversing table

Traversing table control

In RECEIVE order 13, DW 20 ... 30, the position at which the selected table has interpolated along the x axis and the result of this can be read back for every slave axis.

Changes of: table number, table values

If the active table number is to be changed, or if the current table is to be overwritten with new data, the following is recommended:

- Leave synchronization (select different operating mode in SEND order 5 ... 7, DW 0)
- Set guide axis to standstill (SEND order 4, DW 0)

Notes

- If the recommendation is not observed, this might result in unwanted, jumpy movements of the corresponding slave axis.
  - Jumps which result from switching the table / changing the table are transferred directly to the position encoder without limitation, which might lead to jerky compensation movements.
  - The transfer of new data for a currently used table does not cause any problems as the closed-loop control works with a checked copy of the data. Only when triggering the command "Accept table" with SEND order 15, DW 2 = -2, are the data transferred by the control checked for sorting sequence and compliance with the range 0 ... table width and transferred into the copy accessible for the closed-loop control. This procedure is carried out with low priority and can therefore take a longer period of time.

Exception: During running synchronization, switching over the table number is possible without any problems if it is ensured that the two tables (old and new) are identical in the switchover area. To ensure that the switchover really happens in the required area, it must be ensured that this area is long enough (long concerning time), as the times for program run and communication are not precisely known in advance.

Influencing the x coordinate

After switching over to table synchronization, the x coordinate is moved with the correct sign with the movement of the guide axis, starting from the current value:

- After selecting tables in SEND order 5 ... 7, DW 1, low byte = 02 (traversing table), this value is zero.
- As long as a traversing table is selected, the last value is maintained or the value changes in increments if the guide axis traverses. This applies regardless whether synchronization is selected or not and independently of the entry in SEND order 5 ...7, DW 0, low byte.

Table synchronization

With the command "Synchronize table", via SEND order 5 ... 7, DW 0, high byte, bit 3 = 1, the value of the x coordinate is set to the current actual position of the guide axis.
Prerequisite: SEND order 5 ... 7, DW 1, low byte = 02.

Notes

- The current actual position must be in the range 0 ... table width, otherwise the slave axis does not react in a recognized pattern.
- When activating "Synchronize table" in SEND order 5 ... 7, DW 0, low byte, synchronization should **not** be selected as this could otherwise result in jumpy movements of the slave axis.

External synchronization during table synchronization

The x coordinate is set to zero in the following controller cycle when the rising edge of the external synchronization signal (registration mark offset) is detected.

Notes

- If the following commands are active in SEND order 5 ... 7:
  DW 0, low byte = 00 (synchronization)
  DW 1, low byte = 02 (traversing table)
  DW 2, low byte, bit 2 = 0 (absolute output),
  an offset is carried out in a jumpy way. The limitation of the offset speed via DW 18 is not active.

Via the mechanism of the external synchronization it is also possible to reset the x coordinate to zero in the function "Stop at table end". A further table execution / movement procedure for a slave axis can be started with this mechanism.

Parameters for synchronization with table traversing

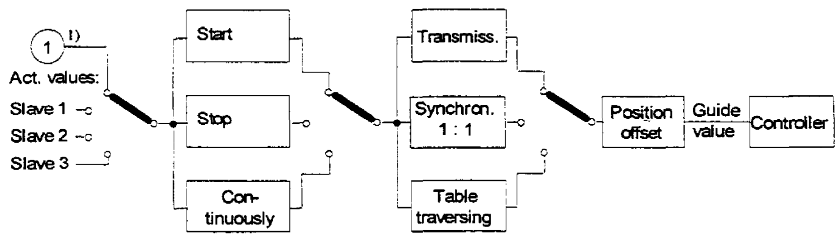
Function	Order/ Signal	DW	Byte/ Bit	Comments
Guide value generation	2	20	Low/	Please see chapter 6, Order description SEND order 2
Guide axis of slave	2	17...19	Low/	See chapter 6, Order description SEND order 2
Operating mode synchro-nization	5 ... 7	0	Low/	00= Synchronization
Function synchro-nization	5 ... 7	1	Low/	02= Traversing table
Synchro-nize table	5 ... 7	0	Low/3	1 = Synchronize table
Table number	5 ... 7	2	High/	Number of the traversing table
Traversing table: Mode / operating mode	5 ...7	2	Low/0 /1 /3	0 = Absolute output 1 = Relative output 0 = Continuous output 1 = Stop at table end 0 = Table without scaling 1 = Table with scaling
Factor for scaling	5 ... 7	8, 9	-	Numerator and denominator of the scaling factor
Table trans-mission	15	-	-	Please see chapter 6, Order description SEND order 15
Table status	16 14	28...31 0...31	-	Please see chapter 6, Order description RECEIVE orders 16 and 14
x, y coordinates	13	20...31	-	Current internal table position per slave axis, please see chapter 6, Order description RECEIVE order 13
Range x coordinate	16	1...3	/5, 6	Bit: 5 | 6 0 | 0 ⇒ 0 ≤ x ≤ Table width 0 | 1 ⇒ x > Table width 1 | 0 ⇒ x < 0 1 | 1 ⇒ Table not selected
Position offset	DI0 DI1 DI2			Slave axis1, alarm at Slave axis2, alarm at Slave axis3, polling to

Table 4-11 Parameters for synchronization with table traversing

4.4.5.4. Start/stop

Method of operation

A selected synchronization function can be modified with start/stop.



1) Please see figures 4.3, 4.4, 4.5, 4.8, 4.9

Fig. 4.38 Overview of slave synchronization functions

The coupling procedure:

- starts with synchronous angles to the guide axis (coupling position)
- is active during a parameterizable section of the guide axis (= length start/stop cycle N_{out} + pulses for ramp N_B)
- is carried out smoothly via a parameterizable coupling/decoupling ramp (pulses for ramp start/stop N_B)
- can be retriggered, i.e. prolonged

Start or stop?

Start is selected if the slave axis is mostly at standstill and is to carry out a movement with synchronous angles to the guide axis on an external preparation signal (DI 5 ... 7).
Example: Start packing procedure after a required number of products has arrived, i.e. do not pack every product individually.

Stop is selected if the slave axis is mostly in motion and is to leave out a movement with synchronous angles to the guide axis on an external preparation signal (DI 5 ... 7).
Example: Sorting out bad products which are not to be packed.

Start conditions, coupling position

The coupling procedure is started by the following conditions:

- Preparation signal recognized, i.e. rising edge at DI 5 ... 7 (depending on the slave axis 1 ... 3)
- Subsequently, the guide axis overtravels the coupling position

---

Note

The signal at the digital input must be pending for at least one controller cycle. The controller cycle is for:

IP 252MC = 6 ms
IP 252MC-DP = 6 ms
IP 252MC-DSP = 0.5 ms

Retriggering or extending

With further rising edges at DI 5 ... 7 (depending on the slave axis), the coupling procedure can be extended by one length of the start/stop cycle N_{out} each.

Prerequisites:

- Second/further edges arrive after the first coupling procedure has started, i.e. the coupling position must have been overtraveled by the guide axis.
- The return to the normal position (ramp at the end of the coupling procedure) must not have already started.

Other start signals are discarded/not saved (please see Fig. 4.39)

High clock pulse rates

The direct, high-speed digital inputs of the IP 252MC (-DP, -DSP) for the external start edge work independently of the SIMATIC cycle. Thus, high clock pulse rates are possible.

Start

The movement of the slave axis starts when the guide axis overtravels the coupling position CP and a preparation signal (rising edge at DI 5 ... 7) has been recognized beforehand. Starting point for the movement of the slave axis is the last valid position of the slave axis (please see Fig. 4.39).

Section at start

The start lets exactly N_{out} (= length of the start cycle) pulses of the guide axis pass. Further pulses are completely suppressed. Of these N_{out} pulses, $N_B/2$ (NB = pulses for ramp start) are used for smooth coupling and at the end again $N_B/2$ pulses are used for smooth decoupling.

During the coupling ramp the guide axis traverses N_B pulses, the slave axis "sees" only $N_B/2$ of it (area triangle under the ramp = ½ area rectangle, please see Fig. 4.38, the same applies for the decoupling ramp).

Result:

- The guide axis traverses $N_{out} + N_B$ pulses over the whole coupling procedure.
- The slave axis "sees" only N_{out} pulses of it.

These overall N_{out} pulses which the slave axis "sees" are transferred to the following synchronization function. If transmission synchronization is selected with the ratio

$$i = \frac{\text{Numerator}}{\text{Denominator}},$$

then the slave axis traverses the section $i \times N_{out}$.

It is also possible that a table with the table width N_{out} could be fully executed once to realize a complete slave axis movement during the start cycle.

Stop

The stop cuts out exactly N_{out} pulses of the guide axis (N_{out} = length of the stop cycle). As with the start, the guide axis traverses $N_{out} + N_B$ pulses during a complete stop cycle, caused by the smooth coupling/decoupling procedure. The slave axis "sees" only N_B pulses of it. These are divided into $N_B/2$ pulses during the decoupling at the beginning and $N_B/2$ pulses during the coupling at the end of the procedure.

Minimum conditions

- Pulses for ramp N_B with: $1 \leq N_B \leq N_{out}$
- For $N_B = 1$ the result is a very steep coupling/decoupling procedure
- For $N_B = N_{out}$ this does not result in a real synchronization with synchronous angles as transition between the coupling and decoupling procedure is almost imperceptible. The trapezium in Fig. 4.38 becomes a triangle.

Example / diagram

The following conditions are prerequisites for Fig. 4.39 "Example for start/stop":

- Synchronization 1:1 and v_{Master} = constant
- Cycle length of the guide axis (machine cycle) = 1000 increments
- Coupling position CP = 400 increments on the guide axis
- Slave acceleration N_B = 100 increments, i.e. the slave axis must accelerate / brake from coupling position 400 onwards. The acceleration lasts for 100 increments of the master axis, equivalent to 50 increments of the slave axis for its acceleration and 50 increments for its braking since synchronization 1:1 was predefined.
  - Start: From master position CP + N_B onwards, the slave axis must work in synchronization (here 1 : 1).
  - Stop: From master position CP + N_B onwards, the slave axis must be at standstill.
- N_{out} = 300 increments on the guide axis starting at:
  - Start: From synchronization onwards
  - Stop: From standstill onwards

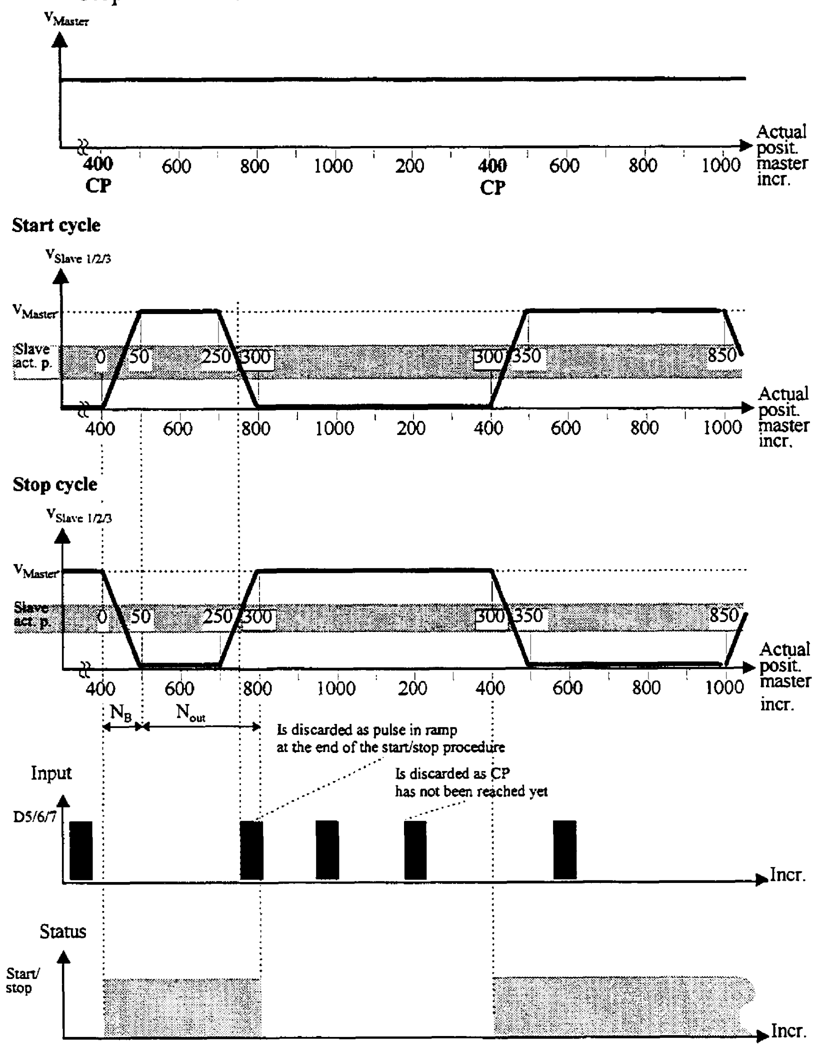


Fig. 4.39 Example for start/stop

Calculation examples for parameters:

- **Coupling position**
- **Nout**
- **NB**

Example 1: Start

- Master and slave axis are similar rotary axes.
  One revolution is the equivalent of 1000 increments.
- The slave axis traverses in synchronization 1:1 to the master axis and is to carry out exactly one revolution from the starting position "0" onwards when the master axis overtravels the position 400.
- 10% of the revolution are to be used for the smooth coupling/decoupling.
- Computation:
  - Slave axis stands at "0"
  - N_{out} = 1000 = One revolution of the slave axis
  - CP = 400 = Beginning of the movement of the slave axis
  - N_B = 10% of N_{out} = 100
- Result:
  - Movement sequence as in Fig. 4.38

Example 2: Start

- Ratio: $i = \frac{\text{Numerator}}{\text{Denominator}} = \frac{\text{Following axis (slave)}}{\text{Guide axis}} = \frac{20}{10}$
- Synchronization with synchronous angles required from $x_{Synchronization}$ = 500 (guide axis position) onwards
- During the start the slave axis is to travel one total cycle length = MN_S[1] = N_S = 2 000.
- The ramp area for smooth coupling/decoupling is to be 10% of the start cycle.
- Computation:

$$\text{Nout} = \frac{Ns}{i} = \frac{2\,000}{20/10} = 1\,000$$

- N_B = 10% or N_{out} = 100
- CP = $x_{Synchronization}$ - N_B
  CP = 500 - 100 = 400

[1] Maximum number of pulses per slave

Example 3: Stop

- Master and slave axis are similar rotary axes. One revolution is the equivalent of 10 000 increments (MN_M[1] = MN_S[2] = 10 000)
- Master and slave axis traverse in synchronization 1 : 1 with a speed of 10 increments/millisecond when coupled
- The slave axis is to be at standstill for exactly one master revolution:
  $\Delta x_{Standstill} = MN_M$[1] $= 10\ 000$
- Standstill of the slave axis starts when master is at $x_{Standstill,\ Master} = 250$
- Braking time of the slave axis is to be 100 ms (during the ramps)
- In the braking time the slave axis is smoothly slowed down with a constant delaying from $v_{Beginning,\ Slave} = v_{Master}$ to zero. The number of the slave increments is half the number of the master increments inside of the braking time.
- Computation:
  - The slave axis traverses the section $\Delta x_{Braking,\ Slave}$:
    $\Delta x_{Braking,\ Slave} = \frac{1}{2} \times T_{Braking} \times v_{Beginning,\ Slave}$
    $= \frac{1}{2} \times 100\ ms \times 10$ increments/ms
    $= 500$ increments
  - The number of the master increments is calculated from the master speed (constant feed rate) and the braking time :
    $\Delta x_{Braking,\ Master} = v_{Master} \times T_{Braking} = 10$ increments/ms $\times$ 100 ms
    $= 1\ 000$ increments
  - N_B $= \Delta x_{Braking,\ Master} = 1\ 000$ increments
  - N_{out} $= \Delta x_{Standstill} + N_B$
    $= 10\ 000 + 1\ 000 = 11\ 000$ increments
  - CP $= 250 - 1\ 000 = -750$ increments
    (corresponds to: 10 000 - 750 = 9 250 increments)

Parameters for start/stop cycle

Function	Order	DW	Byte/ Bit	Comments
Operating mode electr. coupling	5 .. 7	1	/8	0 = Continuous 1 = Start 2 = Stop
Length of the start/stop cycle (N_{out})	5 .. 7	10, 11	-	$0 .. 2^{30}$: Number of master pulses which are accepted or not accepted for the slave axis.
Pulses for ramp (N_B)	5 .. 7	12, 13	-	1 ... N_{out}: Number of master pulses for acceleration or braking ramp
Coupling position	5 .. 7	16, 17	-	$0 .. \pm 2^{30}$: Master position where the slave axis starts or stops.

Table 4-12 Parameters for start/stop cycle

[1] Maximum number of pulses per master
[2] Maximum number of pulses per slave

4.4.5.5. External position offset / external synchronization

Applications

Shiftings may occur between material and slave axis in the synchronization system caused by:

- Slipping
- Wear and tear of the rollers, replacement of the rollers
- Defect of material, material tolerance levels etc.
- Operator intervention (e.g. after a fault has occurred) and consequent new synchronization (resynchronization) of the slave axes.

Possibilities for position offset

- Offsets with standing process
  - Modification of the zero offset, please see chapter 4.3.1
  - Actual value setting, please see chapter 4.3.2
  - Approach reference point again, please see chapter 4.3.3
- Automatic offsets during operation
  - Registration mark control } external synchronization
  - External synchronization } external synchronization

Mode of operation position offset at synchronization:
- **Transmission**
- **Table, relative output**

- The following parameterizations are prerequisites of the slave axes concerned:
  - Operating mode: Synchronization transmission or Synchronization table, relative output
  - "Command position at external synchronization" in SEND order 5 ... 7, DW 14, DW 15
    In a problem-free case the current actual position of the slave axis is exactly the "command position at external synchronization", when a rising edge is recognized at the input DI 0 ... 2. Thereby the master transports the medium that carries the ext. synchronization mark.
- Sequence after the recognition of the rising edge at DI 0 ...2:
  - Calculation of the offset section for the shortest direction, i.e. determination of the difference between the current actual value and the "command position at external synchronization" with a sign.
    The determined offset section is traversed with a maximum offset speed which has been parameterized in SEND order 5 ... 7, DW 18, during which the synchronization feed rate is overlapped with a rectangle-shaped offset profile.
  - If the slave axis traverses in the operating mode synchronization table, relative output, then the x coordinate is additionally set to zero in the next controller cycle. For that, the table must be set up appropriately.

Note

Edges are recognized at the digital inputs DI 0 ... 2 under the following conditions:

IP 252MC IP 252MC-DP	DI 0, 1:	Edges are recognized by the hardware and trigger alarms on the IP 252MC/IP 252MC-DP. Even very short pulses are recognized. Delay time: approx. 0.2 ms
	DI 2:	DI 2 is checked in a polling procedure in every controller cycle. Edges are recognized by the software. Therefore, signals must be pending for at least one controller cycle (6 ms). Delay time: approx. 3 ms
IP 252MC-DSP		Due to the very short cycle time (0.5 ms), alarm processing is not implemented. DI 0 ... 2 are checked for edges by the software in the polling procedure in every controller cycle. Therefore, signals must be pending for at least one controller cycle (0.5 ms). Delay times: DI 0, 1: 0.2 ms DI 2: 3 ms

---

Example registration mark synchronization

When cutting foils for packing, the print on the produced package must always be at the same place. The slave axis traverses in synchronization to the guide axis (master axis) but not to the foil. Example:The foil is stretched or slips through the slave drive rollers (slipping).
The slave axis must be adapted to the actual foil position. A light barrier at the guide axis (master axis) detects registration marks on the foil returning in similar intervals to ascertain the position. Part of this registration mark is the slave position when the foil is transported without faults (e.g. without slipping) (e.g. 500). This command position is saved in SEND order 5 .. 7, DW 14, 15.

Slip offset

If there is slipping, the registration mark signal comes late (e.g. at 550), i.e. the slave axis is already further on than the command position. The result is that the slave axis must be delayed so that the registration mark pulse at the next machine clock pulse arrives at 500 again.

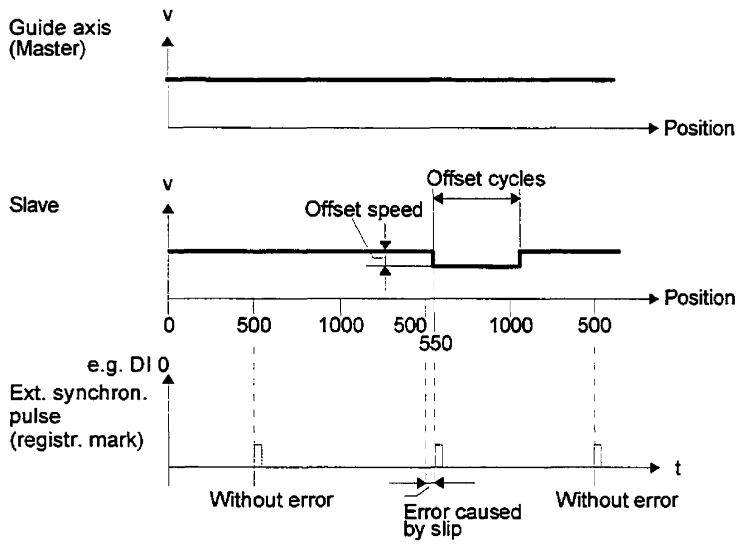


Fig. 4.40 Position offset slave (qualitative representation)

10 increments are set as offset speed.

Offset cycles (position encoder cycles): $C = \frac{50 \text{ incr. deviation}}{10 \text{ incr. control cycle}}$

Meaning that the slave feed rate must be decreased by 5 cycles.

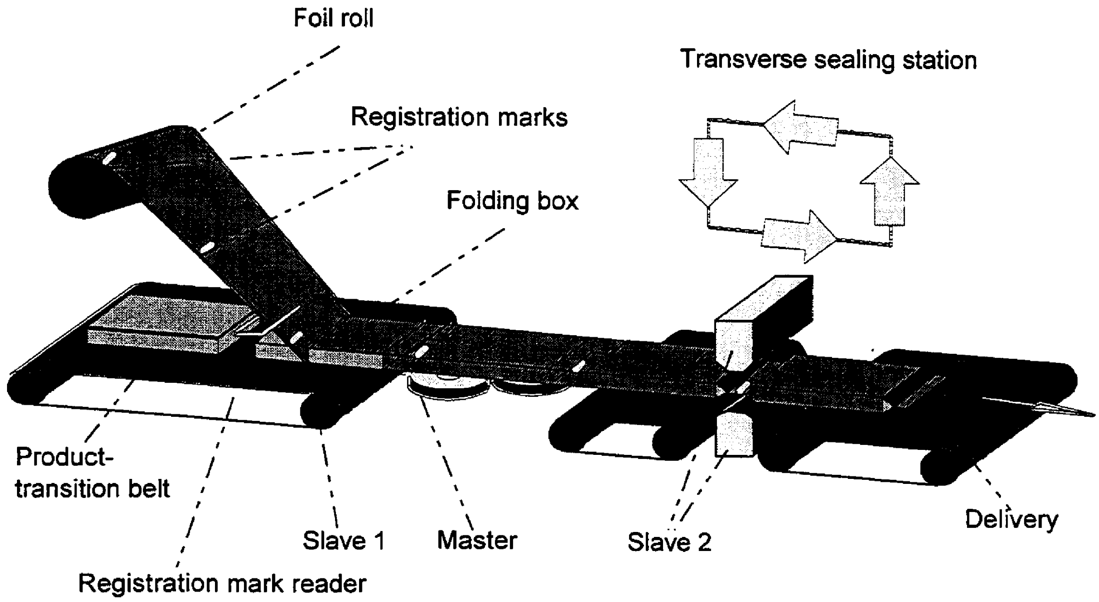


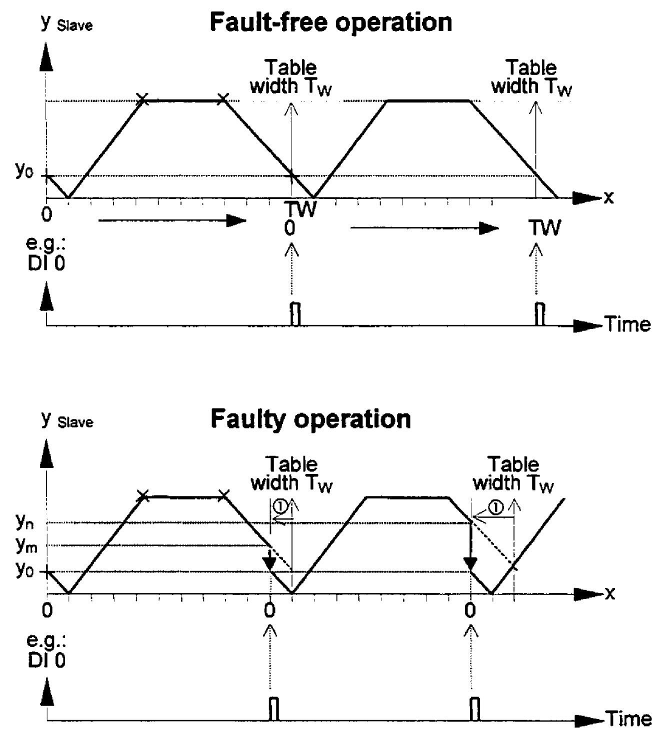
Fig. 4.41 Example: Registration mark control

Note

The initiator for the acquisition of the synchronization pulse is to be installed close to the guide axis (master). If this is not observed, this results in faulty compensation movements.

Mode of operation position offset at synchronization:
- **Table, absolute output**

After recognition of the rising edge, the x coordinate is set to zero in the next controller cycle, i.e. the current actual value of the guide axis is interpreted as x = 0. At that point in time, the slave axis has, for example, the value y_m or y_n (please see the following figure), but it should be at y_0.
This difference is output via a jumpy offset movement (overlapping the synchronization) without feed rate limitation. Therefore, this method is only useful for minor faults.



① The x coordinate is set to zero when the synchronization signal arrives at the DI.

Fig. 4.42 External position offset with table synchronization and absolute output

Parameters for synchronization with position offset

Function	Order	DW	Byte/ Bit	Comments
Command position at ext. synchro-nization	5 ... 7	14, 15	-	Valid for: • Synchronization transmission • Synchronization table, relative output
Maximum offset speed	5 ... 7	18	-	
Operating mode synchro-nization	5 ... 7	0	Low/	00 = Synchronization
Function synchro-nization	5 ... 7	1	Low/	00 = Synchronization 1:1
Traversing table: Mode / operating mode	5 ...7	2	Low/0	0 = Absolute output 1 = Relative output
Factor for scaling	5 ... 7	8, 9	-	Numerator and denominator of the scaling factor
Table status	16	1 ... 3	/11	1 = Offset procedure running

Table 4-13 Parameters for synchronization with position offset

Note

- The position offset can be deactivated as follows:
  - Do not assign synchronization inputs DI 0 ...2
  - Parameterize the offset speed with zero
- An offset procedure which is already running is canceled when a new offset procedure is triggered. Only the most recent requested procedure is processed.

4.5 Error output

Error and status displays are available via RECEIVE orders 13, 14, 16 and 18 of the SIMATIC.

4.5.1 Contouring error

Definition

Following error: Difference between command position and actual position of the axis

Contouring error: Following error > Window

Amongst other things, following errors occur due to:

- mass inertia of the mechanics
- missing dynamics of the axis drives
- encoder errors

The axis follows the command value presetting with a delay. The following error is kept low with a corresponding pilot control and can be further minimized by careful determination of the following parameters:

- Initial scaling (SEND order 3, DW 0, 8, 16, 24)
- Controller parameter K_p (SEND order 3, DW 4, 12, 20, 28)
- Drift adjustment of the drive.

Error window contouring error

In the parameters SEND order 3, DW 1, 9, 17, 25, the internal axes 0 .. 3 (master, slave 1 ...3) can be assigned a maximum permissible following error. If the current following error has a larger value than the window, a contouring error is signaled (without being saved). The axes remain in position control.

Error evaluation

If the maximum permissible following error is exceeded, the error can be evaluated and/or displayed specific to the axis via

- SIMATIC
  via RECEIVE order 16, DW 0 .. 3, bit 8
- high-speed digital output

Via SEND order 1, DW 2 .. 5, any one of the 8 digital outputs can be assigned to the contouring errors of the internal axes 0 .. 3. Thus, fast reaction and stopping the axis via the drive actuator is possible.

Error reaction

The module signals contouring errors which occur but it does not react to this event internally. An error reaction can be carried out by the SIMATIC, e.g. by stopping the axes.

Note

If digital outputs are used for displaying contouring errors, these are not available for the position-dependent switching-signal output.

Parameters for start/stop

Function	Order	DW	Byte/ Bit	Comments
Max. permiss. following error	3	1, 9, 17, 25	-	Window: Entry in increments N
K_P	3	4, 12, 29, 28	-	
Initial scaling	3	0, 8, 16, 24	-	Number of pulses per ms which generate 10 V at the analog output
Parameterization of the DO	1	2 ... 5	-	Assignment of the contouring errors to the digital outputs
Display: • Contouring error	16	0 ... 3	/8	0 ⇒ Following error ≤ Window 1 ⇒ Following error > Window
• Value following error		16, 17, 18, 19		Current following error per axis in increments

Table 4-14 Parameters for start/stop

4.5.2 Encoder monitoring

The connected encoders and the associated modules for incremental encoders or SSI absolute encoders are monitored and/or the status is signaled, such as:

- Cable breakage
- Voltage reduction
- Initialization error
- etc.

Error reaction

The reaction of the IP 252MC to error messages of the encoders can be parameterized in SEND order 4 .. 7, DW 3, bit 0:

- Only signal error to SIMATIC
  - Axis moves on! Guide value for slave axis might be wrong!
  - SIMATIC decides on the right reaction
- Signal error and move on with open-loop control
  - Move on in operating mode follow-up mode by keeping the movement sequence as good as is possible at that point in time, guide value for slave axis might be wrong!
  - SIMATIC decides on the right reaction

The encoder errors are divided into

- saved
- non-saved

Saved errors

Saved errors are errors of the actual value acquisition in RECEIVE order 16, DW 0 ... 3, bit 12, 13. These errors are group errors and are activated by corresponding displays in RECEIVE order 13, DW 0 .. 5. Saved errors can be reset depending on the axis with SEND order 4 ... 7, DW 3, bit 1 = 1.

Non-saved errors

In RECEIVE order 13, DW 0 .. 3, current encoder errors are filed but not saved. These errors can be read out by the SIMATIC for diagnostic purposes.

Parameters for error message/ error handling encoder

Function	Order	DW	Byte/ Bit	Comments
Error reaction	4 ... 7	3	/0	0 ⇒ Only signal error 1 ⇒ Signal error and move on with open-loop control
Group error display	16	0 ... 3	/12 /13	Error at SSI absolute encoder Error at SSI absolute encoder or cable breakage incremental encoder Please see chapter 6, Description of the orders
Error display	13	0 ... 3 4 ... 5	-	Cable breakage, format error SSI Initialization error SSI Please see chapter 6, Description of the orders
Acknow-ledgment encoder error	4 ... 7	4 ... 7	/1	0 ⇒ No acknowledgment of the encoder error 1 ⇒ Acknowledgment encoder error for error RECEIVE order 16 Note: Usually, new setup is required

Table 4-15 Parameters for error message/error handling encoder

4.5.3 IP-Link

Sychronization monitoring

In every controller cycle, the master module sends the guide values (position, feed rate) to all connected slave modules. The task of the slave modules is, among other things:

- to wait for IP-Link data.
  the sychronization of the IP-Link-slave-module(s) is effected by the IP-Link-master-module through data records via IP-Link., The closed-loop control task on the IP-Link slave module(s) starts no later than 1ms after a data record. Thereby jitter-effects of ± 1 ms appear.
- to monitor the time distance of the data telegrams via the IP-Link bus

Effect

If the data telegrams do not arrive, the slave module puts itself into an error state with the following consequences:

- All outputs (digital, analog) are blocked
  (BASP = command output blocking).
- Restart of the module is necessary as the error state cannot be acknowledged.

Error display

The error state is displayed via RECEIVE order 16, DW 20, bit 0 = 1.

If a lot of data is subsequently received via IP-Link, bit 14 (time out IP-Link with return) in RECEIVE order 16, DW 0 ... 3 is additionally set. This makes distinction between sporadical interruptions and continuous errors possible.

LED display

The state of IP-Link can be seen via LED 1, 2 (please see chapter 11).

Parameters for error display and error LED for IP-Link

Function	Order	DW	Byte/ Bit	Comments
Error display	16	0 ... 3	/14	After error IP-Link data arrive on the IP-Link slave module again
		20	/0	Error at IP-Link, BASP triggered
		27	/2	Error at IP-Link

Table 4-16 Parameters for error message IP-Link

LEDs

LED 1	LED 2
LED 3	LED 4
LED 5	LED 6
gn	gn
rt	rt
rt	rt

LED 1	LED 2	Definition
on	on	No start-up or time out at IP-Link
on	off	Start-up master IP
off	on	Start-up slave IP
off	off	Start-up stand-alone IP

4.5.4 PROFIBUS-DP error

The following explanations are only valid for the module IP 252MC-DP.

Monitoring

After complete start-up the IP 252MC-DP monitors cyclically:

- its own DP interface
- to see if DP master is still working

In case of an error this is followed by:

- Tripping of BASP (command output blocking)
- Error display in RECEIVE order 16, DW 20, bit 1 = 1
- Entry of the error code in RECEIVE order 13, DW 6, 7
- LED display: Set LED 3, 4
- Reset of the own DP interface, try to restart DP operation

Parameters for error message and LED for PROFIBUS-DP

Function	Order	DW	Byte/ Bit	Comments
Group error	16	20	/1	
Acknow-ledgment error	4 ... 7	3	/2	Cancels BASP when the communication is established again. An "undangerous" state must be established beforehand.
Current error code	13	6	/0...2	
Error code at initiali-zation		7	-	

Table 4-17 Parameters for error message PROFIBUS-DP

LEDs

LED 1	LED 2
LED 3	LED 4
LED 5	LED 6
gn	gn
rt	rt
rt	rt

LED 3	LED 4	Definition
on		PROFIBUS-DP-Kopplung aktiv
	on	PROFIBUS-DP in Ordnung

Hardware monitoring

A hardware display is recommended for monitoring the PROFIBUS-DP connection. The digital output DO 0 can be parameterized for this purpose:

- SEND order 1, DW 2, bit 8 ... 15 = Ch
- DO 0 = 1 : Connection OK

Activation monitoring

The monitoring of the PROFIBUS-DP is activated after the IP 252MC-DP has been completely parameterized. Thus, the module becomes insensitive to varying design and start-up behavior depending on the DP master system.

4.5.5 Error display tables

Check table data

During the transmission of tables the data are checked for the following conditions after the acceptance command:

- Sorting sequence: $0 \leq x_0 < x_1 < ... < x_n \leq$ table width
  - No data block must be "on the right-hand side" of the table width on the x axis (x_n is defined that way).
    If a data block is, however, on the right-hand side of the table width, no further data blocks are accepted.
  - The number of data blocks is counted and returned with the "completed" display.
- Number of data blocks ≤ maximum number of data blocks depending on the configuration in SEND order 1, DW 15

Parameters for table

Function	Order	DW	Byte/ Bit	Comments
Configu-ration	1	15	-	
Table function active	5 ... 7	2	Low/	02 = Traversing table, i.e. with other code no table function is active
Table number	5 ... 7	2	High/	
Table trans-mission	15	-	-	Transmission of the table data and control of the acceptance
Table status	14 16	- 28...32	- -	All tables 0 ...31 Table 0 ... 4
x, y coordinates	13	20...31	-	For diagnosis of the table processing
Range display	16	1 ... 3	/5, 6	

Table 4-18 Parameters for table

4.5.6 Error display communication

SIMATIC S5 communication

Parameters "ANZW" (display word) and "PAFE" (parameterization error word), please see chapter 5.1.1

Direct communication

Please see operating manual SIMATIC S5 - CPU

DP communication

Parameters "PAFE" and "STAT", please see chapter 5.1.1, description

Communication with SIMATIC 5

DPR/PROFIBUS

The following distinction is made for data exchange PLC - IP 252MC:

- Communication SIMATIC S5 - Dual port RAM IP 252MC
- Communication SIMATIC S7 - Bus with protocol PROFIBUS-DP-IP 252MC

5.1 Communication IP 252MC/IP 252MC-DSP with a SIMATIC S5 CPU via the dual port RAM interface

Standard handling blocks

Communication is realized via the standard handling blocks "SEND" and "RECEIVE" of the SIMATIC S5.

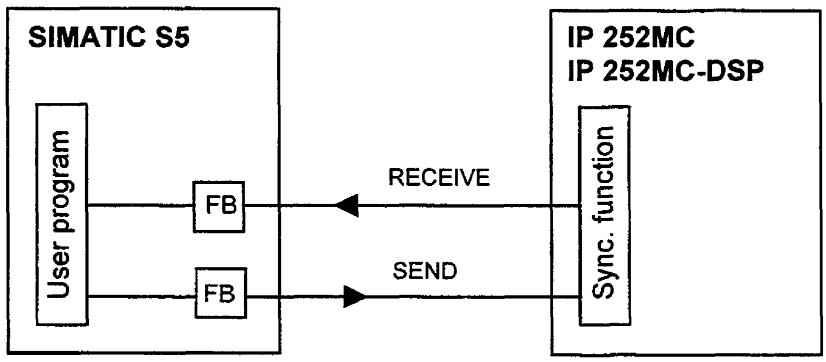


Fig. 5.1 Communication with SIMATIC S5

SEND

In the SIMATIC S5 the following is saved on DBs:

- Parameters, e.g.:
  - Basic parameterization (encoder, controller parameters)
  - Synchronization variants
  - Transmission ratios
- Command values for
  - Speed
  - Position
  - Table position etc.

The DBs are transferred to the IP 252MC via SEND.

RECEIVE

Diagnostic displays and status messages such as those listed below are transferred from the IP 252MC to the SIMATIC S5 via "RECEIVE":

- Diagnostic displays
  - Encoder error
  - Error code
- Status messages
  - Actual values
  - Contouring error

Note

SEND / RECEIVE / CONTROL are contained in:

- S5-115U in the operating system
- S5-135U/S5-155U CPU 922/928/928B/948 on floppy disk available with Order No.: 6ES5 842-7CB01
- S7-400 in the package MC 252/S7 (Order no. see below)

Function module packages: MC 252/S5, MC 252/S7

The function module packages MC 252/S5 and MC 252/S7 are intended for use in the IP 252MC / IP 252MC-DSP in the SIMATIC S5 (-115U, -135U, -155U) and in the SIMATIC S7-400.
These packages contain modules which already realize all of the necessary functions for the operation of the IP 252MC /IP 252MC-DSP, such as:

- Automatic data area initialization
- Automatic startup parameterization
- Comfortable SEND-/RECEIVE-Communication
- Direct communication
- Table transmission
- Multiple table transmission

In scope of supply ..., example program

Furthermore, the necessary data modules (completely commented), test help material (image blocks with S5; variable tables with S7, res.) as well as a **fully programmed example program** on diskette are all included in the scope of supply.

You save

With the packages the user saves the programming of the necessary communication between SIMATIC-CPU and the module. Far-reaching knowledge of the underlying handling functions are no longer necessary.

Package Order no.

MC 252/S5 german:	9AC9 201-0AA00
MC 252/S5 english:	9AC9 201-0AA01

MC 252/S7 german:	9AC9 201-2AA00
MC 252/S7 english:	9AC9 201-2AA01

Start-up notes

- Start-up conditions: (IP 252MC)
  After the start-up of the SIMATIC S5 (BASP=0) the first SEND order must be delayed by 10 ms. This time is required by the IP 252MC operating system.

  Orders 1...7, 9 and 10 must each have been sent for the first time.
- Start-up acknowledgment:
  To be read out via RECEIVE order 16, DW 27, bit 0=1
- Start-up OB21, OB22:
  It is not yet allowed to program any communication to the IP 252MC in these OBs.

Order notes

- Orders:
  - Order length: 32 DWs are required for all orders, unassigned DWs must be assigned with "0".
  - SEND order 1: Must be sent as the first order, is only processed once (hardware settings for encoder, DO)
  - SEND orders 2...15: Are only processed when SEND order 1 has been processed, must be delayed by approx. 1 second if SSI modules have already been parameterized in SEND order 1 (otherwise error display in FB-SEND)
  - RECEIVE order 13, 14, 16: Inquiry cycle should be > 100 ms, otherwise the IP 252MC occupancy rate of communication tasks is too large.

Note

- The transferred data are not checked for plausibility. Unassigned data words and bits must be assigned with "0".
- It is not recommended to call the function blocks SEND and RECEIVE in an alarm OB. This can lead to problems in the S5 program.

Order groups

The SIMATIC S5 SEND and RECEIVE orders are divided into groups.

The following has to be observed:

- Only one order per group can be processed at any one time.
- If a second order from the same group is sent although the first order has not yet been completed, this leads to an error message in the display word (ANZW).
- Prior to sending, the SIMATIC S5 should check:
  - if in the ANZW bit 2=1 ("completed without error")
  - that the interface is signaled as "free" via CONTROL.

Direction	Order	Group
SEND	1	1
	2	2
	3	
	4	3
	5	4
	6	5
	7	6
	9	2
	10	
	15	

Direction	Order	Group
RECEIVE	1[1)]	1
	2[1)]	
	3[1)]	
	4[1)]	
	5[1)]	
	6[1)]	
	7[1)]	
	9[1)]	
	10[1)]	
	13	
	14	
	15[1)]	
	16	
	18	

[1)] Read back of the SEND orders

Note

As all orders can be read back, bit 0 = 1 is always set in the ANZW. This it to be taken into account when evaluating the order status.

5.1.1 Display evaluation

The order status must be evaluated by the S5 program via:

- Display word ANZW
- Parameterization error word PAFE

ANZW

The display word (ANZW) indicates the order status to the user:

Bit 0	= 0	RECEIVE disabled
	= 1	RECEIVE enabled
Bit 1	= 0	SEND enabled
	= 1	SEND disabled, order running
Bit 2	= 1	Order completed without error
Bit 3	= 1	Order completed with error (see bits 8 to 11)
Bit 4	= 1	Data sending/receiving running
Bit 5	= 1	Data sent
Bit 6	= 1	Data received
Bit 7	= 0	
Bits 8 to 11	= 0	No error
(hexa-coded)	= 1 ...5	Programmable controller error
	= 6	Invalid order number
	= 7	Invalid order identifier (neither SEND nor RECEIVE)
	= 8	Too much data to SEND or interface occupied
	= F	Order 1 has been sent for a second time (allowed only once) or last order still running
Bits 12 to 15	= 0	
Bits 16 to 31:		Length word

PAFE

PAFE displays parameterization errors:

Bit 0	= 0	No error
	= 1	Parameter error (see bit 4 ... 7)
Bits 1 to 3	= 0	
Bits 4 to 7	= 0	No error
(hexa-coded)	= 1	Source/destination parameter: Range incorrect
	= 2	Source/destination parameter: DB is not available
	= 3	Source/destination parameter: Range too small
	= 4	Source/destination parameter: Range is not available
	= 5	ANZW incorrect
	= 6	Number not assigned
	= 7	Page frame number is not available
	= 8	Interface unclear
	= 9	Interface overloaded
	= A	Interface occupied by another CPU (with multiprocessor operation)
	= B	Order number invalid
	= C	Interface does not respond in time or acknowledges negative (for details, please see ANZW)
	= E	Other errors

5.1.2 Handling of the direct interface

Absolute addressing

The direct interface of the IP 252MC is addressed via absolute addresses in the dual port RAM.

Via the user program, the following can be read out:

- Status displays
- Actual values

The assignment of the direct interface is described in chapter 5.4 in the table "Direct interface".

The coordination for the direct access is made via a coordinating cell in the direct interface.

Caution

- When using the direct interface, the user program works with absolute addresses of the control. In case of improper handling, data ranges in the control or in the dual port RAM of the IP 252MC might be overwritten.
- When trying to access the module, the SIMATIC S5-CPU stops:
  - as long as the IP module is at stop
  - as long as the IP module has not started
  - if the IP module is not plugged in
  - if the IP module is set to another page frame number

Data consistency

Data consistency means that only the data which are transferred as a unit in their defined width are not modified by the IP 252MC during the transmission.

The following applies for the dual port RAM interface of the IP 252MC:

- Consistency of the double words DW 36 ... 43 (actual values) is ensured via the coordinating cell DW 63.
- Consistency of the remaining words is 1 byte.

Example: Direct coupling

The following program describes the required program run, taking an S5-115U with CPU 943/944 as an example.

Task:

- Set page frame (interface number)
- Set user DB no.XXX, store in FW 208
- Read 32 data words from dual port RAM
- Store 32 data words from dual port RAM in the DB XXX DW 49 ... 81
- For the data words with offset, data consistency is not ensured in the range
  - Offset 32 ... 35
  - Offset 44 ... 63

Note

The user program must ensure that a module access in a low-priority OB level is not interrupted by an access to another module in a higher-priority OB level if several page frame addressable modules (IPs, CPs) are used in one control, and if the communication is to be processed in different OB levels.

Example for a direct coupling with SIMATIC S5-115U CPU 943/944

```
         :
         :L      KF      XXX    Interface number of the IP
         :T      FY      255
         :L      KF      XXX    User DB for storing the data
         :T      FW      208    Pointer DB number
         :C      DB      XXX
         :IA
         :L      KH      EEFF   Transfer of the page frame number into
         :L      KH      FEFF   the select reg. of the DPR
         :TNB            1
         :L      KH      F47E
         :LIR            0
         :T      FW      212    Load status IP
         :L      KH      0011   If IP is updating data,
         :L      FW      212    then end
         :!=F
         :JC     =ENDE          then block end
         :L      KH      0001   Data are available
         :!=F
         :JC     =DATA          then fetch data
         :RA
         :BEU                   otherwise terminate
DATA     :L      FW      208    Destination DB
         :T      DW      240
         :L      KF      +163   End addr. destination DW
         :T      DW      241
         :L      KF      +32
         :T      DW      239    Block length
         :JU     FB      3      Data from DP-RAM into DB
Name     :DPR-COPY
         :L      KH      0000
         :L      KH      F47E
         :TIR            2      Reset status IP for new evaluation
END :RA
         :
FB 3
Network 1        0000    Copy data blocks
Name     :DPR-COPY              Copy DP-RAM into DB 115U
         :L      KH      E400   Calculation of the start address
         :L      DW      240    of the destination data block
         :SLW            1
         :+F
         :LIR            0
         :L      DW      241    Calculation of the end address
         :SLW            1      of the destination data block
         :+F
         :ADD    BN      +1
         :T      DW      238    End address destination DB
         :L      DW      239
         :SLW            1      Calculation copy length
         :T      DW      235
         :L      KH      F47F   Block transfer
         :L      DW      238
         :B      DW      235
         :TNB            0
         :BE
```

5.2 Communication IP 252MC-DP with a SIMATIC S7 CPU via PROFIBUS-DP

Interface IP 252MC-DP

The IP 252MC-DP is designed for connection to the SIMATIC S7 via PROFIBUS-DP.

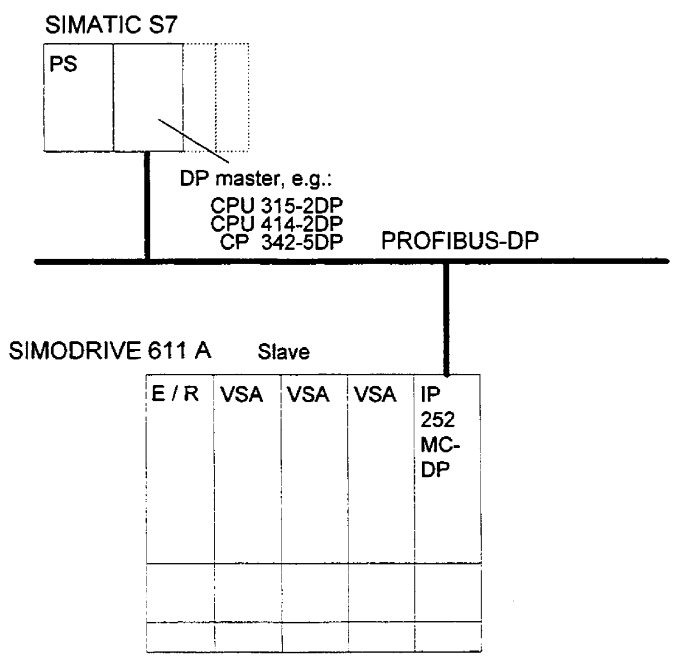


Fig. 5.2 Distributed configuration with SIMATIC S7-300/-400

5.2.1 Order interfaces

The orders of the IP 252MC and the IP 252MC-DP are identical.

The orders are described in chapter 5.4. In general, the following difference is to be taken into account:

Data word addressing S5, S7

- In the SIMATIC S5 data blocks are word-oriented addressed so that consecutive data words are addressed as follows: DW 0, DW 1, DW 2, ...

  This addressing is contained in the left column of the order description.

- In a SIMATIC S7 data blocks are byte-oriented addressed so that consecutive data words are addressed as follows: DBW 0, DBW 2, DBW 4, ...

  Comparison:

SIMATIC S5	DW 0	DW 1	DW 2	DW 3
SIMATIC S7	DBW 0	DBW 2	DBW 4	DBW 6

5.2.2 Monitoring of the PROFIBUS-DP connection

The PROFIBUS interface is monitored for the following errors:

- Life lamp
- Physical errors (e.g. cable breakage)
- Stop of the CPU / stop of the communication processor CP
- Internal slave interface communication errors

Life lamp

- Generation via cyclical call of the coupling interface in the control
- Error triggering of the module if the life lamp fails for more than 150 ms.

Reactions in case of error

When monitoring responds, the following is triggered:

- BASP (internal)
  - Switching off the analog outputs
  - Switching off the digital outputs
- Error display in orders 13 and 16
  - Order 13: Current error status
  - Order 16: Saving error status, until acknowledgment

Acknowledgment

Acknowledgment is made via one of the orders 4, 5, 6, 7, DW 3, bit 2 = 1.

Hardware monitoring

A hardware display is recommended for monitoring the PROFIBUS-DP connection for which the digital output DO 0 can be parameterized:

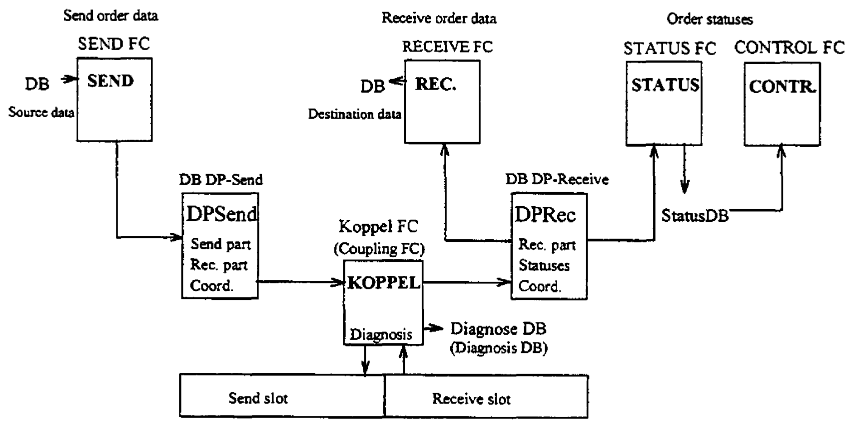
- Order 1, DW 2, bit 8 ... 15 = Ch
- DO 0 = 1 : Connection OK

5.3 Function blocks (FC) for coupling IP 252MC-DP with a SIMATIC S7 CPU

5.3.1 Overview

The functions for addressing an IP 252MC-DP (6ES5 252-5EA11) of SIMATIC S7 controls are described in the following.

Overview diagram:



PROFIBUS data interface

The IP 252MC-DP is a PROFIBUS-DP standard slave.
The following modules/CPUs can be used as PROFIBUS-DP master:

System	PROFIBUS-DP master
S7-300	CP342-5DP with CPU614
S7-300	CPU315-2DP
S7-400	CPU414-2DP

The required FCs can be copied from the supplied disk into the customer-specific project (please see chapter 5.3.3) depending on the PROFIBUS-DP master used. Additionally, the type file with the description of the PROFIBUS-DP characteristics of the IP 252MC-DP is to be installed on the programmer with STEP 7, level 2.1 (please see chapter 5.3.3).

Note

The old designation SINEC-L2 has been replaced by PROFIBUS.

The following functions for the user have been generated for the order-oriented communication between IP 252MC-DP and SIMATIC S7 controls:

Function	Description
FC 10	Coupling module input/output interface from PROFIBUS-DP master to the IP 252MC-DP and diagnosis for CP342-5DP
FC 11	Coupling module input/output interface from PROFIBUS-DP master to the IP 252MC-DP for CPU315-2DP
FC 12	Coupling module input/output interface from PROFIBUS-DP master to the IP 252MC-DP for CPU414-2DP
FC 120	SEND order via PROFIBUS-DP to IP 252MC-DP
FC 121	RECEIVE order via PROFIBUS-DP to IP 252MC-DP
FC 122	STATUS: Read-in of the order statuses, enable of the order lines SEND / RECEIVE and interface control of the IP 252MC-DP via life lamp
FC 123	Start-up and configuration for the coupling and use of the modules
FC 124	CONTROL order via PROFIBUS-DP to IP 252MC-DP

The functions of FC 120, FC 121 and FC 124 have been derived from the corresponding standard handling blocks of the SIMATIC S5.

The send / receive slots of the DP interface work independently of one another, i.e. a SEND and a RECEIVE order can run simultaneously.

Volume of project data:
(depending on the memory space of the CPU and the possibilities of the DP master system)

Max. number of orders per IP 252MC-DP	1-64 Description: Please see interface description IP 252MC-DP
Max. number of IP 252MC-DPs per S7-CPU	10
The following is assigned on the PROFIBUS-DP per IP 252MC-DP	86 bytes transmitted data 96 bytes received data
Type file for describing the PROFIBUS-DP characteristics of the IP 252MC-DP	SI0078AX.200

Average order frequency to be expected in the case of high-speed order run:

Minimum conditions	
Software version IP 252MC-DP	Order No.: 6ES5 252-4E□11, A0 (please see chapter 10)
Status IP 252MC-DP	IP 252MC-DP has started, all slave axes in operating mode *Continuous synchronization 1:1* to the master, master in operating mode *Pulse generator stop*
Order sequence	• If required, send SEND order 4 immediately if last SEND order 4 completed without error • If required, request RECEIVE order 16 again immediately if last RECEIVE order 16 completed without error • Order statuses for orders 1..32 are updated continuously
S7 hardware	CPU315-2DP or CPU614 with CP342-5DP
PROFIBUS-DP	1.5 Mbit/s, one IP 252MC-DP in the DP network
OB1 clock	ca. 3..7 ms (only test program contained)

The following measuring results have been obtained with the two S7-300 versions:

Condition	Medium order frequency
only SEND orders	ca. 8 orders per second
only RECEIVE orders	ca. 10 orders per second
SEND and RECEIVE orders in parallel	ca. 8 SEND orders per second plus ca. 10 RECEIVE orders per second

5.3.2 Contents of the supplied disk

The supplied disk contains the type file SI0078AX.200 (in the main directory) and the S7 project MC252-DP. In the S7 project various S7 programs are stored:

```
SI0078AX.200

MC252-DP                                                      Memory
     I                                                        in Byte
     +--- CP342-5DP modules                           module  MC7-   local
     I         I                                              Code   data
     I         +----- AP-off:FC1                      384     260    18
     I                       FC2                      454     322    22
     I                       FC3                      1060    854    34
     I                       FC10                     844     660    30
     I
     +--- CPU315-2DP modules
     I         I
     I         +----- AP-off:FC11                     514     374    24
     I                       FC20                     370     258    18
     I                       FC21                     370     258    18
     I                       SFC13                    102     2      0
     I                       SFC15                    98      2      0
     I
     +--- CPU414-2DP modules
     I         I
     I         +----- AP-off:FC12                     516     376    24
     I                       FC20                     370     258    18
     I                       FC21                     370     258    18
     I                       SFC13                    102     2      0
     I                       SFC14                    98      2      0
     I                       SFC15                    98      2      0
     I
     +--- Handling blocks
               I
               +---- AP-off: FC120                    1008    830    46
                             FC121                    900     724    44
                             FC122                    1634    1416   64
                             FC123                    818     654    8
                             FC124                    370     242    10
                             SFC20                    98      2      0
                             SFC41                    94      2      0
                             SFC42                    94      2      0
                             UDT1                     1414    0      0
                             DB10                     660     504    0
```

5.3.3 Installation

Installation type file

The type file for the IP 252MC-DP is called SI0078AX.200. This file must be introduced to the STEP7 surface. Please see STEP7 documentation, e.g. manual on NCM S7 for PROFIBUS, for the necessary procedure.

The procedure in brief for STEP 7, V4.0:

- Copy the file from the main directory of the supplied disk into the directory drive:\SIEMENS\Step7\S7data\GSD
- Start the hardware configuration
- Select the menu *OPTIONS->Update GSD-Files*
- Close hardware configuration
- After the next start of the hardware configuration, the configuration information for the IP 252MC-DP is available in the hardware catalog under *PROFIBUS-DP->NORMSLAVE- Additional FIELD DEVICES -> IP252MC-> IP252MC-DP*, and can subsequently be added to the master system of the PROFIBUS master.
- The parameterization of the slots within the IP 252MC-DP configuration may not be arbitrarily changed. In any case, related input and output ranges must be defined for the slots. This must be strictly observed if the start addresses recommended by STEP7, V4.0 are to be changed.

Station	DP identification	Start address	Length
0	239	BAA	32
1	239	BAA+32	32
2	234	BAA+64	22 (!)
3	223	BAE	32
4	223	BAE+32	32
5	223	BAE+64	32

- Communication via the built-in interfaces of CPU315-2DP or 414-2DP: BAA / BAE represent the start addresses of the whole output / input range which are occupied by the IP 252MC-DP. These addresses are required for the parameterization of the coupling FC 11..12.

- Communication via CP342-5DP:
  The addresses BAA / BAE are required to determine the start data words for the data of the IP 252MC-DP in the DBDP-Send / DBDP-Receive, please see overview diagram.

Modules for S7-300, CPU614 with CP342-5DP

The following modules are required for communication via the CP342-5DP as PROFIBUS master:

Module	Definition	see program ... on the supplied disk
DB10	Sample for coordinating DB	Handling blocks
UDT1	Data format for an IP 252MC-DP in the coordinating DB	Handling blocks
FC1	L2-Send Part of the STEP7 option package NCM S7 for PROFIBUS	Modules CP342-5DP
FC2	L2-Receive Part of the STEP7 option package NCM S7 for PROFIBUS	Modules CP342-5DP
FC3	L2 diagnosis Part of the STEP7 option package NCM S7 for PROFIBUS	Modules CP342-5DP
FC10	Coupling FC, is called once per CP342-5DP in the OB1	Modules CP342-5DP
FC120	SEND-FC for sending an order to the IP 252MC-DP	Handling blocks
FC121	RECEIVE-FC for requesting a RECEIVE order from the IP 252MC-DP	Handling blocks
FC122	STATUS-FC, must be called once for every IP 252MC-DP in the OB1 clock	Handling blocks
FC123	Start-up FC, initializes the coordinating DP	Handling blocks
FC124	CONTROL-FC for monitoring an order	Handling blocks
SFC20	BLKMOV STEP7 standard function	Handling blocks
SFC41	DIS_AIRT STEP7 standard function	Handling blocks
SFC42	EN_AIRT STEP7 standard function	Handling blocks

Notes

The modules are contained on the supplied disk and can be copied into the user's own application, but they must not be renamed.

The coordinating DB is initialized by the FC123 during start-up and must not be changed by the user. The structure is to be kept. A sample for this is DB10 on the supplied disk.

The option package NCM S7 for PROFIBUS is absolutely necessary to configure the communication with CP 342-5DP.

Modules for S7-315-2DP

The following modules are required for the communication via the PROFIBUS master integrated in the CPU315-2DP:

Module	Definition	see program ... on the supplied disk
DB10	Sample for coordinating DB	Handling blocks
UDT1	Data format for an IP 252MC-DP in the coordinating DB	Handling blocks
FC11	Coupling FC, is called once per IP 252MC-DP in the OB1	Modules CPU315-2DP
FC20	Auxiliary module of FC11 Copy data from DB into periphery	Modules CPU315-2DP
FC21	Auxiliary module of FC11 Copy data from periphery into DB	Modules CPU315-2DP
FC120	SEND-FC for sending an order to the IP 252MC-DP	Handling blocks
FC121	RECEIVE-FC for requesting a RECEIVE order from the IP 252MC-DP	Handling blocks
FC122	STATUS-FC, is called once for every IP 252MC-DP in the OB1 clock	Handling blocks
FC123	Start-up FC, initializes the coordinating DP	Handling blocks
FC124	CONTROL-FC for monitoring an order	Handling blocks
SFC13	DPNRM_DG STEP 7 standard function	Modules CPU315-2DP
SFC14	DPRD_DAT STEP7 standard function	Modules CPU315-2DP
SFC15	DPWR_DAT STEP7 standard function	Modules CPU315-2DP
SFC20	BLKMOV STEP7 standard function	Handling blocks
SFC41	DIS_AIRT STEP7 standard function	Handling blocks
SFC42	EN_AIRT STEP7 standard function	Handling blocks

Notes

The modules are contained on the supplied disk and can be copied into the user's own application, but they must not be renamed.

The coordinating DB is initialized by the FC123 during start-up and must not be changed by the user. The structure is to be kept. A sample for this is DB10 on the supplied disk.

Modules for S7-414-2DP

The following modules are required for the communication via the PROFIBUS master integrated in the CPU315-2DP:

Module	Definition	see program ... on the supplied disk
DB10	Sample for coordinating DB	Handling blocks
UDT1	Data format for an IP 252MC-DP in the coordinating DB	Handling blocks
FC12	Coupling FC, is called once per IP 252MC-DP in the OB1	Modules CPU414-2DP
FC20	Auxiliary module of FC11 Copy data from DB into periphery	Modules CPU414-2DP
FC21	Auxiliary module of FC11 Copy data from DB into periphery	Modules CPU414-2DP
FC120	SEND-FC for sending an order to the IP 252MC-DP	Handling blocks
FC121	RECEIVE-FC for requesting a RECEIVE order from the IP 252MC-DP	Handling blocks
FC122	STATUS-FC, is called once for every IP 252MC-DP in the OB1 clock	Handling blocks
FC123	Start-up FC, initializes the coordinating DP	Handling blocks
FC124	CONTROL-FC for monitoring an order	Handling blocks
SFC13	DPNRM_DG STEP7 standard function	Modules CPU414-2DP
SFC14	DPRD_DAT STEP7 standard function	Modules CPU414-2DP
SFC15	DPWR_DAT STEP7 standard function	Modules CPU414-2DP
SFC20	BLKMOV STEP7 standard function	Handling blocks
SFC41	DIS_AIRT STEP7 standard function	Handling blocks
SFC42	EN_AIRT STEP7 standard function	Handling blocks

Notes

The modules are contained on the supplied disk and can be copied into the user's own application, but they must not be renamed.

The coordinating DB is initialized by the FC123 during start-up and must not be changed by the user. The structure is to be kept. A sample for this is DB10 on the supplied disk.

5.3.4 Program structure for S7-300 CPU614 with CP342-5DP

Prerequisites

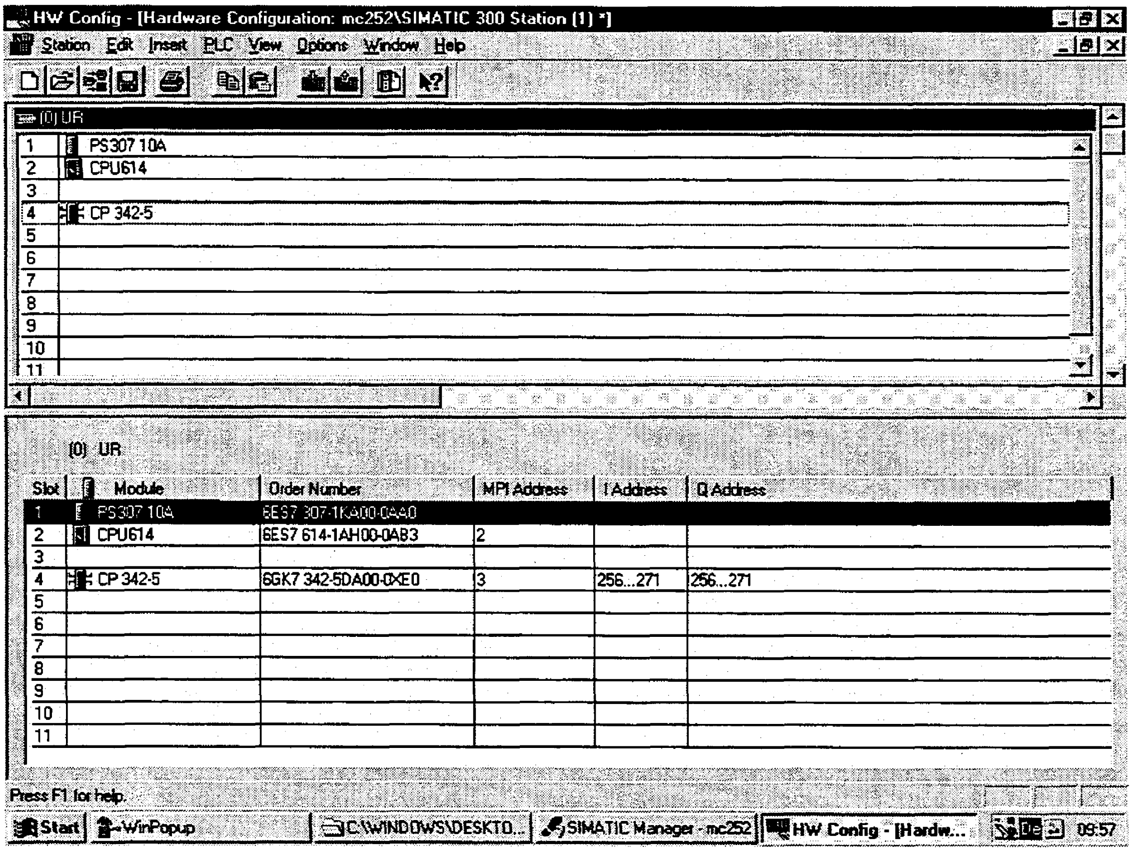
The STEP7 options package NCM S7 for PROFIBUS-DP is necessary for the parameterization of the CP342-5DP.
Without the package the CP342-5DP cannot be registered in the hardware configuration.

Configuration notes

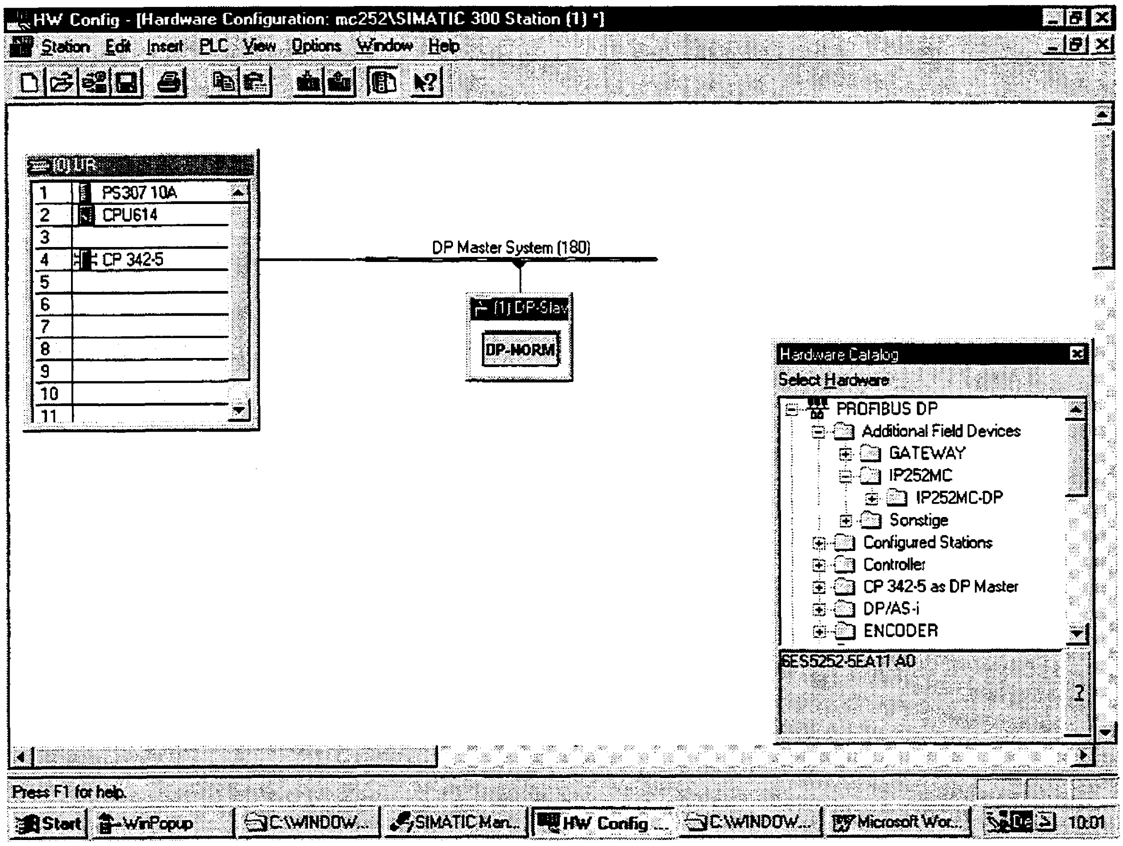
First of all, the configuration of the hardware is to be carried out in accordance with the STEP7 description.

The main steps in brief:

- Start SIMATIC manager
- Create new project
- Enter new SIMATIC-300 station
- Start hardware configuration, open hardware catalog (SIMATIC 300)
- Enter profile rail from the hardware catalog and display (slot 0)
- Enter power supply from the hardware catalog (slot 1)
- Enter CPU614 from the hardware catalog (slot 2)
- Enter CP342-5DP from the hardware catalog (e.g. slot 4)
- Select further hardware components, if required
- The following situation results, for example:



- Configure CP342-5DP:
  - Mark CP342-5DP in the hardware configuration (slot 4)
  - Click on the right mouse button, select *Object properties* from the local menu
- Determine:
  - the MPI address and the PROFIBUS address of the CP342-5DP in the register *General/MPI* or *General/PROFIBUS*
  - the setting *DP Master* in the register *Operating mode*
- Configure the master system of the CP342-5DP the following way:
  - Mark CP342-5DP in the hardware configuration (slot 4)
  - Click on IP252MC-DP and with depressed left mouse button go to *DP-Master System.*
  - Select
    PROFIBUS DP->NORMSLAVE->IP252MC->
    IP 252MC-DP
    from the hardware catalog by double-clicking on the entry *IP 252MC-DP* (not universal module), the following is an example of what could be displayed:



- The PROFIBUS user address of the IP 252MC-DP is created in a dialog which is opened after double-clicking on the symbol *DP-Slave*.
- The hardware configuration can be saved afterwards.

Note

The configuration sequence for the hardware configuration might vary in parts, depending on the STEP7 surface settings. Minor changes also result before starting the HW configuration if a PROFIBUS-DP network is created in the project in which the PROFIBUS users are already configured.

- Change to the SIMATIC manager
- Open project from the supplied disk (A:\MC252-DP)
- Copy modules from the S7 program CP342-5DP into the S7 program for the CPU614 configured beforehand
- Copy modules from the S7 program handling blocks into the S7 program for the CPU614 configured beforehand
- If required, copy DB10 (sample DB for configuration DB) into other DB
- Create/extend cyclical OB, please see below
- Create/extend start-up OB, please see below

Create cyclical program

The cyclical program must carry out the following tasks in the described sequence described below:

- Read data of the CP342-5DP and write them into the DBDP-Send / DBDP-Receive.
  This is done with the help of the so-called coupling FC (FC10).
- Carry out several internal administration tasks, e.g. update life sign in every clock of the cyclical program (IP 252MC-DP monitors this! T = 150 ms max.)
  This is done with the help of the so-called status FC (FC122).
- Triggering/blocking/monitoring of the orders required for the respective applications with the help of the modules SEND-FC (FC120), RECEIVE-FC (FC121), CONTROL-FC (FC124).

Details on the FC: Please see chapter 5.3.7 onwards.

```
cycl. OB --+---- FC10 coupling FC for CP342-5DP #1
           +---- FC10 coupling FC for CP342-5DP #2,
                                                  if available
           .
           .
           +---- FC122 status FC for IP 252MC-DP #1
           +---- FC122 status FC for IP 252MC-DP #2,
                                                  if available
           .
           .
           +---- FC120 e.g. SEND-FC
           .
           +---- FC121 e.g. RECEIVE-FC
           .
           .
```

The FC10 is to be programmed once for every CP342-5DP deployed and to which IP 252MC-DP modules are connected; FC122 is required once for each IP 252MC-DP deployed.

The coupling FC makes available the data of **all** DP slaves connected to the CP342-5DP in one DB (to be defined), each with the corresponding size, for every direction.

The size of these DBs results from the hardware configuration, configuration of the master system for the CP342-5DP. In the above picture this would be 86 bytes for the DBDP-Send and 96 bytes for the DBDP-Receive.

It has to be taken into account that spaces in the master system configuration of the CP342-5DP are also relevant since it its impossible to access the individual DP slaves connected to the CP342-5DP separately, the access has to be made to **all** DP slaves of the connected DP sequence.

The parameter *CPLAdresse* of the coupling FC is to be assigned a configuration-dependent constant. In the above example, the CP342-5DP has the address 256, i.e. W#16#100 (hexa-decimal representation).

The parameters *Anz_Sendbytes, Anz_Receivebytes* of the coupling FC are also to be assigned configuration-dependent constants and correspond to the number of bytes required for the whole DP sequence. In the above example, this is 86 bytes / 96 bytes.

The coupling FC constantly stores the data of the DP sequence in the stated DB. The remaining FCs use these data to administer and transfer the orders.

Note

If an error indicator has been entered in the parameter "Pafe" during the processing of the coupling FC, order selection is not to be recommended.

Create start-up OB

```
Start-up OB --+---- FC123 Start-up FC for IP 252MC-DP #1
              +---- FC123 Start-up FC for IP 252MC-DP #2,         if
available
                .
                .
```

In the start-up OB the configuration DB is initialized. One call of the start-up FC is required for each IP 252MC-DP.

Note

If the start-up FC has been completed with an error, further use of the function blocks is not permissible and also not possible (please see chapter "Error messages").

The parameters *DB_DPSend, DW_DPSend* indicate the DB or offset in the DB for the sending slot of the respective IP 252MC-DP. This data result from the configuration of the master system of the CP342-5DP and the parameterization of the coupling FC in the cyclical program. The same applies for the parameters *DB_DPReceive, DW_DPReceive.*

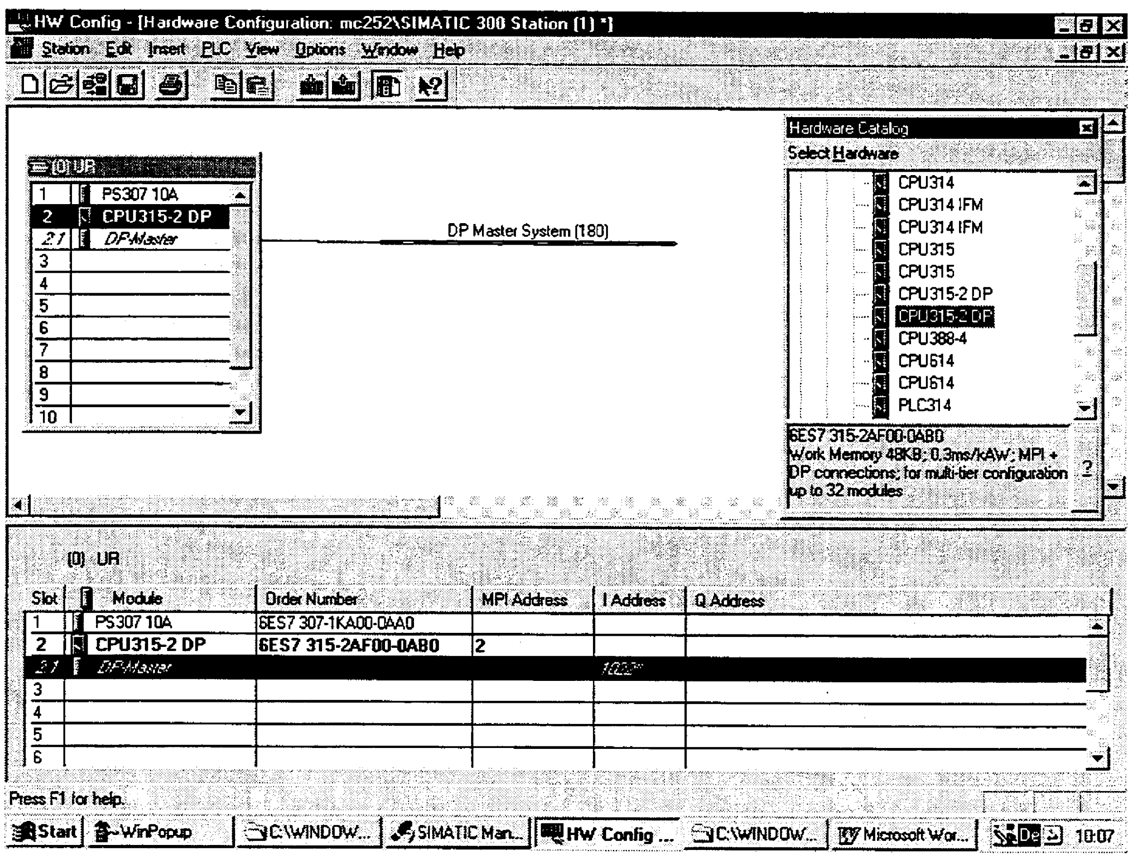
5.3.5 Program structure for S7-300 CPU315-2DP with built-in DP interface

Configuration notes

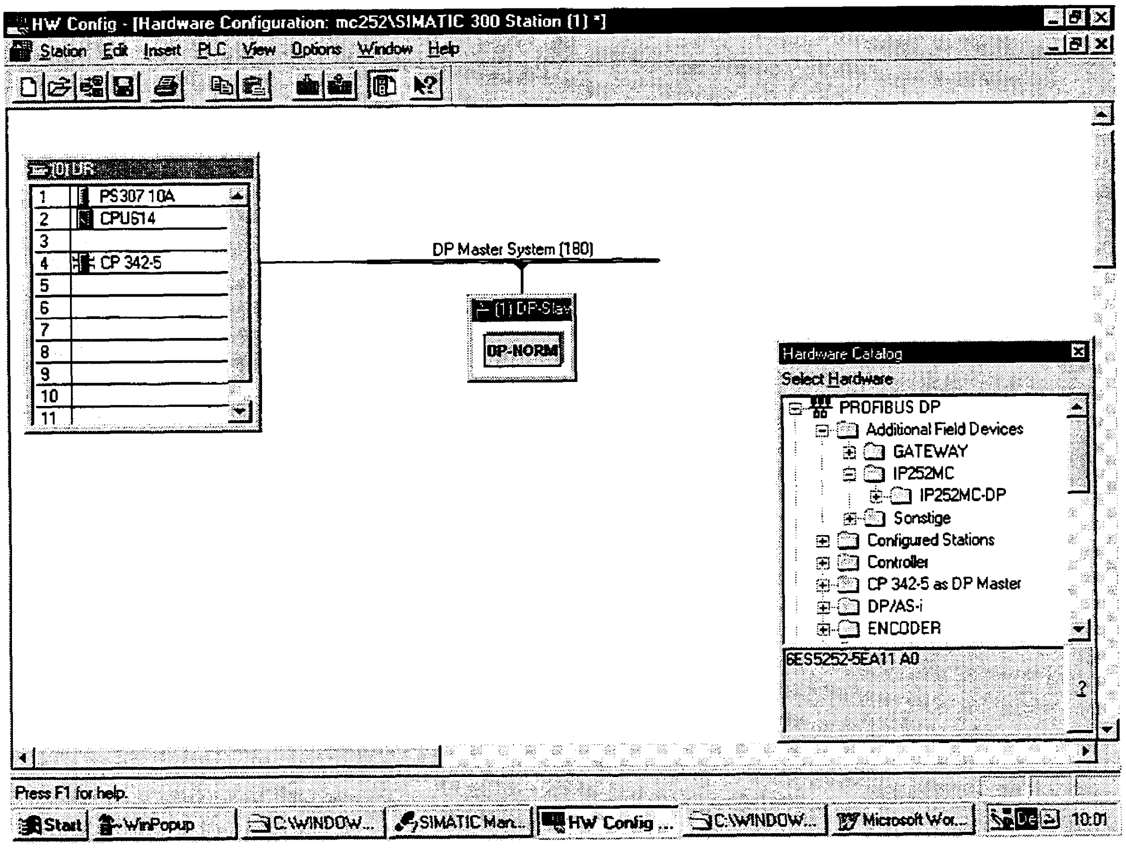
First of all, the configuration of the hardware is to be carried out in accordance with the STEP7 description.

The main steps in brief:

- Start SIMATIC manager
- Create new project
- Enter new SIMATIC-300 station
- Start hardware configuration, open hardware catalog (SIMATIC 300)
- Enter profile rail from the hardware catalog and display (slot 0)
- Enter power supply from the hardware catalog (slot 1)
- Enter CPU315-2DP from the hardware catalog (slot 2) and extend the representation
- Select further hardware components, if required
- The following situation, for example, results:



- Configure the master system of the CP315-2DP:
  - Extend CPU315-2DP in the hardware configuration (slot 2.1 is displayed)
  - Mark the connection *DP master system*
  - Select *PROFIBUS DP->NORMSLAVE ->IP252MC->*
    IP 252MC-DP
    from the hardware catalog by double-clicking on the entry *IP 252MC-DP* (not universal module), the following is an example of what could be displayed:



- The PROFIBUS user address of the IP 252MC-DP is created in a dialog which is opened after double-clicking on the symbol *DP-Slave*.

- The hardware configuration can be saved afterwards.

Note

The configuration sequence for the hardware configuration might vary in parts, depending on the STEP7 surface settings. Minor changes also result before starting the HW configuration if a PROFIBUS-DP network is created in the project in which the PROFIBUS users are already configured.

- Change to the SIMATIC manager
- Open project from the supplied disk (A:\MC252-DP)
- Copy modules from the S7 program CPU315-2DP into the S7 program for the CPU315-2DP configured beforehand
- Copy modules from the S7 program handling blocks into the S7 program for the CPU315-2DP configured beforehand
- If required, copy DB10 (sample DB for configuration DB) into other DB
- Create/extend cyclical OB, please see below
- Create/extend start-up OB, please see below

Create cyclical program

The cyclical program must carry out the following tasks in the described sequence:

- Read data of the built-in DP interface (periphery) and write them into the DBDP-Send / DBDP-Receive.
  This is done with the help of the so-called coupling FC (FC10).
- Carry out several internal administration tasks, e.g. update life sign in every clock of the cyclical program (IP 252MC-DP monitors this! T = 150 ms max.)
  This is done with the help of the so-called status FC (FC122).
- Triggering/blocking/monitoring of the orders required for the respective applications with the help of the modules SEND-FC (FC120), RECEIVE-FC (FC121), CONTROL-FC (FC124).

Details on the FC: Please see description of the FC.

```
cycl. OB --+---- FC11 coupling FC for IP 252MC-DP #1
           +---- FC11 coupling FC for IP 252MC-DP #2,
                                                  if available
           .
           .
           +---- FC122 status FC for IP 252MC-DP #1
           +---- FC122 status FC for IP 252MC-DP #2,
                                                  if available
           .
           .
           +---- FC120 e.g. SEND-FC
           .
           +---- FC121 e.g. RECEIVE-FC
           .
```

The FC11 and FC122 is to be programmed once for every IP 252MC-DP deployed.

The FC11 makes available the data of an IP 252MC-DP in one DB (to be defined), each with the corresponding size, for every direction.

The size of these DBs results from the hardware configuration, configuration of the master system for the DP interface. In the above picture this would be 86 bytes for the DBDP-Send and 96 bytes for the DBDP-Receive.

The parameters *DPSendAdresse, DPReceiveAdresse* of the coupling FC are to be assigned configuration-dependent constants. In the above example, the sending slot with a length of 86 bytes lies in the periphery as of start address 256, i.e. DPSendAdresse := W#16#100; the receive slot with a length of 96 bytes is in the periphery from the receive address 256 onwards, i.e. DPReceiveAdresse := w#16#100.

The coupling FC constantly stores the data of the DP sequence in the stated DB. The remaining FCs use these data to administer and transfer the orders.

Note

If an error indicator has been entered in the parameter "Pafe" during processing of the coupling FC, order selection is not to be recommended.

Create start-up OB

```
Start-up OB --+---- FC123 Start-up FC for IP 252MC-DP #1

              +---- FC123 Start-up FC for IP 252MC-DP #2,
                                                   if available
              .
              .
```

In the start-up OB the configuration DB is initialized. One call of the start-up FC is required for each IP 252MC-DP.

Note

If the start-up FC has been completed with an error, further use of the function blocks is not permissible and also not possible (please see chapter "Error messages").

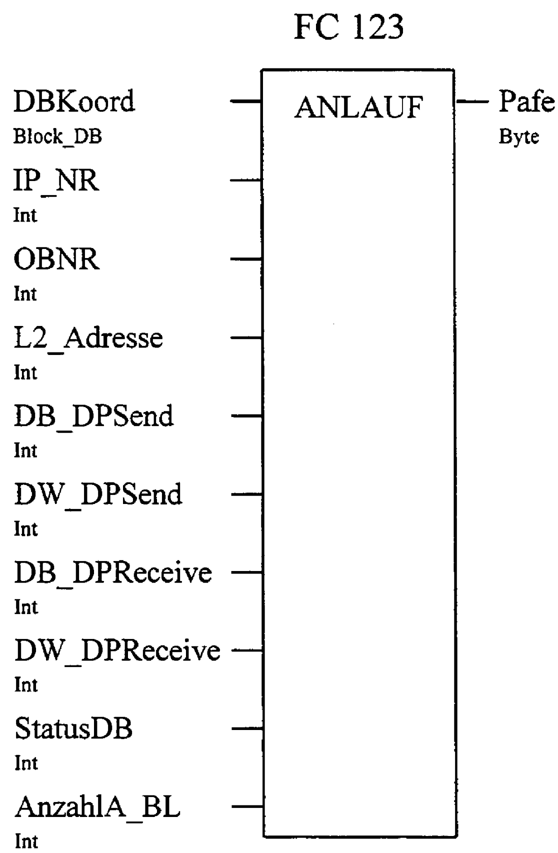
The parameters *DB_DPSend, DW_DPSend* indicate the DB or offset in the DB for the sending slot of the respective IP 252MC-DP. This data result from the configuration of the master system of the CP342-5DP and the parameterization of the coupling FC in the cyclical program. The same applies for the parameters *DB_DPReceive, DW_DPReceive.*

5.3.6 Program structure for S7-400 CPU414-2DP

The same descriptions as in chapter 5.3.5 apply.

However, the coupling FC for the CPU414-2DP is the FC12 (for CPU315-2DP: FC11).

5.3.7 Description of the START-UP FC (ANLAUF-FC)



Function

The coordinating DB of the functions described here is preset with the start-up parameterization.

Moreover, the data ranges DP-Send interface and the status DB are preset.

The preset is only carried out if the parameter test has been completed without error, please see Pafe.

In case of an error, the entry in the data field "Plausibility check" in the coordinating DB is an invalid identification (9999 int). The processing of all further function blocks is then blocked.

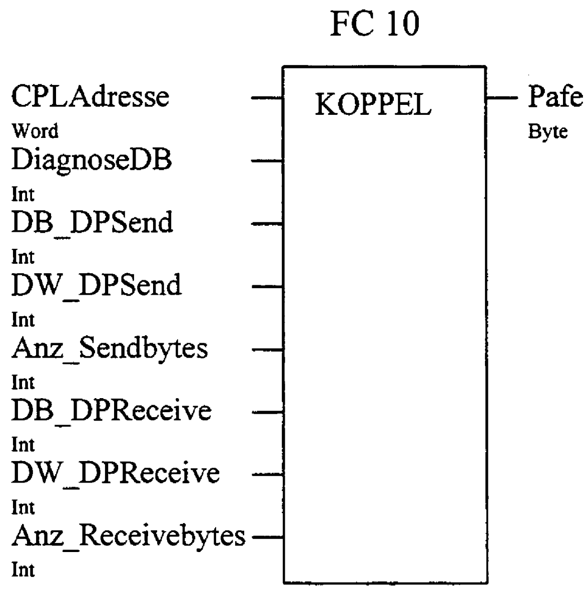
A sample for the declaration of a coordinating DB is available on the supplied disk (DB10).

Parameter description for FC 123 (start-up)

Parameter	Value range	Definition
DBKoord	depending on the CPU	Coordinating DB for addressing the data ranges
IP_NR	1 .. 10	IP 252MC-DP to be configured
OBNR	100	Call takes place in the start-up OB 100
L2_Adresse	1 .. 125	L2 station address of the IP_NR (matching to the DIL switch on the IP 252MC-DP)
DB_DPSend		DB with DP transmitted data
DW_DPSend		Offset in the DB with DP transmitted data
DB_DPReceive		DB with DP received data
DW_DPReceive		Offset in the DB with DP received data
StatusDB		DB for storing the order statuses and diagnosis data of the PROFIBUS
AnzahlA_BL	1 .. 4	Number of order status blocks which are to be updated 1 for order statuses 1..16 2 for order statuses 17..32 3 for order statuses 33..48 4 for order statuses 49..64 **Note:** When parameterizing with 2, for example, the order statuses of orders 1..32 are updated. **Only** those orders can be sent or received, which have been released via this parameter. It is **impossible** to update only order statuses of orders 17-32, for example.
Pafe	Byte	Parameterization error (values are -integer-) During start-up, possible parameterization error recognitions are: 5 Invalid IP No. 7 Invalid call block number "OBNR" 15 Invalid number of order status blocks 17 Invalid L2 station address 19 Length coordinating DB too short 21 Length DB_DPSend too short 23 Length DB_DPReceive too short 25 Length status DB too short **Note:** If the data blocks are not available, the CPU changes to the operating state stop with system error. The event is of top priority and **cannot** be displayed in the Pafe byte.

5.3.8 COUPLING FC (KOPPEL-FC) (CPU-/CP-specific)

Coupling FC (KOPPEL-FC) for CPU614 with CP342-5DP



Function

This module establishes the connection between the DP master module and the DP slave IP 252MC-DP. This coupling FC is only valid for the CP342-5DP as DP master.
An entry (identification 1) is made in the diagnosis DB in DBB0 by the module.

In the coupling FC the diagnosis data which are stored in the diagnosis DB as of DBB1 are prepared. The further function is to read and/or describe the periphery.

The coupling FC calls the following function blocks internally:

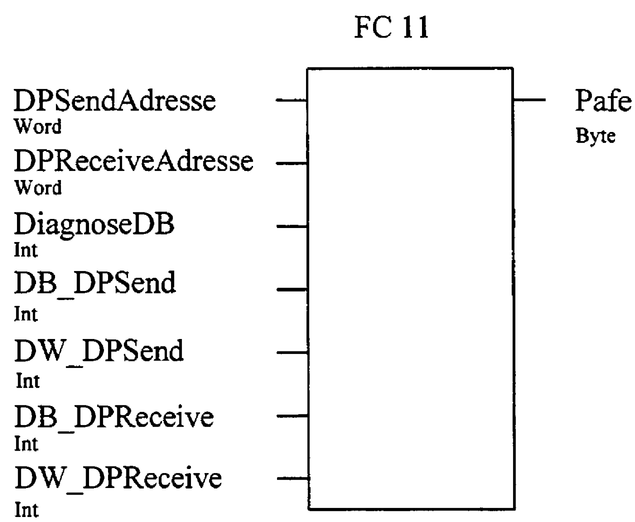
- FC1-L2 Send (for description, please see NCM S7 for PROFIBUS)
- FC2-L2-Receive (for description, please see NCM S7 for PROFIBUS)
- FC3-L2 Diagnosis (for description, please see NCM S7 for PROFIBUS)

If a parameterization error identification is output at the output parameter "Pafe", it is not recommended sending orders to the IP 252MC-DP (interference of the data transfer via PROFIBUS-DP). In this case, the diagnosis must be awaited to rectify errors.

Parameter description for FC 10 (coupling FC for CPU614 with CP342 5DP)

Parameter	Value range	Definition
CPLAdresse	Word	Module address of the CP342-5DP e.g. W#16#100 (Notes on the module addressing, please see manual SINEC S7-CP - Chapter 8)
DiagnoseDB	depending on the CPU	DB with diagnosis data
DB_DPSend	depending on the CPU	DB with DP transmitted data
DW_DPSend		Offset in the DB with DP transmitted data
Anz_Sendbytes	0...240	Number of bytes to send -total-
DB_DPReceive	depending on the CPU	DB with DP received data
DW_DPReceive		Offset in the DB with DP received data
Anz_Receivebytes	0...240	Number of bytes to receive -total-
Pafe	Byte	Parameterization errors (values are -integer-) Possible parameterization error recognitions are: 9 Length diagnosis DB too short 21 Length DB_DPSend too short 23 Length DB_DPReceive too short 31 Interface does not acknowledge (DP station signals station error)

Coupling FC (KOPPEL-FC) for CPU315-2DP



Parameter description for FC 11 (coupling FC for CPU315 2DP)

Parameter	Direction	Type	Definition
DPSendAdresse	Input	Word	Address in the periphery for DP output data to the IP 252MC-DP
DPReceiveAdresse	Input	Word	Address in the periphery for DP input data from IP 252MC-DP
DiagnoseDB	Input	Int	Module for diagnosis data
DB_DPSend	Input	Int	Data block for the image of the DP transmitted data
DW_DPSend	Input	Int	Start offset in the DB_DPSend 86 bytes are written
DB_DPReceive	Input	Int	Data block for the image of the DP receive data
DW_DPReceive	Input	Int	Start offset in the DB_DPReceive 96 bytes are received
Pafe		Byte	Parameterization error (values are integer) Possible identifications are: 9 Length diagnosis DB too short 21 Length DB_DPSend too short 23 Length DB_DPReceive too short 41 Error when reading the periphery 43 Error when writing onto the periphery

Function

This module establishes the connection between the DP master interface and the DP slave IP 252MC-DP. This coupling FC is only valid for the CP315-2DP as DP master.
An entry (identification 3) is made in the diagnosis DB in DBB0 by the module.

In the coupling FC the diagnosis data which are stored in the diagnosis DB as of DBB2 are prepared. The further function is to read and/or describe the periphery.

The coupling FC internally calls the following function blocks:

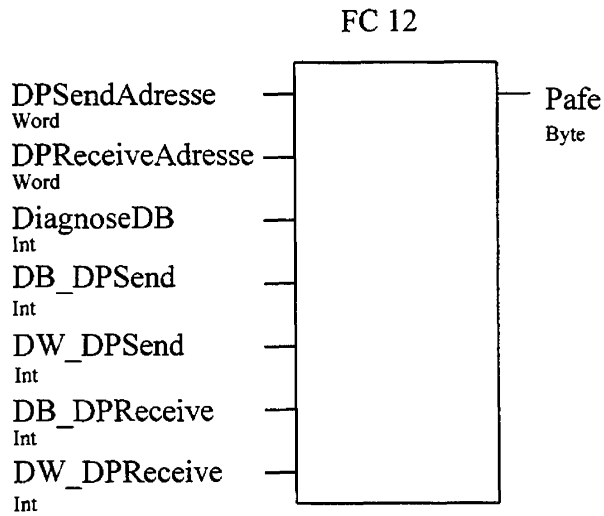
- FC20 Writing data in periphery from DB
- FC21 Reading data from periphery in DB
- SFC14 DPRD_DAT (is called by FC21)
- SFC15 DPWR_DAT (is called by FC20)

If a parameterization error identification is output at the output parameter "Pafe", it is not recommended sending orders to the IP 252MC-DP. (Interference of the data transfer via PROFIBUS-DP). In this case, the diagnosis must be awaited to rectify errors.

Note

If an error is detected on the PROFIBUS-DP and no corresponding error handling OB has been programmed, the CPU315-2DP comes to a stop.

Coupling FC (KOPPEL-FC) for CPU414-2DP



Parameter description for FC 12 (coupling FC for CPU414 2DP)

Parameter	Direction	Type	Definition
DPSendAdresse	Input	Word	Address in the periphery for DP output data to the IP 252MC-DP
DPReceiveAdresse	Input	Word	Address in the periphery for DP input data from IP 252MC-DP
DiagnoseDB	Input	Int	Module for diagnosis data
DB_DPSend	Input	Int	Data block for the image of the DP transmitted data
DW_DPSend	Input	Int	Start offset in the DB_DPSend 86 bytes are written
DB_DPReceive	Input	Int	Data block for the image of the DP receive data
DW_DPReceive	Input	Int	Start offset in the DB_DPReceive 96 bytes are received
Pafe		Byte	Parameterization error (values are integer) Possible identifications are: 9 Length diagnosis DB too short 21 Length DB_DPSend too short 23 Length DB_DPReceive too short 41 Error when reading the periphery 43 Error when writing onto the periphery

Function

This module establishes the connection between the DP master interface and the DP slave IP 252MC-DP. This coupling FC is only valid for the CP414-2DP as DP master.
An entry (identification 4) is made in the diagnosis DB in DBB0 by the module.

In the coupling FC the diagnosis data which are stored in the diagnosis DB as of DBB2 are prepared. The further function is to read and/or describe the periphery.

The coupling FC calls the following function blocks internally:

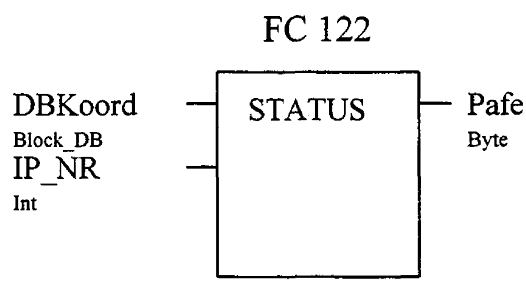
- FC20 Writing data in periphery from DB
- FC21 Reading data from periphery in DB
- SFC14 DPRD_DAT (is called by FC21)
- SFC15 DPWR_DAT (is called by FC20)

If a parameterization error identification is output at the output parameter "Pafe", it is not recommended sending orders to the IP 252MC-DP. (Interference of the data transfer via PROFIBUS-DP). In this case, the diagnosis must be awaited to rectify errors.

Note

If an error is detected on the PROFIBUS-DP and no corresponding error handling OB has been programmed, the CPU315-2DP comes to a stop.

5.3.9 STATUS FC



Function

This module must be called once in the cyclical OB for every IP 252MC-DP.

This is monitored by the IP 252MC-DP; interval max. 150 ms cycle time.

The tasks of the STATUS FC are the updating of the order statuses, the sending of a life lamp to the IP 252MC-DP in the form of an rotating "1" and the coordination of running orders, i.e. if the L2 interface acknowledges an order in the send or receive slot, the STATUS FC releases the interface again.

Connected with this, the module also carries out a TIME OUT monitoring of running orders. If this monitoring finds an error, the order is acknowledged negatively with the status "Communication error" (value of the error trade = 1) and the interface is released.

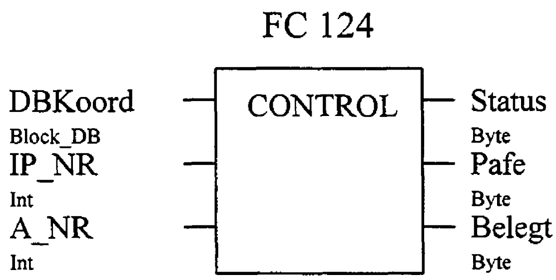
The STATUS FC calls the following module internally:

- SFC20 BLKMOV - Data block transfer

Parameter description for FC 122 (status FC)

Parameter	Value range	Definition
DBKoord	depending on the CPU	Coordinating DB for addressing the data range
IP_NR	1 .. 10	IP 252MC-DP to be called
Pafe	Byte	Parameterization error (values are integer) Possible parameterization error recognitions are: 3 Invalid coordinating DB 5 Invalid IP No.

5.3.10 CONTROL FC



Function

This module issues the current order status of the parameterized order (parameter A_NR). Independently of that, the module issues the status of the send or receive slot at the output parameter "Belegt" (occupied). This status helps the user in controlling the orders.

Send or receive slot are occupied as long as order data are transferred via the interface. As long as these bits are set, further order starts from the SEND FC or RECEIVE FC are acknowledged negatively.

A SEND order can only be started successfully if:

- the send slot is free, i.e. no (other) SEND order occupies the send slot and
- the same SEND order is no longer running but has been completed

The same applies for a RECEIVE order.

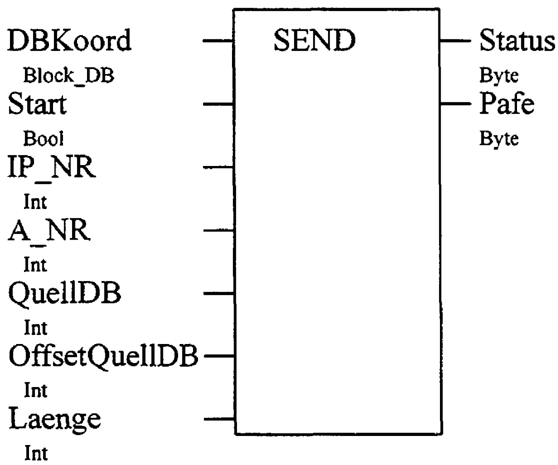
The IP 252MC-DP has accepted/processed an order when the status signals "Completed without error".

Parameter description for FC 124 (CONTROL-FC)

Parameter	Value range	Definition
DBKoord	depending on the CPU	Coordinating DB for addressing the data ranges
IP_NR	1 .. 10	IP to be addressed in the PROFIBUS
A_NR	1 .. 64	Order number **Note:** Order and contents must be known to the IP module (please see chapter 6). Max. order number is also determined by the parameter in the start-up "AnzahlA_BL" (NumberA_BL)
Status	Byte	Order status (please see structure of the status byte, chapter 5.3.13)
Pafe	Byte	Parameterization error (values are -integer-) Possible parameterization error recognitions are: 3 Invalid coordinating DB 5 Invalid IP No. 11 Invalid order number "A_NR"
Belegt	Byte	Status order slot SEND/RECEIVE Bit 0 = 1 Send slot occupied (SEND order still running) Bit 1 = 1 Receive slot occupied (RECEIVE order still running) Bit 2...7 Reserve

5.3.11 SEND FC

FC 120



Function

This module starts a SEND order to the IP 252MC-DP when the parameter "Start" = 1. With the value "Start" = 0 this module has CONTROL functionality and supplies the current order status. If the start bit is set continuously, this order is sent to the IP 252MC-DP continuously via the interface. Further SEND orders cannot then be started.

The start flag can be reset via an evaluation of the output parameter "Status" or "Pafe". (Please see programming example "Order control")

The SEND FC calls the following modules internally:

- SFC20 BLKMOV - Data block transfer
- SFC41 DIS_AIRT - Block alarms
- SFC42 EN_AIRT - Release alarms

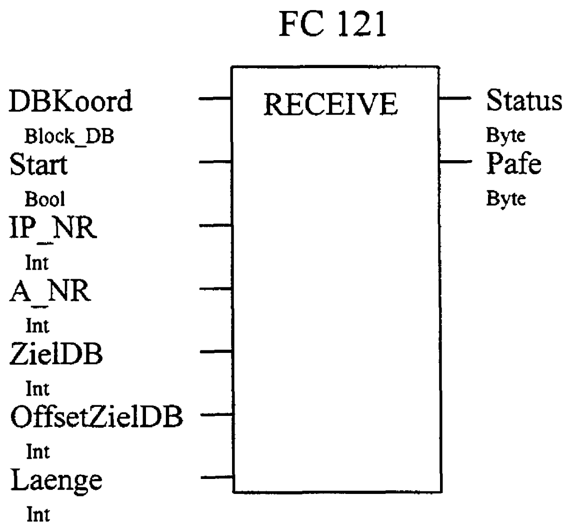
As soon as the order is running the start flag should be reset to *Start.* If not, it tries to send the order again during the next processing. However, if the order is still running, this leads to error messages or to continuous sending of this order (blocking of other SEND orders).

The output parameter *Pafe* should be evaluated to recognize and handle errors which have arisen.

Parameter description for FC 120 (SEND FC)

Parameter	Value range	Definition
DBKoord	depending on the CPU	Coordinating DB for addressing the data ranges
Start	Bool	0 = Order Control 1 = Order Start
IP_NR	1 .. 10	IP 252MC-DP to be addressed
A_NR	1 .. 64	Order number **Note:** Order and contents must be known to the IP 252MC-DP (please see chapter 6). Max. order number is also determined by the parameter in the start-up "AnzahlA_BL" (NumberA_BL)
QuellDB		Data block number of the transmitted data
OffsetQuellDB		Number of the first data word in the source data range
Laenge	1 .. 32	Number of data words to be transmitted
Status	Byte	Order status (please see structure of the status byte, chapter 5.3.13)
Pafe	Byte	Parameterization error (values are -integer-) Possible parameterization error recognitions are: 3 Invalid coordinating DB 5 Invalid IP No. 11 Invalid order number "A_NR" 13 Invalid order length "Laenge" 27 Send interface overloaded 33 Length source DB too short 37 Last send order still running

5.3.12 RECEIVE FC



Function

This module starts a RECEIVE order to the IP 252MC-DP when the parameter "Start" = 1. With the value "Start" = 0 this module has CONTROL functionality and supplies the current order status. If the start bit is set continuously, this order is sent to the IP 252MC-DP continuously via the interface. Further RECEIVE orders cannot then be started.

The start flag can be reset via an evaluation of the output parameters "Status" or "Pafe". (Please see programming example "Order control")

The RECEIVE FC internally calls the following modules:

- SFC41 DIS_AIRT - Block alarms
- SFC42 EN_AIRT - Release alarms

As soon as the order is running the start flag should be reset to *Start*. If not, it tries to request the order again during the next processing. However, if the order is still running, this leads to error messages or to continuous request of this order (blocking of other RECEIVE orders).

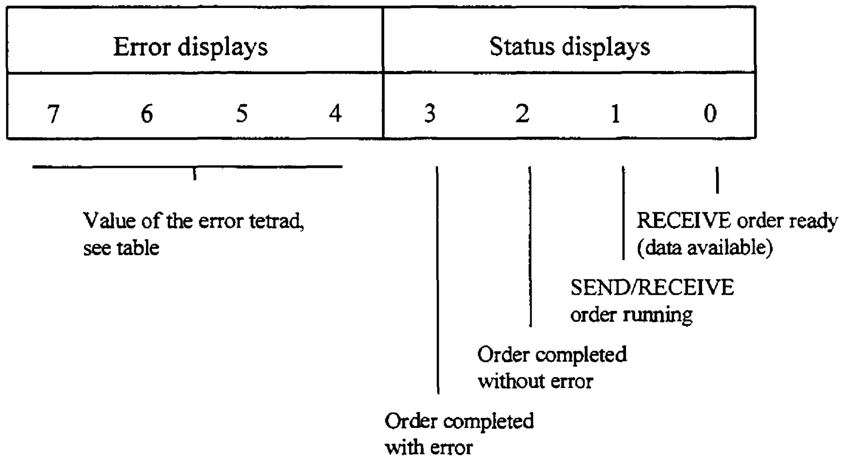
The output parameter *Pafe* should be evaluated to recognize and handle errors which have arisen.

Parameter description for FC121 (RECEIVE FC)

Parameter	Value range	Definition
DBKoord	depending on the CPU	Coordinating DB for addressing the data ranges
Start	Bool	0 = Order Control 1 = Order Start
IP_NR	1 .. 10	IP 252MC-DP to be called
A_NR	1 .. 64	Order number **Note:** Order and contents must be known to the IP 252MC-DP (please see chapter 6). Max. order number is also determined by the parameter in the start-up "AnzahlA_BL" (NumberA_BL)
ZielDB		Data block number of the destination data
OffsetZielDB		Number of the first data word in the destination data range
Laenge	1 .. 32	Number of data words to be transmitted
Status	Byte	Order status (please see structure of the status byte, chapter 5.3.13)
Pafe	Byte	Parameterization error (values are integer) Possible parameterization error recognitions are: 3 Invalid coordinating DB 5 Invalid IP No. 11 Invalid order number "A_NR" 13 Invalid order length "Laenge" 29 RECEIVE interface overloaded 35 Length destination DB too short 39 Last RECEIVE order still running

5.3.13 Output parameter "Status"

Structure of the output parameter "Status"



If bit 3 is set, the value in the error tetrad gives more details on the error which has arisen:

Error tetrad "Status"

Value of the error tetrad	Error	Solution/Comment
0	No error	
1	Communication error	IP 252MC-DP does not acknowledge data transfer/acceptance fast enough
2...5	Reserved	
6	Invalid order no.	FW of the IP 252MC-DP does not know order
7	Reserved	
8	Interface occupied	Transfer area occupied by other running order; repeat order later
9	Data length error	SEND: more than 32 DWs sent RECEIVE: Number of data requested< > supplied data
A...F	Application-specific error message	⇒Please see description there

5.3.14 Output parameter "Pafe"

Identifications in the output parameter "Pafe"

Binary identification	integer	Comment
00000011	3	Invalid coordinating DB (DBKoord)
00000101	5	Invalid IP No. (IP_NR)
00000111	7	Invalid call module no. (OBNR)
00001001	9	Length diagnosis DB too short (DiagnoseDB)
00001011	11	Invalid order number (A_NR)
00001101	13	Invalid order length (Laenge)
00001111	15	Invalid number of order status blocks (A_BL)
00010001	17	Invalid L2 station address (L2_Adresse)
00010011	19	Length coordinating DB too short
00010101	21	Length DB-DPSend too short
00010111	23	Length DB-DPReceive too short
00011001	25	Length status DB too short
00011011	27	SEND interface overloaded
00011101	29	RECEIVE interface overloaded
00011111	31	Interface does not acknowledge
00100001	33	Length source DB too short (QuellDB/OffsetQuellDB)
00100011	35	Length destination DB too short (ZielDB/OffsetZielDB)
00100101	37	Last SEND order still running
00100111	39	Last RECEIVE order still running
00101001	41	Error when reading from periphery
00101011	43	Error when writing on periphery
00101101	45	Reserve
00101111	47	Reserve
00110001	49	Reserve
etc.		Reserve

5.3.15 Structure of the data blocks of the software package

Coordinating data block

Byte	Field	Value range	Contents
0/1		1 ... 10	Highest parameterized IP No.
2/3		1234	Plausibility check coordinating DB
4/5	1	50	Field size
6/7		1	IP No. to be addressed
8/9		1 ... 125	L2 address of the DP slave
10/11			Address DB DP-SEND
12/13			Offset in the DB DP-SEND
14/15		86	Number of input data bytes
16/17			Address DB DP-RECEIVE
18/19			Offset in the DB DP-RECEIVE
20/21		96	Number of output data bytes
22/23		1 ... 4	Number of order status blocks
24/25			Address of the status DB
26/27			Offset in the status DB
28/29			Max. counter for time out monitoring
30/31			Work data SEND-FC
32/33			Time out counter SEND
34/35			Old value SEND coordination
36/37			Work data RECEIVE-FC
38/39			Time out counter RECEIVE
40/41			Old value RECEIVE coordination
42/43			SEND line occupied
44/45			RECEIVE line occupied
46/47			RECEIVE destination DB
48/49			RECEIVE destination DW
50/51			RECEIVE length
52/53			Reserve
54 ... 103	2		Structure as in field 1 - Data for IP No. 2 to be addressed
104 ... 153	3		Structure as in field 1 - Data for IP No. 3 to be addressed
	:		
454 ... 503	10		Structure as in field 1 - Data for IP No. 10 to be addressed

Note

This data block exclusively serves internal purposes and must not be overwritten or changed by the user!

DP Send interface per IP 252MC-DP

Byte	Contents
0	SEND block consistency start
1	SEND order identifier
2	SEND order number
3	SEND number of data words
4/5	SEND useful data word 0
6/7	SEND useful data word 1
8/9	SEND useful data word 2
10/11	SEND useful data word 3
12/13	SEND useful data word 4
14/15	SEND useful data word 5
16/17	SEND useful data word 6
18/19	SEND useful data word 7
20/21	SEND useful data word 8
22/23	SEND useful data word 9
:	
64/65	SEND useful data word 30
66/67	SEND useful data word 31
68	SEND reserve 0
69	SEND reserve 1
70	SEND reserve 2
71	SEND reserve 3
72	SEND reserve 4
73	SEND reserve 5
74	SEND reserve 6
75	SEND reserve 7
76	SEND coordination
77	SEND block consistency end
78	RECEIVE block consistency start
79	RECEIVE order identifier
80	RECEIVE order number
81	RECEIVE number of data words
82	RECEIVE coordination
83	RECEIVE block consistency end
84	STATUS request
85	STATUS life lamp

Note

This data range must be available once for every IP 252MC-DP and must not be overwritten or changed by the user!

DP Receive interface per IP 252MC-DP

Byte	Contents
0	RECEIVE block consistency start
1	RECEIVE order identifier
2	RECEIVE order number
3	RECEIVE Status
4/5	RECEIVE useful data word 0
6/7	RECEIVE useful data word 1
8/9	RECEIVE useful data word 2
10/11	RECEIVE useful data word 3
12/13	RECEIVE useful data word 4
14/15	RECEIVE useful data word 5
16/17	RECEIVE useful data word 6
18/19	RECEIVE useful data word 7
20/21	RECEIVE useful data word 8
22/23	RECEIVE useful data word 9
:	
64/65	RECEIVE useful data word 30
66/67	RECEIVE useful data word 31
68	RECEIVE coordination
69	RECEIVE block consistency end
70	SEND coordination
71	SEND status (at the time of the data acceptance of the L2 interface)
72	STATUS block consistency start
73	STATUS block-n order 1/ 17/ 33/ 49
74	STATUS block-n order 2/ 18/ 34/ 50
75	STATUS block-n order 3/ 19/ 35/ 51
76	STATUS block-n order 4/ 20/ 36/ 52
76	STATUS block-n order 5/ 21/ 37/ 53
77	STATUS block-n order 6/ 22/ 38/ 54
:	
88	STATUS block-n order 16/ 32/ 48/ 64
89	STATUS request back
90	STATUS life lamp
91	STATUS block consistency end
92-95	Reserve

Note

This data range must be available once for every IP 252MC-DP and must not be overwritten or changed by the user!

Status DB

Byte	Contents/Order statuses
0	Reserve
1	Order status1
2	Order status 2
3	Order status 3
4	Order status 4
5	Order status 5
6	Order status 6
7	Order status 7
8	Order status 8
9	Order status 9
10	Order status 10
11	Order status 11
12	Order status 12
13	Order status 13
14	Order status 14
15	Order status 15
16	Order status 16
17	Order status 17
:	
64	Order status 64
65/66	Reserve
68/69	Start-up end (updating of the order statuses after start-up S7 is completed)
70	Old value order status n
71	Old value order status n+1
72	Old value order status n+2
73	Old value order status n+3
74	Old value order status n+4
75	Old value order status n+5
76	Old value order status n+6
77	Old value order status n+7
78	Old value order status n+8
79	Old value order status n+9
:	
85	Old value order status n+16
86 .. 99	Reserve

Note

This data block must be available once for every IP 252MC-DP and must not be overwritten or changed by the user!

Diagnosis DB (DiagnoseDB) (general)

Byte	Diagnosis data
0	Coupling identification - DP master 1 = CP342-5DP 3 = S7-300 CPU315-2DP with built-in interface 4 = S7-400 CPU414-2DP with built-in interface
	Further bytes and required total length: Different depending on the identification

Note

This data block must be available once for every coupling FC, it contains the diagnosis data and must not be overwritten or changed by the user!

Diagnosis DB (DiagnoseDB) assignment for CP342-5DP

Byte	Contents (Notes on the parameter description, please see manual SINEC S7-CP - chapter 8)			
0	1 (identification CP342-5DP)			
1	Order DPSEND		FC SEND L2	(Call in the coupling FC)
	Bit 0	=	DPSend completed (DONE)	
	Bit 1	=	Error DPSend	
	Bit 2...7	=	Reserve	
2/3	Output parameter		FC SEND L2:	Error status DPSEND
4	Order DP-RECEIVE		FC RECEIVE L2	(Call in the coupling FC)
	Bit 0	=	DPReceive completed (NDR)	
	Bit 1	=	Error DPReceive	
	Bit 2...7	=	Reserve	
5	DP status DP-RECEIVE		FC RECEIVE L2	
6/7	Output parameter		FC RECEIVE L2:	Error status DP OUT
8	Order diagnosis		FC DIAGNOSE	(Call in the coupling FC)
	Bit 0	=	New station diagnosis (NDR)	DTYPE 0
	Bit 1	=	Station error (ERROR)	DTYPE 0
	Bit 2	=	New individual diagnosis (NDR)	DTYPE 1
	Bit 3	=	Diagnosis error (ERROR)	DTYPE 1
	Bit 4...7	=	Reserve	
9	Individual diagnosis		FC DIAGNOSE	Parameter DIAGLNG
10/11	Output parameter		FC DIAGNOSE:	STATUS diagnosis
12 .. 15	Reserve			

DB diagnosis (DiagnoseDB) assignment for CP3425DP

Byte	Contents (Notes on the parameter description, please see manual SINEC S7-CP - Chapter 8)
16	Station diagnosis bits L2DP slave stations 0-7 e.g. bit 0 = 1 if station 7 faulty
17	Station diagnosis bits L2DP slave stations 8-15
18	Station diagnosis bits L2DP slave stations 16-23
19	Station diagnosis bits L2DP slave stations 24-31
20	Station diagnosis bits L2DP slave stations 32-39
21	Station diagnosis bits L2DP slave stations 40-47
22	Station diagnosis bits L2DP slave stations 48-55
23	Station diagnosis bits L2DP slave stations 56-63
24	Station diagnosis bits L2DP slave stations 64-71
25	Station diagnosis bits L2DP slave stations 72-79
26	Station diagnosis bits L2DP slave stations 80-87
27	Station diagnosis bits L2DP slave stations 88-95
28	Station diagnosis bits L2DP slave stations 96-103
29	Station diagnosis bits L2DP slave stations 104-111
30	Station diagnosis bits L2DP slave stations 112-119
31	Station diagnosis bits L2DP slave stations 120-127

Diagnosis DB (DiagnoseDB) assignment for CP3422DP

Byte	Contents
0	3 (identification CPU315-2DP)
1	Reserve
2/3	Return value RET_VAL from SFC15 (Call from FC20)
4/5	Return value RET_VAL from SFC14 (Call from FC21)

Diagnosis DB (DiagnoseDB) assignment for CPU414 2DP

Byte	Contents
0	4 (identification CPU414-2DP)
1	Reserve
2/3	Return value RET_VAL from SFC15 (Call from FC20)
4/5	Return value RET_VAL from SFC14 (Call from FC21)

Operation and Programming 6

6.1 Description of the orders

Preliminary remarks

- Unit "N" corresponds to increments
- Bits which are not described in the order must be parameterized with "0"
- Bits in data words with hexa-decimal coding are marked with:
  - "L" for Low byte (corresponds to DR)
  - "H" for High byte (corresponds to DL)

applies to the following orders.

SEND order No. 1

Hardware presetting

Note

SEND order No. 1 is accepted only once and must be the first one to be sent.

DW	Byte/Bit	Value/Function	Unit	Range
0		*Function module 2:*		
	/0:	0: Incremental encoder module		bit-coded
		1: SSI absolute encoder module		
	/1 ... 7:	0: Reserve		
		Reversal of direction of rotation encoder master axis :		
	/8:	0: No reversal		
		1: Reversal		
	/9 ... 11:	0: Reserve		
		Reversal of direction of rotation encoder slave axis 1:		
	/12:	0: No reversal		
		1: Reversal		
	/13 ... 15:	0: Reserve		
1		*Function module 3:*		
	/0:	0: Incremental encoder module		bit-coded
		1: SSI absolute encoder module		
	/1 ... 7:	0: Reserve		
	/8:	Reversal of direction of rotation encoder slave axis 2:		
		0: No reversal		
		1: Reversal		
	/9 ... 11:	0: Reserve		
		Reversal of direction of rotation encoder slave axis 3:		
	/12:	0: No reversal		
		1: Reversal		
	/13 ... 15:	0: Reserve		

DW	Byte/Bit Value/Function	Unit	Range
2	L/0 ... 7: ***Function DA 1***		
	00: Cam controller 0, track 2		00 ... 0Bh
	01: Contouring error master axis		
	02: Cam controller 1, track 2		
	03: Contouring error slave axis 1		
	04: Cam controller 2, track 2		
	05: Contouring error slave axis 2		
	06: Cam controller 3, track 2		
	07: Contouring error slave axis 3		
	08: Cam controller 0, track 1		
	09: Cam controller 1, track 1		
	0A: Cam controller 2, track 1		
	0B: Cam controller 3, track 1		
	H/0 ... 7 ***Function DA 0***		
	00: Cam controller 0, track 1		
	01: Contouring error master axis		00 ... 0Ch
	02: Cam controller 1, track 1		
	03: Contouring error slave axis 1		
	04: Cam controller 2, track 1		
	05: Contouring error slave axis 2		
	06: Cam controller 3, track 1		
	07: Contouring error slave axis 3		
	08: Cam controller 0, track 2		
	09: Cam controller 1, track 2		
	0A: Cam controller 2, track 2		
	0B: Cam controller 3, track 2		
	0C: PROFIBUS-DP communication OK		
3	L/0 ... 7: ***Function DA 3***		00 ... 0Bh
	00: Cam controller 1, track 2		
	01: Contouring error slave axis 1		
	02: Cam controller 2, track 2		
	03: Contouring error slave axis 2		
	04: Cam controller 3, track 2		
	05: Contouring error slave axis 3		
	06: Cam controller 0, track 2		
	07: Contouring error master axis		
	08: Cam controller 0, track 1		
	09: Cam controller 1, track 1		
	0A: Cam controller 2, track 1		
	0B: Cam controller 3, track 1		
	H/0 ... 7: ***Function DA 2***		
	00: Cam controller 1, track 1		00 ... 0Bh
	01: Contouring error slave axis 1		
	02: Cam controller 2, track 1		
	03: Contouring error slave axis 2		
	04: Cam controller 3, track 1		
	05: Contouring error slave axis 3		
	06: Cam controller 0, track 1		
	07: Contouring error master axis		
	08: Cam controller 0, track 2		
	09: Cam controller 1, track 2		
	0A: Cam controller 2, track 2		
	0B: Cam controller 3, track 2		

DW	Byte/Bit Value/Function	Unit	Range
4	L/0 ... 7: ***Function DA 5***		
	00: Cam controller 2, track 2		00 ... 0Bh
	01: Contouring error slave axis 2		
	02: Cam controller 3, track 2		
	03: Contouring error slave axis 3		
	04: Cam controller 0, track 2		
	05: Contouring error master axis		
	06: Cam controller 1, track 2		
	07: Contouring error slave axis 1		
	08: Cam controller 0, track 1		
	09: Cam controller 1, track 1		
	0A: Cam controller 2, track 1		
	0B: Cam controller 3, track 1		
	H/0 ... 7: ***Function DA 4***		
	00: Cam controller 2, track 1		00 ... 0Bh
	01: Contouring error slave axis 2		
	02: Cam controller 3, track 1		
	03: Contouring error slave axis 3		
	04: Cam controller 0, track 1		
	05: Contouring error master axis		
	06: Cam controller 1, track 1		
	07: Contouring error slave axis 1		
	08: Cam controller 0, track 2		
	09: Cam controller 1, track 2		
	0A: Cam controller 2, track 2		
	0B: Cam controller 3, track 2		
5	L/0 ... 7: ***Function DA 7***		
	00: Cam controller 3, track 2		00 ... 0Bh
	01: Contouring error slave axis 3		
	02: Cam controller 0, track 2		
	03: Contouring error master axis		
	04: Cam controller 1, track 2		
	05: Contouring error slave axis 1		
	06: Cam controller 2, track 2		
	07: Contouring error slave axis 2		
	08: Cam controller 0, track 1		
	09: Cam controller 1, track 1		
	0A: Cam controller 2, track 1		
	0B: Cam controller 3, track 1		
	H/0 ... 7: ***Function DA 6***		
	00: Cam controller 3, track 1		00 ... 0Bh
	01: Contouring error slave axis 3		
	02: Cam controller 0, track 1		
	03: Contouring error master axis		
	04: Cam controller 1, track 1		
	05: Contouring error slave axis 1		
	06: Cam controller 2, track 1		
	07: Contouring error slave axis 2		
	08: Cam controller 0, track 2		
	09: Cam controller 1, track 2		
	0A: Cam controller 2, track 2		
	0B: Cam controller 3, track 2		

DW	Byte/Bit Value/Function	Unit	Range
6[1]	*SSI absolute encoder type master axis* (see table 9.1) L/0 ...3: 6: 64 steps/360° 9: 512 steps/360° A: 1024 steps/360° B: 2048 steps/360° C: 4096 steps/360° L/4 ... 7: 4: 16 revolutions 8: 256 revolutions C: 4096 revolutions	Steps/ 360° Revolutions	00 46h ... 00 CCh
7	/0 ...15: *SSI absolute encoder type slave axis 1* (analog DW 6)		
8	/0 ...15: *SSI absolute encoder type slave axis 2* (analog DW 6)		
9	/0 ...15: *SSI absolute encoder type slave axis 3* (analog DW 6)		
10 to 13	/0 ...15: Reserve		00 00h
14	*IP-Link* /0 ...15: 00: Without IP-Link 01: IP-Link module is master module 02: IP-Link module is slave module		00 00h ... 00 02h
15	*Configuration table* /0 ... 15: 00: 8 tables with 1022 nodes each 01: 16 tables with 510 nodes each 02: 32 tables with 254 nodes each		00 00h ... 00 02h
16 to 31	/0 ...15: Reserve		00 00h

[1] 00 00h, if no encoder is connected

SEND order No. 2 **Presetting**

DW	Byte/Bit Value/Function			Unit	Range
0	/0 ... 15:	*Counting values per cycle master axis*	High	N	0 . . 2^{30}
1	/0 ... 15:		Low		
2	/0 ... 15:	*Counting values per cycle slave axis 1*	High	N	0 . . 2^{30}
3	/0 ... 15:		Low		
4	/0 ... 15:	*Counting values per cycle slave axis 2*	High	N	0 . . 2^{30}
5	/0 ... 15:		Low		
6	/0 ... 15:	*Counting values per cycle slave axis 3*	High	N	0 . . 2^{30}
7	/0 ... 15:		Low		
8	/0 ... 15:	*Zero offset master axis*	High	N	0 . . $\pm 2^{30}$
9	/0 ... 15:		Low		
10	/0 ... 15:	*Zero offset slave axis 1*	High	N	0 . . $\pm 2^{30}$
11	/0 ... 15:		Low		
12	/0 ... 15:	*Zero offset slave axis 2*	High	N	0 . . $\pm 2^{30}$
13	/0 ... 15:		Low		
14	/0 ... 15:	*Zero offset slave axis 3*	High	N	0 . . $\pm 2^{30}$
15			Low		
16	/0 ...1:	Reserve			00 00h
17	L/0 ... 7: 00: 01: 02:	*Guide axis of slave axis 1:* Master axis Slave axis 2 Slave axis 3			00 00h ... 00 02h
18	L/0 ... 7: 00: 01: 02:	*Guide axis of slave axis 2:* Master axis Slave axis 1 Slave axis 3			00 00h ... 00 02h
19	L/0 ... 7: 00: 01: 02:	*Guide axis of slave axis 3:* Master axis Slave axis 1 Slave axis 2			00 00h ... 00 02h
20	L/0 ... 7: 00: 01: 02: 03: 04:	*Guide value source:* External master (actual value guidance) Internal master (command value guidance) IP-Link with acceptance of the absolute position (parameterization only with IP-Link slave modules) IP-Link with own position generation from relative position values (parameterization only with IP-Link slave modules) Virtual master			00 00h ... 00 04h

DW	Byte/Bit Value/Function	Unit	Range
21	***Software limit switch/cam controller*** /0: 1: Software limit switch master axis active, Control via cam controller 0, track 1 0: Software limit switch master axis inactive /1: 1: Software limit switch slave axis 1 active, Control via cam controller 1, track 1 0: Software limit switch slave axis 1 inactive /2: 1: Software limit switch slave axis 2 active, Control via cam controller 2, track 1 0: Software limit switch slave axis 2 inactive /3: 1: Software limit switch slave axis 3 active, Control via cam controller 3, track 1 0: Software limit switch slave axis 3 inactive /4 ... 15 Reserve		bit-coded
22	/0 ... 15: Reserve		00 00h
23	/0 ... 15: Reserve		00 00h
24	***Cam controller 0 refers to:*** L/0 ... 7: 00: Actual position master axis 01: Actual position slave axis 1 02: Actual position slave axis 2 03: Actual position slave axis 3 04: Reserve 05: Internal table position (x axis) slave axis 1 06: Internal table position (x axis) slave axis 2 07: Internal table position (x axis) slave axis 3		00 00h ... 00 07h
25	***Cam controller 1 refers to:*** L/0 ... 7: 00: Actual position slave axis 1 01: Actual position master axis 02: Actual position slave axis 2 03: Actual position slave axis 3 04: Reserve 05: Internal table position (x axis) slave axis 1 06: Internal table position (x axis) slave axis 2 07: Internal table position (x axis) slave axis 3		00 00h ... 00 07h
26	***Cam controller 2 refers to:*** L/0 ... 7: 00: Actual position slave axis 2 01: Actual position slave axis 1 02: Actual position master axis 03: Actual position slave axis 3 04: Reserve 05: Internal table position (x axis) slave axis 1 06: Internal table position (x axis) slave axis 2 07: Internal table position (x axis) slave axis 3		00 00h ... 00 07h
27	***Cam controller 3 refers to:*** L/0 ... 7: 00: Actual position slave axis 3 01: Actual position slave axis 1 02: Actual position slave axis 2 03: Actual position master axis 04: Reserve 05: Internal table position (x axis) slave axis 1 06: Internal table position (x axis) slave axis 2 07: Internal table position (x axis) slave axis 3		00 00h ... 00 07h
28 to 31	/0 ...15: Reserve		00 00h

SEND order No. 3 **Parameters**

DW	Byte/Bit	Value/Function	Unit	Range
		Master axis		
0	/0 ... 15:	Initial scaling (pulses/ms with analog command value = 10 V)[1]	N/ms at 10 V	0 . . ± 32000
1	/0 ... 15:	Maximum following distance	N	0 .. 32000
2	/0 ... 15:	Reserve		00 00h
3	/0 ... 15:	Reserve		00 00h
4	/0 ... 15:	Controller parameter K_P [1]	1/256	0 .. 1000
5	/0 ... 15:	Reserve		00 00h
6	/0 ... 15:	Reserve		00 00h
7	/0 ... 15:	Reserve		00 00h
		Slave axis 1		
8	/0 ... 15:	Initial scaling (pulses/ms with analog command value = 10 V) [1]	N/ms at 10 V	0 . . ± 32000
9	/0 ... 15:	Maximum following distance	N	0 .. 32000
10	/0 ... 15:	Reserve		00 00h
11	/0 ... 15:	Reserve		00 00h
12	/0 ... 15:	Controller parameter K_P [1]	1/256	0 .. 1000
13	/0 ... 15:	Reserve		00 00h
14	/0 ... 15:	Reserve		00 00h
15	/0 ... 15:	Reserve		00 00h
		Slave axis 2		
16	/0 ... 15:	Initial scaling (pulses/ms with analog command value = 10 V) [1]	N/ms at 10 V	0 . . ± 32000
17	/0 ... 15:	Maximum following distance	N	0 .. 32000
18	/0 ... 15:	Reserve		00 00h
19	/0 ... 15:	Reserve		00 00h
20	/0 ... 15:	Controller parameter K_P [1]	1/256	0 .. 1000
21	/0 ... 15:	Reserve		00 00h
22	/0 ... 15:	Reserve		00 00h
23	/0 ... 15:	Reserve		00 00h
		Slave axis 3		
24	/0 ... 15:	Initial scaling (pulses/ms with analog command value = 10 V) [1]	N/ms at 10 V	0 . . ± 32000
25	/0 ... 15:	Maximum following distance	N	0 .. 32000
26	/0 ... 15:	Reserve		00 00h
27	/0 ... 15:	Reserve		00 00h
28	/0 ... 15:	Controller parameter K_P [1]	1/256	0 .. 1000
29	/0 ... 15:	Reserve		00 00h
30	/0 ... 15:	Reserve		00 00h
31	/0 ... 15:	Reserve		00 00h

[1] The initial scaling and the controller parameter K_P of axes not used should be set to "0". If this is not done, there will be an uncontrolled output of analog values.

SEND order No. 4 **Traversing parameter guide axis (master axis)**

DW	Byte/Bit	Value/Function	Unit	Range
0		*Operating mode*		
	L/0 ... 7: 00:	Off		00h ...04h
	01:	Pulse generator		
	02:	Positioner: • Linear axis absolute dimension • Rotary axis absolute dimension shortest distance		
	03:	Positioner: • Linear axis absolute dimension same as 02h • Rotary axis absolute dimension with direction presetting in DW 0, H/1		
	04:	Positioner incremental dimension (relative), direction presetting in DW 6, 7		bit-coded
		Commands		
	H/0: 0:	Stop for pulse generator / positioner		
	1:	Start for pulse generator / positioner		
	H/1: 0:	Positive pulse direction		
	1:	Negative pulse direction		
	H/2: 0:	Following-error controller		
	1:	Open-loop controlled traversing		
	H/3: 0:	Reserve		
	H/4: 0:	Reserve		
	H/5: 0:	No intermediate stop positioner		
	1:	Intermediate stop positioner		
		Synchronization master		
	H/6: 0:	No reset synchronization master axis		
	1:	Reset synchronization master axis (Reset of the synchronization which has been generated with reference point approach)		
	H/7: 0:	No setting actual value		
	1:	Setting actual value		
1	/0 ... 15:	Reserve		00 00h
2	/0 ... 15:	Reserve		00 00h
3		*Behavior in case of encoder fault*		
	/0: 0:	Signaling only		bit-coded
	1:	Signaling and controlled continuation of motion		
	/1: 0:	No acknowledgment encoder fault		
	1:	Acknowledgment encoder fault for error order 16		
		PROFIBUS-DP error		
	/2: 0:	No acknowledgment PROFIBUS-DP error		
	1:	Acknowledgment PROFIBUS-DP error		
		Controller disable		
	/3: 0:	No controller disable (controller poss. off due to DW 0, H/2=1)		
	1:	Controller disable (command value output "0")		
	/4 ... /15: 0:	Reserve		
4	/0 ... 15:	Nominal pulse speed pulse generator or maximum pulse speed positioning travel	N/(16 ms)	0...32000
5	/0 ... 15:	Acceleration pulse generator / positioner	N/(16 ms)^2	1 ... 32000
6	/0 ... 15:	Command position / incremental dimension positioner High	N	0 ... 2^{30}
7	/0 ... 15:	Low		

DW	Byte/Bit Value/Function			Unit	Range
8 to 19	/0 ... 15:	Reserve			00 00h
20	/0 ... 15:	Preset value actual value setting	High	N	0 ... +/-2^{30}
21	/0 ... 15:		Low		
22 to 31	/0 ... 15:	Reserve			00 00h

SEND order No. 5 Traversing parameter following axis (slave axis) 1

DW	Byte/Bit Value/Function	Unit	Range
0	*Operating mode* L/0 ...7: 00: Synchronization 01: Pulse generator 02: Positioner: • Linear axis absolute dimension • Rotary axis absolute dimension shortest distance 03: Positioner: • Linear axis absolute dimension same as 02h • Rotary axis absolute dimension with direction presetting in DW 0, H/1 04: Positioner incremental dimension (relative), direction presetting in DW 6, 7 *Commands* H/0: 0: Stop for pulse generator / positioner 1: Start for pulse generator / positioner H/1: 0: Positive pulse direction 1: Negative pulse direction H/2: 0: Following-error controller 1: Open-loop controlled traversing H/3: 0: No synchronization of the table 1: Synchronization of the table *Position preset* H/4: 0: Of SIMATIC interface 1: From traversing table H/5: 0: No intermediate stop positioner 1: Intermediate stop positioner *Synchronization slave axis 1* H/6: 0: No reset synchronization slave axis 1 1: Reset synchronization slave axis 1 (Reset of the synchronization which has been generated with reference point approach/actual value setting) H/7: 0: No actual value setting 1: Actual value setting		00h ... 04h bit-coded
1	*Synchronization function* L/0 ... 7: 00: 1:1 01: Transmission 02: Traversing table H/0 ... 7: 00: Continuously 01: Start 02: Stop		00h ...02h 00h ...02h
2	*Traversing table: Operating mode* L/0: 0: Mode: Absolute output 1: Mode: Relative output / continuous connection - no jumps L/1: 0: Operating mode: Continuous output 1: Operating mode: Stop at table end L/2: 0: Reserve L/3: 0: Table without scaling (without multiplier) 1: Table scaling (slave positions in order 15 are multiplied with value from DW 8, 9 from here) H/0 ... 7: Table number for traversing table		bit-coded 0...7/15/31 (depending on config., see SEND order 1, DW 15)

DW	Byte/Bit	Value/Function		Unit	Range
3		***Behavior in case of encoder fault***			
	/0:	0: Signaling only 1: Signaling and controlled continuation of motion			bit-coded
	/1:	0: No acknowledgment encoder fault 1: Acknowledgment encoder fault for error order 16			
		PROFIBUS-DP error			
	/2:	0: No acknowledgment PROFIBUS-DP error 1: Acknowledgment PROFIBUS-DP error			
	/3:	***Controller disable*** 0: No controller disable (controller possibly off due to DW 0, H/2=1) 1: Controller disable (command value output "0")			
	/4...15:	0: Reserve			
4	/0 ... 7:	Nominal pulse speed pulse generator / pulse speed positioning travel		N/(16 ms)	0...32000
5	/0 ... 7:	Acceleration pulse generator / positioner		N/(256 ms^2)	1 ... 32000
6	/0 ... 7:	Command position / incremental dimension positioner	High	N	0 ... +/- 2^{30}
7	/0 ... 7:		Low		
8	/0 ... 7:	Scaling factor / scaling factor table	Numerator		0 ... ± 32000
9	/0 ... 7:		Denominator		1 ... 32000
10	/0 ... 7:	Start/stop pulses	High	N	0 ... 2^{30}
11	/0 ... 7:		Low		
12	/0 ... 7:	Pulses for ramp start/stop	High	N	1 ... 2^{30}
13	/0 ... 7:		Low		
14	/0 ... 7:	Command position with ext. synchronization	High	N	0 ... +/-2^{30}
15	/0 ... 7:		Low		
16	/0 ... 7:	Coupling position (start/stop)	High	N	0 ... +/-2^{30}
17	/0 ... 7:		Low		
18	/0 ... 7:	Offset speed (pulses per module cycle)		N/cycle time	0...10000
19	/0 ... 7:	Reserve			00 00h
20	/0 ... 7:	Preset actual value setting	High	N	0 ... +/-2^{30}
21	/0 ... 7:		Low		
22 to 31	/0 ... 7:	Reserve			00 00h

SEND order No. 6 **Traversing parameter following axis (slave axis) 2**

DW	Byte/Bit Value/Function	Unit	Range
0	*Operating mode* L/0 ...7: 00: Synchronization 01: Pulse generator 02: Positioner: • Linear axis absolute dimension • Rotary axis absolute dimension shortest distance 03: Positioner: • Linear axis absolute dimension same as 02h • Rotary axis absolute dimension with direction presetting in DW 0, H/1 04: Positioner incremental dimension (relative), direction presetting in DW 6		00h ... 04h
	Commands H/0: 0: Stop for pulse generator / positioner 1: Start for pulse generator / positioner H/1: 0: Positive pulse direction 1: Negative pulse direction H/2: 0: Following-error controller 1: Open-loop controlled traversing H/3: 0: No synchronization of the table 1: Synchronization of the table *Position preset* H/4: 0: Of SIMATIC interface 1: From traversing table H/5: 0: No intermediate stop positioner 1: Intermediate stop positioner *Synchronization slave axis 2* H/6: 0: No reset synchronization slave axis 2 1: Reset synchronization slave axis 2 (Reset of the synchronization which has been generated with reference point approach/actual value setting) H/7: 0: No actual value setting 1: Actual value setting		bit-coded
1	*Function synchronization* L/0 ... 7: 00: 1:1 01: Transmission 02: Traversing table		00h ...02h
	H/0 ... 7: 00: Continuously 01: Start 02: Stop		00h ...02h
2	*Traversing table: Operating mode* L/0: 0: Mode: Absolute output 1: Mode: Relative output / continuous connection - no jumps L/1: 0: Operating mode: Continuous output 1: Operating mode: Stop at table end L/2: 0: Reserve L/3: 0: Table without scaling (without multiplier) 1: Table scaling (slave positions in order 15 are multiplied with value from DW 8, 9 from here)		bit-coded
	H/0 ... 7: Table number for traversing table		0...7/15/31 (depending on config., see SEND order 1, DW 15)

DW	Byte/Bit	Value/Function		Unit	Range
3	 /0: /1: /2: /3: /4...15:	***Behavior in case of encoder fault*** 0: Signaling only 1: Signaling and controlled continuation of motion 0: No acknowledgment encoder fault 1: Acknowledgment encoder fault for error order 16 ***PROFIBUS-DP error*** 0: No acknowledgment PROFIBUS-DP error 1: Acknowledgment PROFIBUS-DP error ***Controller disable*** 0: No controller disable (controller possibly off due to DW 0, H/2=1) 1: Controller disable (command value output "0") 0: Reserve			bit-coded
4	/0 ... 7:	Nominal pulse speed pulse generator / pulse speed positioning travel		N/(16 ms)	0...32000
5	/0 ... 7:	Acceleration pulse generator / positioner		N/(256 ms^2)	1 ... 32000
6	/0 ... 7:	Command position / incremental dimension positioner	High	N	0 ... +/- 2^{30}
7	/0 ... 7:		Low		
8	/0 ... 7:	Scaling factor / scaling factor table	Numerator		0 ... ± 32000
9	/0 ... 7:		Denominator		1 ... 32000
10	/0 ... 7:	Start/stop pulses	High	N	0 ... 2^{30}
11	/0 ... 7:		Low		
12	/0 ... 7:	Pulses for ramp start/stop	High	N	1 ... 2^{30}
13	/0 ... 7:		Low		
14	/0 ... 7:	Command position at ext. synchronization	High	N	0 ... +/-2^{30}
15	/0 ... 7:		Low		
16	/0 ... 7:	Coupling position (start/stop)	High	N	0 ... +/-2^{30}
17	/0 ... 7:		Low		
18	/0 ... 7:	Offset speed (pulses per module cycle)		N/cycle time	0...10000
19	/0 ... 7:	Reserve			00 00h
20	/0 ... 7:	Preset actual value setting	High	N	0 ... +/-2^{30}
21	/0 ... 7:		Low		
22 to 31	/0 ... 7:	Reserve			00 00h

SEND order No. 7 **Traversing parameter following axis (slave axis) 3**

DW	Byte/Bit Value/Function	Unit	Range
0	*Operating mode*		
	L/0 ...7: 00: Synchronization		00h ... 04h
	01: Pulse generator		
	02: Positioner: • Linear axis absolute dimension • Rotary axis absolute dimension shortest distance		
	03: Positioner: • Linear axis absolute dimension same as 02h • Rotary axis absolute dimension with direction presetting in DW 0, H/1		
	04: Positioner incremental dimension (relative), direction presetting in DW 6, 7		bit-coded
	Commands		
	H/0: 0: Stop for pulse generator / positioner		
	1: Start for pulse generator / positioner		
	H/1: 0: Positive pulse direction		
	1: Negative pulse direction		
	H/2: 0: Following-error controller		
	1: Open-loop controlled traversing		
	H/3: 0: No table synchronization		
	1: Table synchronization		
	Position preset		
	H/4: 0: From SIMATIC interface		
	1: From traversing table		
	H/5: 0: No intermediate stop positioner		
	1: Intermediate stop positioner		
	Synchronization slave axis 1		
	H/6: 0: No reset synchronization slave axis 1		
	1: Reset synchronization slave axis 1 (Reset of the synchronization which has been generated with reference point approach/actual value setting)		
	H/7: 0: No actual value setting		
	1: Actual value setting		
1	*Synchronization function*		
	L/0 ... 7: 00: 1:1		00h ...02h
	01: Transmission		
	02: Traversing table		00h ...02h
	H/0 ... 7:00: Continuously		
	01: Start		
	02: Stop		
2	*Traversing table: Mode/operating mode*		
	L/0: 0: Mode: Absolute output		bit-coded
	1: Mode: Relative output / continuous connection - no jumps		
	L/1: 0: Operating mode: Continuous output		
	1: Operating mode: Stop at table end		
	L/2: 0: Reserve		
	L/3: 0: Table without scaling (without multiplier)		
	1: Table scaling (slave positions in order 15 are multiplied with value from DW 8, 9 from here)		
	H/0 ... 7: Table number for traversing table		0...7/15/31 (depending on config., see SEND order 1, DW 15)

DW	Byte/Bit	Value/Function		Unit	Range
3	 /0: /1: /2: /3: /4...15:	***Behavior in case of encoder fault*** 0: Signaling only 1: Signaling and controlled continuation of motion 0: No acknowledgment encoder fault 1: Acknowledgment encoder fault for error order 16 ***PROFIBUS-DP error*** 0: No acknowledgment PROFIBUS-DP error 1: Acknowledgment PROFIBUS-DP error ***Controller disable*** 0: No controller disable (controller possible off due to DW 0, H/2=1) 1: Controller disable (command value output "0") 0: Reserve			 bit-coded
4	/0 ... 7:	Nominal pulse speed pulse generator / pulse speed positioning travel		N/(16 ms)	0...32000
5	/0 ... 7:	Acceleration pulse generator / positioner		N/(256ms^2)	1 ... 32000
6	/0 ... 7:	Command position / incremental dimension positioner	High	N	0 ... 2^{30}
7	/0 ... 7:		Low		
8	/0 ... 7:	Scaling factor / scaling factor table	Numerator		0 ... ± 32000
9	/0 ... 7:		Denominator		1 ... 32000
10	/0 ... 7:	Start/stop pulses	High	N	0 ... 2^{30}
11	/0 ... 7:		Low		
12	/0 ... 7:	Pulses for ramp start/stop	High	N	1 ... 2^{30}
13	/0 ... 7:		Low		
14	/0 ... 7:	Command position with ext. synchronization	High	N	0 ... +/-2^{30}
15	/0 ... 7:		Low		
16	/0 ... 7:	Coupling position (start/stop)	High	N	0 ... +/-2^{30}
17	/0 ... 7:		Low		
18	/0 ... 7:	Offset speed (pulses per module cycle)		N/cycle time	0...10000
19	/0 ... 7:	Reserve			00 00h
20	/0 ... 7:	Preset actual value setting	High	N	0 ... +/-2^{30}
21	/0 ... 7:		Low		
22 to 31	/0 ... 7:	Reserve			00 00h

SEND order No. 9 **Cam controller 0, 1**

	Cam controller 0					
DW	Track	Cam	Function		Unit	Range
0	1	1	Beginning	High	N	0 ... +/-2^{30}
1				Low		
2			End	High	N	0 ... +/-2^{30}
3				Low		
4	1	2	Beginning	High	N	0 ... +/-2^{30}
5				Low		
6			End	High	N	0 ... +/-2^{30}
7				Low		
8	2	1	Beginning	High	N	0 ... +/-2^{30}
9				Low		
10			End	High	N	0 ... +/-2^{30}
11				Low		
12	2	2	Beginning	High	N	0 ... +/-2^{30}
13				Low		
14			End	High	N	0 ... +/-2^{30}
15				Low		
	Cam controller 1					
16	1	1	Beginning	High	N	0 ... +/-2^{30}
17				Low		
18			End	High	N	0 ... +/-2^{30}
19				Low		
20	1	2	Beginning	High	N	0 ... +/-2^{30}
21				Low		
22			End	High	N	0 ... +/-2^{30}
23				Low		
24	2	1	Beginning	High	N	0 ... +/-2^{30}
25				Low		
26			End	High	N	0 ... +/-2^{30}
27				Low		
28	2	2	Beginning	High	N	0 ... +/-2^{30}
29				Low		
30			End	High	N	0 ... +/-2^{30}
31				Low		

SEND order No. 10 **Cam controller 2, 3**

	Cam controller 2					
DW	**Track**	**Cam**	**Function**		**Unit**	**Range**
0	1	1	Beginning	High	N	0 ... +/-2^{30}
1				Low		
2			End	High	N	0 ... +/-2^{30}
3				Low		
4	1	2	Beginning	High	N	0 ... +/-2^{30}
5				Low		
6			End	High	N	0 ... +/-2^{30}
7				Low		
8	2	1	Beginning	High	N	0 ... +/-2^{30}
9				Low		
10			End	High	N	0 ... +/-2^{30}
11				Low		
12	2	2	Beginning	High	N	0 ... +/-2^{30}
13				Low		
14			End	High	N	0 ... +/-2^{30}
15				Low		
	Cam controller 3					
16	1	1	Beginning	High	N	0 ... +/-2^{30}
17				Low		
18			End	High	N	0 ... +/-2^{30}
19				Low		
20	1	2	Beginning	High	N	0 ... +/-2^{30}
21				Low		
22			End	High	N	0 ... +/-2^{30}
23				Low		
24	2	1	Beginning	High	N	0 ... +/-2^{30}
25				Low		
26			End	High	N	0 ... +/-2^{30}
27				Low		
28	2	2	Beginning	High	N	0 ... +/-2^{30}
29				Low		
30			End	High	N	0 ... +/-2^{30}
31				Low		

RECEIVE order No. 13

Diagnostic display

Note

Status and error indications are signaled with "1".

DW	Byte/Bit	Value/Function	Unit	Range
0		***Status actual value acquisition master axis***		
		Incremental encoder module:		***bit-coded***
	/0:	0: Cable OK		
		1: Cable breakage		
	/1:	0: Reserve		
		Status input GSYNC1 (reference switch):		
	/2:	0: Module 2 pin 1="0" (0 V)		
		1: Module 2 pin 1="1" (24 V)		
	/3 ... 15:	0: Reserve		
		SSI absolute encoder module:		
	/0 ... 3:	0: Reserve		
	/4:	0: Level before data OK		
		1: Level before data faulty		
	/5:	0: Level after data OK		
		1: Level after data faulty		
	/6:	0: Voltage at encoder OK		
		1: Encoder signals voltage reduction		
	/7 ... 13:	0: Reserve		
		Initialization error		
	/14:	0: No initialization error (group error to DW 4)		
		1: Initialization error (group error to DW 4)		
		Group error signal		
	/15:	0: No group error signal for this DW 0		
		1: Group error signal for this DW 0		
1		***Status actual value acquisition slave axis 1***		
		Incremental encoder module:		bit-coded
	/0:	0: Reserve		
	/1:	0: Cable OK		
		1: Cable breakage		
	/2:	0: Reserve		
	/3:	Status input GSYNC2 (reference switch):		
		0: Module 2 pin 2="0" (0 V)		
		1: Module 2 pin 2="1" (24 V)		
	/4 ... 15:	0: Reserve		
		SSI absolute encoder module:		
	/0 ... 3:	Reserve		
	/4:	0: Level before data OK		
		1: Level before data faulty		
	/5:	0: Level after data OK		
		1: Level after data faulty		
	/6:	0: Voltage at encoder OK		
		1: Encoder signals voltage reduction		
	/7 ... 13:	0: Reserve		
		Initialization error		
	/14:	0: No initialization error (group error to DW 4)		
		1: Initialization error (group error to DW 4)		
		Group error signal		
	/15:	0: No group error signal for this DW 1		
		1: Group error signal for this DW 1		

DW	Byte/Bit Value/Function			Unit	Range
2			***Status actual value acquisition slave axis 2*** analog DW 0		bit-coded
3			***Status actual value acquisition slave axis 3*** analog DW 1		bit-coded
4			***Initialization status actual value acquisition module 2*** (master axis and slave axis 1) ***Incremental encoder module:*** No information ***SSI absolute encoder module:***		bit-coded
	/0 ... 3:	0:	Reserve		
	/4:	0: 1:	Encoder type valid Encoder type invalid (SEND order 1, DW 6, 7)		
	/5 ... 11:	0:	Reserve		
	/12:	0: 1:	No RAM error recognized in the module RAM error in the module		
	/13:	0: 1:	No EPROM error recognized in the module EPROM error in the module		
	/14:	0:	Reserve		
	/15:	0: 1:	No error pending (group error to DW 4) Error pending (group error to DW 4)		
5			***Initialization status actual value acquisition module 3*** (slave axes 2 and 3) ***Incremental encoder module:*** No information ***SSI absolute encoder module:***		bit-coded
	/0 ... 3:	0:	Reserve		
	/4:	0: 1:	Encoder type valid Encoder type invalid (SEND order 1, DW 8, 9)		
	/5 ... 11:	0:	Reserve		
	/12:	0: 1:	No RAM error recognized in the module RAM error in the module		
	/13:	0: 1:	No EPROM error recognized in the module EPROM error in the module		
	/14:	0:	Reserve		
	/15:	0: 1:	No error pending (group error to DW 5) Error pending (group error to DW 5)		

DW	Byte/Bit Value/Function	Unit	Range
6	***Status PROFIBUS-DP communication***		
	/0: 0: No general error 1: General error		bit-coded
	/1: 0: No error SEND 1: Error SEND		
	/2: 0: No error RECEIVE 1: Error RECEIVE /3 ... 15: 0: Reserve		
7	***Initialization status PROFIBUS-DP communication***		
	L/0 ... 7: 00: No error 01: PROFIBUS-DP not ready 02: Operation on PROFIBUS-DP OK 03: Error on PROFIBUS-DP 04: Parameterization error 05: Hardware initialization error		00h ...05h
	H/0 ... 7: 00: Reserve		00h
8 to 19	/0 ... 15: ***Reserve***		00 00h
	Current internal table positions		
20	/0 ... 15: To internal axis 1: (x position) High	N	0 ... 2^{30}
21	/0 ... 15: Low		
22	/0 ... 15: (y position) High	N	0 ... 2^{23}
23	/0 ... 15: Low		
24	/0 ... 15: To internal axis 2: (x position) High	N	0 ... 2^{30}
25	/0 ... 15: Low		
26	/0 ... 15: (y position) High	N	0 ... 2^{23}
27	/0 ... 15: Low		
28	/0 ... 15: To internal axis 3: (x position) High	N	0 ... 2^{30}
29	/0 ... 15: Low		
30	/0 ... 15: (y position) High	N	0 ... 2^{23}
31	/0 ... 15: Low		

RECEIVE order No. 14

Status displays tables

Note

Updating of the status only in case of acceptance or reset commands.

DW	Byte/Bit Value/Function	Unit	Range
0	*Status table 0:* /0 ... 10: Number of data sets (nodes) /11 ... 13: Error code (same as for RECEIVE order 16, DW 28): 000: No error 001: Table configuration missing 010: Reserve 011: No valid data sets (nodes) 100: Too many data sets (nodes) 101: Reserve 110: Reserve 111: Reserve /14: 0: No error during acceptance of the table 1: Error during acceptance of the table /15: 0: This bit becomes "0" when there is a parameterization in order 15, DW 2 = -3 or -4. 1: Acceptance of the table completed (after order 15, DW 2 = -2)		0 ... 253/509/1021 depending on the config. bit-coded
1	/0 ... 15: ***Status table 1:*** same as for DW 0		bit-coded
2	/0 ... 15: ***Status table 2:*** same as for DW 0		bit-coded
3	/0 ... 15: ***Status table 3:*** same as for DW 0		bit-coded
4	/0 ... 15: ***Status table 4:*** same as for DW 0		bit-coded
5	/0 ... 15: ***Status table 5:*** same as for DW 0		bit-coded
6	/0 ... 15: ***Status table 6:*** same as for DW 0		bit-coded
7	/0 ... 15: ***Status table 7:*** same as for DW 0		bit-coded
8	/0 ... 15: ***Status table 8:*** same as for DW 0		bit-coded
9	/0 ... 15: ***Status table 9:*** same as for DW 0		bit-coded
10	/0 ... 15: ***Status table 10:*** same as for DW 0		bit-coded
11	/0 ... 15: ***Status table 11:*** same as for DW 0		bit-coded
12	/0 ... 15: ***Status table 12:*** same as for DW 0		bit-coded
13	/0 ... 15: ***Status table 13:*** same as for DW 0		bit-coded
14	/0 ... 15: ***Status table 14:*** same as for DW 0		bit-coded
15	/0 ... 15: ***Status table 15:*** same as for DW 0		bit-coded
16	/0 ... 15: ***Status table 16:*** same as for DW 0		bit-coded
17	/0 ... 15: ***Status table 17:*** same as for DW 0		bit-coded
18	/0 ... 15: ***Status table 18:*** same as for DW 0		bit-coded
19	/0 ... 15: ***Status table 19:*** same as for DW 0		bit-coded
20	/0 ... 15: ***Status table 20:*** same as for DW 0		bit-coded
21	/0 ... 15: ***Status table 21:*** same as for DW 0		bit-coded
22	/0 ... 15: ***Status table 22:*** same as for DW 0		bit-coded
23	/0 ... 15: ***Status table 23:*** same as for DW 0		bit-coded
24	/0 ... 15: ***Status table 24:*** same as for DW 0		bit-coded
25	/0 ... 15: ***Status table 25:*** same as for DW 0		bit-coded
26	/0 ... 15: ***Status table 26:*** same as for DW 0		bit-coded
27	/0 ... 15: ***Status table 27:*** same as for DW 0		bit-coded
28	/0 ... 15: ***Status table 28:*** same as for DW 0		bit-coded
29	/0 ... 15: ***Status table 29:*** same as for DW 0		bit-coded
30	/0 ... 15: ***Status table 30:*** same as for DW 0		bit-coded
31	/0 ... 15: ***Status table 31:*** same as for DW 0		bit-coded

SEND order No.15 **Nodes table**

DW	Byte/Bit Value/Function			Unit	Range
0	/0 ... 15: Table number				0 . . 31 depending on the config.
1	/0 ... 15: Offset table entry (n)				0 . . 1021 depending on the config.
2	/0...15: 1 ... 7 Number of nodes which are transmitted with this order Special cases: 0: Send table width of DW 4, 5 (counting values per table cycle) - 1: Erase table (erase all former entries) - 2: Calculate, check all entries if No error ⇒ Accept table - 3: Erase table and reset ⇒ "Acceptance completed" in order 14 DW 0, Bit 15 = 0 - 4: Reset ⇒ "Acceptance completed" in order 14, DW 0, Bit 15 = 0				- 4 ... 7 dec.
3	/0 ... 15: Reserve				0
4	/0 ... 15: Guide axis position (x position) or table width (special case "0")	n	High	N	0 ... table width table width = 1 ... 2^{23}-1
5	/0 ... 15:		Low		
6	/0 ... 15: Slave axis position	n	High	N	0 ... 2^{23}
7	/0 ... 15:		Low		
8	/0 ... 15: Guide axis position	n + 1	High	N	0 ... table width
9	/0 ... 15:		Low		
10	/0 ... 15: Slave axis position	n + 1	High	N	0 ... 2^{23}
11	/0 ... 15:		Low		
12	/0 ... 15: Guide axis position	n + 2	High	N	0 ... table width
13	/0 ... 15:		Low		
14	/0 ... 15: Slave axis position	n + 2	High	N	0 ... 2^{23}
15	/0 ... 15:		Low		
16	/0 ... 15: Guide axis position	n + 3	High	N	0 ... table width
17	/0 ... 15:		Low		
18	/0 ... 15: Slave axis position	n + 3	High	N	0 ... 2^{23}
19	/0 ... 15:		Low		
20	/0 ... 15: Guide axis position	n + 4	High	N	0 ... table width
21	/0 ... 15:		Low		
22	/0 ... 15: Slave axis position	n + 4	High	N	0 ... 2^{23}
23	/0 ... 15:		Low		
24	/0 ... 15: Guide axis position	n + 5	High	N	0 ... table width
25	/0 ... 15:		Low		
26	/0 ... 15: Slave axis position	n + 5	High	N	0 ... 2^{23}
27	/0 ... 15:		Low		
28	/0 ... 15: Guide axis position	n + 6	High	N	0 ... table width
29	/0 ... 15:		Low		
30	/0 ... 15: Slave axis position	n + 6	High	N	0 ... 2^{23}
31	/0 ... 15:		Low		

RECEIVE order No. 16 **Status / actual values**

DW	Byte/Bit	Value/Function	Unit	Range
0		***Status cam controller 0***		
	/0:	0: Track 1, cam 1 not set		bit-coded
		1: Track 1, cam 1 set		
	/1:	0: Track 1, cam 2 not set		
		1: Track 1, cam 2 set		
	/2:	0: Track 2, cam 1 not set		
		1: Track 2, cam 1 set		
	/3:	0: Track 2, cam 2 not set		
		1: Track 2, cam 2 set		
		Status master axis		
	/4 ... 6:	0: Reserve		
	/7:	0: Command feed rate ≠ 0		
		1: Command feed rate = 0		
	/8:	0: Following distance ≤ Window		
		1: Following distance > Window		
	/9:	0: Speed not reached (pulse generator)		
		1: Speed reached (pulse generator)		
	/10:	0: Position not reached (positioner)		
		1: Position reached (positioner)		
	/11:	0: Reserve		
	/12:	0: No error actual value acquisition module 2		
		1: Error actual value acquisition module 2 (group error to order 13 DW 4)		
	/13:	0: No error actual value acquisition encoder		
		1: Error actual value acquisition encoder (group error to order 13 DW 0)		
	/14:	0: IP-Link OK or no return		
		1: Time out IP-Link and return		
	/15:	0: Reserve		

DW	Byte/Bit	Value/Function	Unit	Range
1		***Status cam controller 1***		
	/0:	0: Track 1, cam 1 not set		bit-coded
		1: Track 1, cam 1 set		
	/1:	0: Track 1, cam 2 not set		
		1: Track 1, cam 2 set		
	/2:	0: Track 2, cam 1 not set		
		1: Track 2, cam 1 set		
	/3:	0: Track 2, cam 2 not set		
		1: Track 2, cam 2 set		
		Status slave axis 1		
	/4:	0: Reserve		
	/5, 6:	00: Internal table position: 0 ≤ x ≤ Table width		
		01: Internal table position: x > Table width		
		10: Internal table position: x < 0		
		11: Table not selected		
	/7:	0: Command feed rate ≠ 0		
		1: Command feed rate = 0		
	/8:	0: Following distance ≤ Window		
		1: Following distance > Window		
	/9:	0: Speed not reached (pulse generator)		
		Speed reached (pulse generator)		
	/10:	0: Position not reached (positioner)		
		1: Position reached (positioner)		
	/11:	0: Offset not running (ext. synchronization)		
		1: Offset running (ext. synchronization)		
	/12:	0: No error actual value acquisition module 2		
		1: Error actual value acquisition module 2 (group error to order 13, DW 4)		
	/13:	0: No error actual value acquisition encoder		
		1: Error actual value acquisition encoder (group error to order 13 DW 1)		
	/14:	0: IP-Link OK or no return		
		1: Time out IP-Link and return		
	/15:	0: Reserve		
2		***Status cam controller 2***		
	/0:	0: Track 1, cam 1 not set		bit-coded
		1: Track 1, cam 1 set		
	/1:	0: Track 1, cam 2 not set		
		1: Track 1, cam 2 set		
	/2:	0: Track 2, cam 1 not set		
		1: Track 2, cam 1 set		
	/3:	0: Track 2, cam 2 not set		
		1: Track 2, cam 2 set		
		Status slave axis 2		
	/4:	0: Reserve		
	/5, 6:	00: Internal table position: 0 ≤ x ≤ Table width		
		01: Internal table position: x > Table width		
		10: Internal table position: x < 0		
		11: Table not selected		
	/7:	0: Command feed rate ≠ 0		
		1: Command feed rate = 0		
	/8:	0: Following distance ≤ Window		
		1: Following distance > Window		
	/9:	0: Speed not reached (pulse generator)		
		Speed reached (pulse generator)		
	/10:	0: Position not reached (positioner)		
		1: Position reached (positioner)		
	/11:	0: Offset not running (ext. synchronization)		
		1: Offset running (ext. synchronization)		
	/12:	0: No error actual value acquisition module 3		
		1: Error actual value acquisition module 3 (group error to order 13, DW 5)		
	/13:	0: No error actual value acquisition encoder		
		1: Error actual value acquisition encoder (group error to order 13 DW 2)		
	/14:	0: IP-Link OK or no return		
		1: Time out IP-Link and return		
	/15:	0: Reserve		

DW	Byte/Bit	Value/Function	Unit	Range
3		***Status cam controller 3***		
	/0:	0: Track 1, cam 1 not set		bit-coded
		1: Track 1, cam 1 set		
	/1:	0: Track 1, cam 2 not set		
		1: Track 1, cam 2 set		
	/2:	0: Track 2, cam 1 not set		
		1: Track 2, cam 1 set		
	/3:	0: Track 2, cam 2 not set		
		1: Track 2, cam 2 set		
		Status slave axis 3		
	/4:	0: Reserve		
	/5, 6:	00: Internal table position: 0 ≤ x ≤ Table width		
		01: Internal table position: x > Table width		
		10: Internal table position: x < 0		
		11: Table not selected		
	/7:	0: Command feed rate ≠ 0		
		1: Command feed rate = 0		
	/8:	0: Following distance ≤ Window		
		1: Following distance > Window		
	/9:	0: Speed not reached (pulse generator)		
		Speed reached (pulse generator)		
	/10:	0: Position not reached (positioner)		
		1: Position reached (positioner)		
	/11:	0: Offset not running (ext. synchronization)		
		1: Offset running (ext. synchronization)		
	/12:	0: No error actual value acquisition module 3		
		1: Error actual value acquisition module 3 (group error to order 13, DW 5)		
	/13:	0: No error actual value acquisition encoder		
		1: Error actual value acquisition encoder (group error to order 13 DW 3)		
	/14:	0: IP-Link OK or not return		
		1: Time out IP-Link and return		
	/15:	0: Reserve		

DW	Byte/Bit	Value/Function		Unit	Range
		Actual position			
4	/0 ... 15:	Master axis	High	N	0 ... +/-2^{30}
5	/0 ... 15:		Low		
6	/0 ... 15:	Slave axis 1	High	N	0 ... +/-2^{30}
7	/0 ... 15:		Low		
8	/0 ... 15:	Slave axis 2	High	N	0 ... +/-2^{30}
9	/0 ... 15		Low		
10	/0 ... 15:	Slave axis 3	High	N	0 ... +/-2^{30}
11	/0 ... 15:		Low		
		Actual pulse frequency			
12	/0 ... 15:	Master axis		N/10 ms	0 ... ±32000
13	/0 ... 15:	Slave axis 1		N/10 ms	0 ... ±32000
14	/0 ... 15:	Slave axis 2		N/10 ms	0 ... ±32000
15	/0 ... 15:	Slave axis 3		N/10 ms	0 ... ±32000
		Following distance			
16	/0 ... 15:	Master axis		N	0...32767
17	/0 ... 15:	Slave axis 1		N	0...32767
18	/0 ... 15:	Slave axis 2		N	0...32767
19	/0 ... 15:	Slave axis 3		N	0...32767
20	 /0: 0: 1: /1: 0: 1: /2 . . 15: 0:	***Status module*** No time out IP-Link Time out IP-Link No PROFIBUS-DP error (only with IP 252MC-DP) PROFIBUS-DP error (only with 252MC-DP) Reserve			bit-coded
21 to 24	/0 ... 15:	***Reserve***			00 00h
25	 /n: 0→1	***Toggle bits*** - and/or 1→0 - level change, if SEND order n+1 has been processed (e.g. bit 0 for order 1)			bit-coded
26	 /0: 0: /1: 0: 1: /2: 0: 1: /3: 0: 1: /4: 0: /5: 0: 1: /6: 0: 1: /7: 0: 1: /8 ... 15: 0:	***Status start/stop*** Reserve Start slave axis 1 Start slave axis 1 Start slave axis 2 Start slave axis 2 Start slave axis 3 Start slave axis 3 Reserve Stop slave axis 1 Stop slave axis 1 Stop slave axis 2 Stop slave axis 2 Stop slave axis 3 Stop slave axis 3 Reserve	 not active active not active active not active active not active active not active active not active active		bit-coded

DW	Byte/Bit Value/Function	Unit	Range
27	***Status module*** /0: 0: Module has not started 1: Module started /1 ... 3: 0: Reserve /4: 0: No initialization error module 2 (only SSI absolute encoder equipment) 1: Initialization error module 2 (only SSI absolute encoder equipment) /5: 0: No initialization error module 3 (only SSI absolute encoder equipment) 1: Initialization error module 3 (only SSI absolute encoder equipment) (/4, /5: please see RECEIVE order 13, DW 4, 5) /6, 7: 0: Reserve ***Synchronization with reference point approach or actual value setting*** 8: 0: Master axis not synchronized 1: Master axis synchronized /9: 0: Slave axis 1 not synchronized 1: Slave axis 1 synchronized /10: 0: Slave axis 2 not synchronized 1: Slave axis 2 synchronized /11: 0: Slave axis 3 not synchronized 1: Slave axis 3 synchronized /12 ... 15: 0: Reserve		bit-coded
28	***Status table 0*** (updating of the status only in case of acceptance or reset commands by SEND order 15) /0 ... 10: Number of data sets (nodes) /11 ... 13: Error code (same as for RECEIVE order 14, DW 0): 000: No error 001: Table configuration missing 010: Reserve 011: No valid data sets (nodes) 100: Too many data sets (nodes) 101: Reserve 110: Reserve 111: Reserve /14: 0: No error when accepting the table 1: Error when accepting the table /15: 0: This bit becomes "0" if there is a parameterization in order 15, DW 2 = -3 and/or -4. 1: Acceptance of the table completed (after order 15, DW 2 = -2)		bit-coded
29	/0 ... 15: ***Status table 1*** same as for DW 28		bit-coded
30	/0 ... 15: ***Status table 2*** same as for DW 28		bit-coded
31	/0 ... 15: ***Status table 3*** same as for DW 28		bit-coded

RECEIVE order No. 18

Counter readings for SIMATIC orders

Note

This order gives notes on which order has been transmitted to the module how often and gives information even when the module has not yet started. Thus, the fundamental functioning of the communication between module and SIMATIC can be checked.

DW	Byte/Bit	Value/Function	Unit	Range
		Counter		
0	/0 ... 15:	Order 18		
1	/0 ... 15:	Order 1		
2	/0 ... 15:	Order 2		
3	/0 ... 15:	Order 3		
4	/0 ... 15:	Order 4		
5	/0 ... 15:	Order 5		
6	/0 ... 15:	Order 6		
7	/0 ... 15:	Order 7		
8	/0 ... 15:	0: Reserve		00 00h
		Counter		
9	/0 ... 15:	Order 9		
10	/0 ... 15:	Order 10		
11	/0 ... 15:	0: Reserve		00 00h
12	/0 ... 15:	0: Reserve		00 00h
		Counter		
13	/0 ... 15:	Order 13		
14	/0 ... 15:	Order 14		
15	/0 ... 15:	Order 15		
16	/0 ... 15:	Order 16		
17 to 29	/0 ... 15:	0: Reserve		1234h
30	/n:	*Toggle bits* 0→1 or 1→0 level change, if SEND order n+1 has been processed (e.g. bit 0 for order 1)		bit-coded
31	/0 ... 15:	0: Reserve		1234h

Direct interface RECEIVE

Status / actual values

Note

Offset = Word offset refers to the start address of the Dual Port RAM
Example: Offset 32 = F440 / F441

The hardware only allows byte access. Ensure the data consistency with SIMATIC software, if required.

For handling the data interface, please see chapter 5.1.2

Offset	Byte/Bit Value/Function		Unit	Range
	Status			
32	Cam controller 0 / int. axis 0	cf. RECEIVE 16, DW0		
33	Cam controller 1 / int. Axis 1	cf. RECEIVE 16, DW1		
34	Cam controller 2 / int. Axis 2	cf. RECEIVE 16, DW2		
35	Cam controller 3 / int. Axis 3	cf. RECEIVE 16, DW3		
	Actual position			
36	Master axis	cf. RECEIVE 16, DW4		
37	Master axis	cf. RECEIVE 16, DW5		
38	Internal axis 1	cf. RECEIVE 16, DW6		
39	Internal axis 1	cf. RECEIVE 16, DW7		
40	Internal axis 2	cf. RECEIVE 16, DW8		
41	Internal axis 2	cf. RECEIVE 16, DW9		
42	Internal axis 3	cf. RECEIVE 16, DW10		
43	Internal axis 3	cf. RECEIVE 16, DW11		
	Actual pulse frequency			
44	Master axis	cf. RECEIVE 16, DW12		
45	Slave axis 1	cf. RECEIVE 16, DW13		
46	Slave axis 2	cf. RECEIVE 16, DW14		
47	Slave axis 3	cf. RECEIVE 16, DW15		
	Following distance			
48	Master axis	cf. RECEIVE 16, DW16		
49	Slave axis 1	cf. RECEIVE 16, DW17		
50	Slave axis 2	cf. RECEIVE 16, DW18		
51	Slave axis 3	cf. RECEIVE 16, DW19		
52	***Status module***	cf. RECEIVE 16, DW20		
53	***Toggle bits SIMATIC orders***	cf. RECEIVE 16, DW25		
54 to 62	*Reserve*			
63	***Coordinating cell direct receive range:*** (only for offset 36 . . . 43, other offsets are always updated in the controller cycle) 00h SIMATIC requests updating of the data (range not occupied) 01h IP has written new data (range occupied) 11h IP is updating data (S5 has to wait)			00h, 01h, 11h

6.2 Sequence description

Note

The sequences described in this chapter are **suggestions**, which, on the one hand, are to give an insight into the handling of the module and, on the other hand, must be adapted to the actual conditions.

6.2.1 Module start-up

Start-up sequence:

Start-up SIMATIC

- SIMATIC
  - Switch on voltage
  - SIMATIC starts: Command output blocking (BASP) active
  - SIMATIC has started: Command output blocking (BASP) inactive

Start-up module

- Module
  - With BASP inactive, the operating system of the module starts
  - Approx. 10 ms after BASP inactive, first sending of orders 1 ... 7, 9 and 10 in ascending sequence (please see note)
  - Start-up of the module completed, is acknowledged via RECEIVE order 16, DW 27, Bit 0 = 1

Now orders for traverse/operation of the axis can be sent.

Note

- SEND order 1 (determines the hardware configuration and equipment):
  - must be sent first during start-up
  - must be sent only once
- SEND order 2 and following must be delayed by approx. 1s when sent for the first time if an SSI absolute encoder module has been parameterized in SEND order 1.
- SEND orders 4 ... 7 (traversing orders):
  - DW 0 ... 2 = 0 (first time)
  - When sent for the first time, orders must be sent completely even if certain axes are not required in the corresponding application. Otherwise there is no start-up of the module!
- The module knows no restart. After deactivation of BASP and/or STOP => RUN there is always a new start. All previously transmitted data are lost.

6.2.2 Cyclical inquiry of the module status

Purpose

The module status in the SIMATIC must always be up-to-date to be able to monitor the data transmission, measuring systems, axis states, etc.

Sequence

Constantly check RECEIVE order 13, 14 or 16, but no more often than every 100 ... 200 ms so as not to interfere with the control function.

A RECEIVE order:

- can be triggered by a timer, for example
- should not be configured in an alarm OB

6.2.3 Reference point approach of the axes

(not required for axes with SSI absolute encoders)

Purpose

For incremental encoders, a relation between the mechanical position of the axis and the absolute position in the module must be established. This is only required once after start-up of the module (please also see chapter 4.4.3).

Prerequisite

The axis is at standstill before the start of the reference point approach (please also see chapter 4.4.3).

Determination

The mechanical conditions determine if all axes are allowed to carry out the reference point approach simultaneously or in a certain sequence (danger of collision!).

Special case

The module also works without a previous reference point approach. This can be used if no reference to the mechanical position of the axes is required.
The start status of the actual values is zero.

Warning

Before the end of a reference point approach no position-dependent procedures such as cam signals should be activated since the actual position display may not be valid.

Step 1

Determine if the corresponding axis has already approached the reference point (see RECEIVE order 16, DW 27, Bit 8 ... 11). If not, continue with step 5.

Step 2

Parameterize traversing order (SEND order 4 ... 7) of the axis/axes:

Data word	Byte/Bit	Value	Definition
0	Low/	01	Operating mode axis = Pulse generator
	High/0	0	Stop pulse generator
	High/1	0 or 1	Depending on the direction required in which the zero mark is to be searched
	High/2	0	Switch on following-error controller
	High/6	1	Command: Reset synchronization
4	/0...15	0 .. 32000	Required feed rate for the traverse
5	/0...15	1 .. 32000	Required ramp steepness (acceleration) for the approach of the traversing speed

Step 3

Send traversing order of the axis/axes (SEND order 4 ... 7).

Step 4

Wait until bit "Axis synchronized" is reset (see RECEIVE order 16, DW 27, bits 8 ... 11, depending on the axis).

Step 5

Data word	Byte/Bit	Value	Definition
0	Low/	01	Operating mode axis = Pulse generator
	High/0	1	Start pulse generator
	High/1	0 or 1	Depending on the direction required in which the zero mark is to be searched
	High/2	0	Switch on following-error controller
	High/6	0	No command: Reset synchronization
4	/0...15	0 .. 32000	Required feed rate for the traverse
5	/0...15	1 .. 32000	Required ramp steepness (acceleration) for the approach of the traversing speed

Step 6

Send traversing order of the axis/axes (SEND order 4 ... 7)
=> Reference point approach starts.

Step 7

Wait until:

- e.g. the limit switch (e.g. DI) has responded during a search at a reference point, then change the direction (see SEND order 4 ... 7, DW 0, High/1) and continue with Step 5, searching in the opposite direction.
- axis synchronizes (see RECEIVE order 16. DW 27, bit 8 ... 11 = 0 → 1), continue with Step 8

Note

When overtraveling the zero mark and there is an active GSYNC signal, the zero offset is accepted in the actual value display, regardless of the approached feed rate.

Wait for feedback in RECEIVE order 16, "Status module", depending on the axis:

Data word	Byte/Bit	Value	Definition
27	/8	1	Master synchronized
	/9	1	Slave 1 synchronized
	/10	1	Slave 2 synchronized
	/11	1	Slave 3 synchronized

Step 8

Stop axis in SEND order 4 ... 7, depending on the axis used:

Data word	Byte/Bit	Value	Definition
0	Low/	01	Operating mode axis = Pulse generator
	High/0	0	Stop pulse generator

Step 9

Send traversing order of the axis (SEND order 4, 5, 6, 7)
=> Axis stops in accordance with the parameterized acceleration.

Step 10

Wait until the axis stops, i.e.:

- RECEIVE order 16, DW 0 ... 3, bit 7 = 1
- RECEIVE order 16, DW 0 ... 3, bit 9 = 1

Step 11

If required, carry out positioning travel to the basic position as the axis stops "somewhere" close to the zero mark.

Note

One possible way of compensating for mounting differences is to change the zero offset (SEND order 2, DW 8 ... 15) enabling a precise and accurate alteration of the electrical actual position display to a mechanical axis position according to the reference point.

Warning

The zero offset should only be carried out in small steps with an active position encoder since the axis would otherwise make jumpy compensation movements.

Consequence: A larger zero offset is to be divided into several smaller changes and to be realized with multiple transmission of SEND order 2, DW 8 ... 15.

The following is an alternative:

- Select follow-up mode (SEND order 4 ... 7, DW 0, High/2 = 1)
- Stop axis (controller disable on regulating unit, brake)
- Implement a complete zero offset in one transmission (SEND order 2, DW 8 ... 15)

Step 12

Usually, this step is only required once during commissioning to determine the machine data "Zero offset".

Carry out minor changes of the zero offset on the corresponding axis in SEND order 2:

Data word	Byte/Bit	Value	Definition
8 ... 15 (2 DW per axis)	/0...15	01	Zero offset

Caution: Please see the above!

Step 13

Send SEND order 2, repeat steps 12, 13 several times after minor changes, if required.

Additional comments on the reference point approach

Note:

The axis does not stand on a defined position after the reference point approach. A stop and subsequently a positioning operation to an absolute measure is required to calculate its position. A flying transition to positioning, without already being in standstill, is impossible.

Alternative:

The control traverses the axis until an external digital signal (initiator) responds, then it stops and searches this digital signal edge in the opposite direction at a slow feed rate. "Actual value setting" is then carried out (SEND order 4 ... 7, DW 0, High/7 = 1, DW 20/21).
The bit "Axis synchronized" is set as acknowledgment (RECEIVE order 16, DW 27, Bit 8 ... 11 = 1).
This procedure is also possible with SSI absolute encoders.

6.2.4 Positioning travel of the axes

Purpose

Travel axis to the absolute position to be preset on the shortest way.

Prerequisite

Synchronized axis if a defined position of the mechanical axis is to be reached.

- Axis is at standstill.

Step 1

Parameterize traversing order of the axis (SEND order 4 ... 7):

Data word	Byte/Bit	Value	Definition
0	Low/0...7	02	Operating mode axis = Positioner, shortest way, absolute
	High/0	1	Start positioner
	High/2	0	Switch on following-error controller
	High/4	0	SEND order 5 ...7: Take command value of the axes 1 ... 3 of S5 interface, not from table, master axis always takes position command value of the S5 interface
4	/0...15	0 .. 32000	Required max. feed rate for the traverse
5	/0...15	1 .. 32000	Required ramp steepness (acceleration) for approaching the traversing speed
6, 7	/0...15	0 ... $\pm 2^{30}$	Required position for the axis

Step 2

Send the traversing order of the axis (SEND order 4 ... 7)
=> Start of the movement(s).

Step 3

Wait for feedback per axis/evaluation in RECEIVE order 16 before Step 4 is realized:

Data word	Byte/Bit	Value	Definition
0 ... 3	/10	1	Position reached
	/7	1	Axis stands

Step 4

Complete procedure by parameterizing and sending SEND order 4 ... 7, depending on the axis being used:

Data word	Byte/Bit	Value	Definition
0	Low/0...7	02	Same as Step 1
	High/0	0	Stop positioner

Note

The axis remains in the momentary position.
The acceptance of a new position is at the rising edge of the start bit only. Therefore, the start bit must be reset before the next start of the axis and transferred to the module.

6.2.5 Procedure actual value setting

Purpose

Set electrical actual position display to defined value after the axis has been brought to a defined position, e.g. manually or in jog.

Prerequisite

Axis is at standstill

Step 1

Parameterize momentary physical (real) actual position in the traversing order of the axis/axes (SEND order 4 ... 7):

Data word	Byte/Bit	Value	Definition
0	High/0	0	Stop positioner / pulse generator
	High/7	1	Set actual value
20, 21 (4 bytes per axis)		0... ± 2^{30}	Preset value actual value setting

Step 2

Send traversing order of the axis/axes (SEND order 4 ... 7).

The module accepts the actual value without compensation movement and sets the synchronization bit (RECEIVE order 16, DW 27, bit 8 ... 11).

6.2.6 Synchronization 1:1 or electronic transmission

Prerequisite

The system should usually be at standstill during switchover, deviations may be possible in the individual case.

Caution

Caution is required with a moving guide axis to ensure that there are no uncontrolled movements when switching on the respective following axis/axes.

Purpose

Couple the following axis to the movement of the respective guide axis.

Sequence:

Step 1

Specify the guide axis to the respective following axis (slave axis) 1 ... 3, by parameterizing SEND order 2 "Presetting":

Data word	Byte/Bit	Value	Definition
17	Low/	00, 01, 02	Required guide axis of following axis (slave axis) 1
18	Low/	00, 01, 02	Required guide axis of following axis (slave axis) 2
19	Low/	00, 01, 02	Required guide axis of following axis (slave axis) 3

Step 2

Send SEND order 2.

Step 3

Parameterize synchronization function in the traversing order of the respective following axes (internal axis 1 ... 3, SEND order 5 ... 7):

Data word	Byte/Bit	Value	Definition±
0	Low/	00	Operating mode int. axis 1 ... 3 Synchronization for the respective guide axis
	High/	00	No commands
1	Low/	00 or 01	Function synchronization 1:1 or transmission (or value 02h = traversing table)
	High/	00	Continuous operation
18	/0...7	0...10000	Offset speed

Parameterization start/stop, please see chapter 4.

Step 4

Send traversing order of the axis (SEND order 5 ... 7).

The following axis (slave axis) subsequently follows the movement of the respective master axis (guide axis) corresponding to the selected synchronization function.

Caution

Switching on the synchronization implements synchronization straightaway. Therefore, different feed rates lead to jerky accelerations and/or abrupt compensation movements.

6.2.7 Send (transfer) table

Purpose

Specification of a position profile for one or several following axes above the position of a guide axis.

Note

A table can be used by several following axes simultaneously. Nevertheless, this is only useful if the guide axis is the same axis for these following axes, since the cycle length of the guide axis has to be specified before calculating the table. Every table (no. 0 .. 31) can be assigned to every following axis.

Warning

The next step must not be carried out as long as the respective table is used; otherwise an undefined behavior may arise.

Step 1

Erase nodes for table by parameterizing the following in SEND order 15:

Data word	Byte/Bit	Value	Definition±
0	/0...15	0 to 31	Required table number, depending on the configuration
2	/0...15	-1 or -3*)	Special operation: Erase all former data sets

*) If -3 is sent here, Steps 8 and 9 may be omitted

Step 2

Send SEND order 15.

Step 3

Usually, the cycle length of the guide axis is to be parameterized as table width for the respective following axis which uses the table, in SEND order 15.

Data word	Byte/Bit	Value	Definition±
0	/0...15	0 to 31	Required table number, depending on the configuration
2	/0...15	0	Special operation: Send table width
4, 5	/0...15	$1 \ldots 2^{23}-1$	Table width of the guide axis to the respective following axis which uses the table (in increments)

Step 4 Send SEND order 15.

Step 5 Parameterize the data sets (nodes: guide and following axis positions) of the table in SEND order 15:

Data word	Byte/Bit	Value	Definition
0	/0...15	0 to 31	Required table number
1	/0...15	n	First data set number in this SEND order
2	/0...15	1 ... 7	Number of valid data sets in this SEND order
4, 5	/0...15	0 ... Tab. width	1st guide axis position (x position in the table representation)
6, 7	/0...15	0 ... 2^{23}	1st following axis position (y position in the table representation)
⋮			
28, 29	/0...15	0 ... Tab. width	7th guide axis position
30, 31	/0...15	0 ... 2^{23}	7th following axis position

Step 6 Send SEND order 15.

Step 7 Repeat steps 5, 6 each with changed entries in DW 1 to 31 until all data sets (nodes, a total max. of 1022 depending on the configuration in SEND order 1, DW 15) have been sent.

Step 8 Reset "Acceptance completed" (RECEIVE order 14, DW 0 ... 31 depending on the table number, bit 15), by parameterizing the following in SEND order 15:

Data word	Byte/Bit	Value	Definition
0	/0...15	0 to 31	Required table number
2	/0...15	- 4	Reset "Acceptance completed" for RECEIVE order 14, DW 0, Bit 15

Step 9 Send SEND order 15.

Step 10

Accept data sets by parameterizing the following in SEND order 15:

Data word	Byte/Bit	Value	Definition
0	/0...15	0 to 31	Required table number
2	/0...15	- 2	Accept data sets

Step 11

Send order 15.

Step 12

Wait until table has been converted - i.e. in RECEIVE order 16, DW 28 ... 31 (depending on the table number) the bits have been set as follows:

Bit 0 .. 10	≠	0,	Number of nodes transmitted
Bit 11 .. 13	=	000,	No error
Bit 14 =	0		Acceptance without error
Bit 15 =	1		Acceptance completed

The table is now ready for reading out by a following axis.
If required, repeat all steps for further tables.

6.2.8 Preparation for table traversing (couple following axis to guide axis via table)

Prerequisite

The guide and following axis (master and slave axis) must usually be synchronized, i.e. reference point approach and/or actual value setting has been carried out. In individual cases the above must not always be observed.

The system should be at standstill when synchronizing the table. The respective guide and following axis must, at the very least, be at standstill.

The table has to be sent (transmitted) completely.

Purpose

Couple the following axis to the movement of the respective guide axis via the traversing table.

Note

The procedure can be varied depending on the conditions in the actual system.

Step 1

Specify the guide axis to the respective following axis, by parameterizing the following in SEND order 2 "Presetting":

Data word	Byte/Bit	Value	Definition
17	Low/	00, 01, 02	Required guide axis of following axis (slave axis) 1
18	Low/	00, 01, 02	Required guide axis of following axis (slave axis) 2
19	Low/	00, 01, 02	Required guide axis of following axis (slave axis) 3

Step 2

Send SEND order 2.

Step 3

Traverse the following axis to "undangerous" position and stop. (Positioning, please see chapter 6.2.4 Positioning travel of the axes).

Caution

If the operating ranges of the axes overlap there is the danger of collision!

Step 4

Position the respective guide axis to a position within the table width. (Positioning, please see chapter 6.2.4 Positioning travel of the axes)

Step 5

Synchronize the table for the following axis to the position of the respective guide axis. Parameterize the following in the traversing order of the following axis (SEND order 5 ... 7 depending on the axis):

Data word	Byte/Bit	Value	Definition
0	Low/	02	Operating mode axis = Positioner (please see page 15).
	High/0	0	Stop for positioner.
	High/3	1	Synchronize table, i.e. x axis accepts the actual position of the guide axis.
	High/4	0	Position preset from S5 interface (without effect as High/0 = 0).
1	Low/	02	Synchronization traversing table.
	High/	00, 01, 02	Continuous operation or via start/stop (optional).
2	Low/0...3	bit-coded	Operating mode select traversing table.
	High/	0 to 31	Select the table number to be used for the following axis, table must already be completely transmitted!
6, 7	/0...15	$0 \ldots 2^{30}$	Command position stays the same as in Step 3 (without effect, as DW 0, High/0 = 0).
10, 11	/0...15	$0 \ldots 2^{30}$	Number of pulses of the respective guide axis, while start/stop is active, if selected.
12, 13	/0...15	$1 \ldots 2^{30}$	Number of pulses for ramp width during coupling/decoupling with start/stop, if selected.
14, 15	/0...15	$0 \ldots \pm 2^{30}$	Command position of the following axis when triggering the ext. synchronization (via the respective guide axis) if an external synchronization is used.
16, 17	/0...15	$0 \ldots \pm 2^{30}$	Coupling position: Start/stop starts when overtraveling the coupling position if the ext. start pulse for the start/stop has been recognized before.
18		0...10000	Max. offset speed for external synchronization.

Step 6

Send the traversing order (SEND order 5 ... 7) depending on the axis being used.

Caution

The user (S5 program) must ensure that the actual position of the respective guide axis to the relevant following axis is within the range of 0 to table width of the used table.

Otherwise, there will be undefined states if continuous output is selected (relative or absolute)!

When selecting the type of output "Stop at table end", a deviation is possible but it could lead to undesired results. This has to be decided for the individual cases.

Step 7

Position the following axis to the position in accordance with the table. This is the position which belongs to the guide axis position of that point in time (Step 4). Parameterize the following in the traversing order of the following axis (SEND order 5 ... 7 depending on the axis):

Data word	Byte/Bit	Value	Definition
0	Low/	02	Operating mode axis = Positioner (stays the same as for Step 3)
	High/0	1	Start for positioner
	High/3	0	Do not synchronize table
	High/4	1	Position preset from table
1	Low/	02	Synchronization - traversing table (stays the same as for Step 5)
	High/	00, 01, 02	Cont. operation or via start/stop (stays the same as for Step 5)
2	Low/0...3	bit-coded	Select operating mode traversing table (stays the same as for Step 5)
	High/	0 to 31	Select the table number to be used for the following axis, table has to be transmitted completely! (Stays the same as for Step 5)

Step 8

Send the traversing order (SEND order 5 ... 7) depending on the axis being used.

Step 9

Wait until the following axis is in position, i.e. RECEIVE order 16, DW 1 ... 3 (depending on the axis), Bit 10 "Position reached" = 1.

Step 10

End the position traverse by parameterizing the following in the traversing order of the following axis (SEND order 5 ... 7):

Data word	Byte/Bit	Value	Definition
0	Low/	02	Operating mode axis = positioner (stays the same as for Step 7)
	High/0	0	Stop for positioner

Step 11

Switch over to synchronization of the following axis to the respective guide axis by parameterizing the following in the traversing order of the following axis (SEND order 5 ... 7):

Data word	Byte/Bit	Value	Definition
0	Low/	00	Operating mode axis = synchronization
	High/0...7	00	No commands

Step 12

Send traversing order of the following axis (SEND order 5 ... 7).

Subsequently, the following axis follows the movement of the respective guide axis in accordance with the traversing table and the selected type of output of the traversing table when the guide axis is started.

Commissioning 7

7.1 Switch settings

Definition page frame (S5)

A page frame in the SIMATIC S5 is a memory area to which the PLC and the intelligent module have access. The two processors communicate via this memory area and exchange their data.

Page frame No. IP 252MC IP 252MC-DSP

A DIL switch is located on the IP 252MC for setting the page frame number. With this switch, the number of the page frame is set binarily for the required data exchange.

Every module occupies one page frame area.

Note

- The page frame No. 0 is invalid, i.e. the factory setting **must** be changed.
- The set page frame number must be stated as parameter "SSNR" at the standard handling blocks FB Send / FB Receive in the control program.

Slave address IP 252MC-DP

There is a DIL switch with binary coding on the IP 252MC-DP for setting the slave address (= PROFIBUS DP station address) which is analogous to the IP 252MC.

Note

The set station address must be stated in the control program as parameter "L2_Adresse" at the FC start-up and entered in the hardware configuration.

Arrangement switches for page frame number/ DP station address

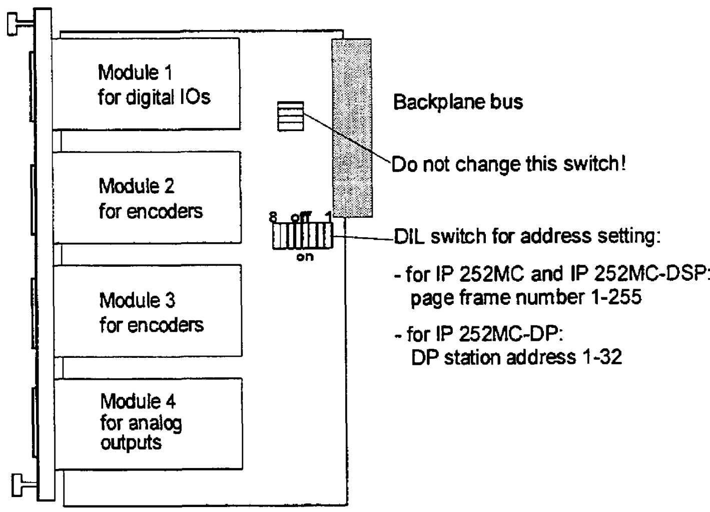


Fig. 7.1 Arrangement of the switches for page frame number / DP station address

Example

Page frame number 56 (= $2^3 + 2^4 + 2^5$):

8	7	6	5	4	3	2	1	
Prjctn.	Prjctn.	Slot	Slot	Slot	Prjctn.	Prjctn.	Prjctn.	OFF Top of the board
Slot	Slot	Prjctn.	Prjctn.	Prjctn.	Slot	Slot	Slot	ON Bottom of the board
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	

The top side of the switch disconnector has a slot and a projection for operation. To activate an address the appropriate projection must be put into the "ON" position.

Fig. 7.2 Setting the page frame number

Note

The standard setting 0 with which the modules are delivered is invalid and must be changed to suit every case!

Note

All other DIL switches on the module are preset and must not be changed by the user.

7.2 Adjustment of the initial scaling and control parameters

Purpose

When the controller is switched off, exact coincidence of the mechanical feed rate of the axis and the analog command value presetting should, if possible, be set.

Prerequisite

- Controller disable off, i.e. in SEND order 4 ... 7, DW 3, bit 3 = 0
- Connecting cables between module and drive are plugged in
- The drift of the drive has already been compensated
- The drives have already been optimized

Sequence:

Step 1

Switch off the controller by parameterizing the following in order 3:

Data word	Byte/Bit	Value	Definition
4, 12, 20, 28 (depending on the axis being used)	/0...15	0	Switch off the controller via $K_P = 0$

Step 2

Send order 3.

Step 3

Roughly calculate the initial scaling.

Example of calculation for order 3 DW 0, 8, 16, 24:

Encoder:

- Runs at an analogous command value 9 V at 3000 r/min
- Supplies 1000 incr. / r
- With incremental encoder pulse quadruplication (module-internal)

Computation:

$$\frac{4 \cdot 1000\,{}^{\text{incr.}}\!/_{\text{U}} \cdot 10\text{V} \cdot 3000\,{}^{\text{U}}\!/_{\text{min}}}{60000\,{}^{\text{ms}}\!/_{\text{min}} \cdot 9\text{V}} \approx 222\,{}^{\text{incr.}}\!/_{\text{ms}}$$

Step 4

Parameterize the calculated initial scaling for the axis in order 3:

Data word	Byte/Bit	value	Definition
0, 8, 16, 24 (depending on the axis being used)	/0...15	0 ... ± 32000	Enter calculated initial scaling

Step 5

Send order 3.

Step 6

Parameterize the axis in SEND order 4, 5, 6, 7:

- Operating mode pulse generator
- Open-loop controlled traversing (following-error controller off)

Data word	Byte/Bit	Value	Definition
0	L/0 ... 7	01	Operating mode axis = Pulse generator
	H/0	1	Start pulse generator
	H/1	0	Positive direction of rotation pulse generator
	H/2	1	Open-loop controlled traversing
4	/0...15	160	Required nominal pulse speed for the traverse e.g. 10 incr./ms = 160 incr./16 ms
5	/0...15	5	Required acceleration (ramp steepness) for the approach

Step 7

Send traversing order of the axis (SEND order 4, 5, 6, 7).

Step 8

Read actual pulse speed in RECEIVE order 16, DW 12, 13, 14, 15 (depending on the axis being used), check that:

- the direction of rotation of the mechanical axis coincides with the preset (positive) direction of rotation in the IP 252 MC.
  - If the axis rotates in positive direction of rotation, but actual value indication < 0:

    Adjust the encoder's direction of rotation:
    Depending on the axis being used, DW 0, 1, bit 8 or 12 in order 1 must be adapted.
  - If the axis rotates in negative direction of rotation, but actual value indication > 0:

    Change the sign of the initial scaling and adapt the encoder's direction of rotation by changing the sign in order 3, DW 0, 8, 16, 24, depending on the axis being used, and adapting bit 8 or 12 in order 1, DW 0, 1, depending on the axis being used.
  - If the axis rotates in the negative direction and actual value indication < 0:

    Change the sign of the initial scaling by changing the sign in order 3, DW 0, 8, 16 and 24, depending on the axis being used.

- the value of the mechanical feed rate corresponds to the preset feed rate.
  - If at a command value = 160 pulses/16 ms, i.e. 100 pulses/10 ms, the actual value indication < 100:

    Reduce the initial scaling by the relative amount.
  - If at a command value = 160 pulses/16 ms, i.e. 100 pulses 10 ms, the actual value indication > 100:

    Increase the initial scaling by the relative amount.

Note

In RECEIVE order 16, DW 12 to 15, the pulse feed rate is stated in the unit pulses/10 ms, whereas the command feed rate is stated in pulses/16 ms in the traversing orders (SEND order 4 ... 7)!

Step 9

Parameterize changed initial scaling in SEND order 3:

Data word	Byte/Bit	Value	Definition
0, 8, 16, 24 (depending on the axis being used)	/0...15	0 ... ± 32000	Enter changed initial scaling

Step 10

Send order 3.

Step 11

Repeat steps 8 to 10 until the anticipated difference between the actual value indication and the real actual value indication is only a few pulses/time unit.

Step 12

Parameterize controller parameter K_P of the axis in SEND order 3:

Data word	Byte/Bit	Value	Definition
4, 12, 20, 28 (depending on the axis being used)	/0...15	0...1000	Switch on controller, value < > 0

Step 13

Send order 3.

Step 14

Switch on following-error controller:
Parameterize the following in the traversing order of the axis (SEND order 4, 5, 6, 7):

Data word	Byte/Bit	Value	Definition
0	L/0 ... 7	00	Operating mode axis = Pulse generator
	H/1	1	Start pulse generator
	H/2	0	Positive direction of rotation pulse encoder
	H/3	0	Switch on following-error controller

Step 15

Send traversing order of the axis (SEND order 4, 5, 6, 7).

Step 16

If required, repeat steps 12 and 13 until the controller parameters are correct.

Step 17

Stop pulse generator by parameterizing the following in the traversing order of the axis (SEND order 4, 5, 6, 7):

Data word	Bit	Value	Definition
0	L/0 ... 7	01	Operating mode axis = Pulse generator
	H/0	0	Stop pulse generator

Step 18

Send traversing order of the axis (SEND order 4, 5, 6, 7).

EMC Recommendations

8

Interference prevention

An important basis for interference-free operation of the control is the grounding of the whole system as well as the shielding of signal lines.

System interferences and hence downtimes can be prevented with little time and expense by consistently carrying out EMC measures.

Information: We very much advise reading the recommendations in the brochure "EMC Recommendation".
Order No.: 6ZB5 440-0QX02-0BA4

The EMC recommendations give guidelines on increasing the interference resistance against different ground potentials and electromagnetic fields.
The following subjects are covered:

EMC subjects

- Spreading of an interference
- Connection principle for potential equalization lines
- Simplification of the connection principle to save potential equalization lines
- Potential connection of power sections and non-power sections
- Grouping of potential equalization lines at the potential equalization cable
- Connection of screened lines
- Connection and installation guidelines
- Information on EEC guidelines

Additional information/ regulations

Information: In addition, the following has to be observed:

- Installation instructions of the SIMATIC S5 in the operating manual
- Standards:
  - DIN VDE 0100: Installation of power systems up to 1000 V.
  - DIN VDE 0160: Equipment of power installations up to 1000 V with electronic resources.
  - DIN VDE 0113, Part 1
  - DIN 57848, Part 1: Danger from electromagnetic fields
  - DIN 57870: Electromagnetic interference
  - IEC 801: Electromagnetic compatibility for industrial process measurement.

Suppliers:

• DIN	Beuth Verlag GmbH 10772 Berlin, Germany
• DIN, VDE, IEC	VDE-Auslieferungsstelle Merianstr. 29 63069 Offenbach, Germany

Note

Please pay attention to the notes in:

- the sheet supplied with the module
- chapter 11

Technical Data

9

In addition to national and international regulations, various Siemens standards (SN) are also applicable.

Information about the relevant standards is to be found in the respective sub-chapters.

9.1 General data

Number of axes	4 (1 master, 3 slaves)
Cycle time: IP 252MC IP 252MC-DP IP 252MC-DSP	 6 ms 6 ms 0.5 ms
Width of page frame	1 Kbyte
Width of module	2 SPS

Digital input/output	
Number of inputs:	8
Input voltage:	U_H = +13 V to +33 V U_L = - 2 V to +4.5 V
Input current:	I_H = 8.5 mA
Delay:	t_{delay} = 3 ms or 0.2 ms (inputs 0 and 1)
Galvanic isolation:	Via optoelectronic coupler square root
Creating an interruption:	Input 0 positive edge, 0.2 ms delay Input 1 positive edge, 0.2 ms delay
Number of outputs:	8 current-sourcing switches
Rated voltage:	U_N = 24 V (20 to 30 V)
Ripple content:	3.6 V
Max. current:	I_H = 100 mA
Galvanic isolation:	Via optoelectronic coupler fourth root
Re-readability:	No
Command output blocking (BASP):	Yes
Connection:	25-pin D-sub connector
Resistance to jamming:	1 kV in acc. with IEC 801-4

Analog output	
Number of outputs:	4
Output voltage:	- 10 V to + 10 V
Resolution:	12 bits
Accuracy:	± 5 LSB for gain and ± 0.5 LSB for linearity
Output current, max.:	2 mA per output short circuit proof
Transducer time:	10 µs
Galvanic isolation	No
Output blocking (0 V) with BASP:	Yes
Connection:	25-pin D-sub connector
Resistance to jamming:	1 kV in acc. with IEC801-4 (screened cable required, with screen applied on the module side)

Encoder	
Incremental encoder	Signals A, $\bar{A}$, B, $\bar{B}$, Z, $\bar{Z}$ in acc. with RS 422 A Floating coarse synchronization (GSYNC) → 24 V DI, via optoelectronic coupler
Input current:	10 mA
Encoder frequency, max.:	500 kHz
Distance, max.:	35 m
Pulse quadruplication:	Internal; fixed setting
Counter channels:	2
Connection:	25-pin D-sub connector
SSI absolute encoder	25 bit communications protocol, SSI, gray-coded, Multiturn (for data format, see Table 9-1)
Input current:	7 mA
Data transfer rate:	120 kbit/s
Updating rate:	500 µs Freewheeling actual value, asynchronous to the control clock pulse
Distance, max.:	100 m
Counter channels:	2
Connection:	25-pin D-sub connector

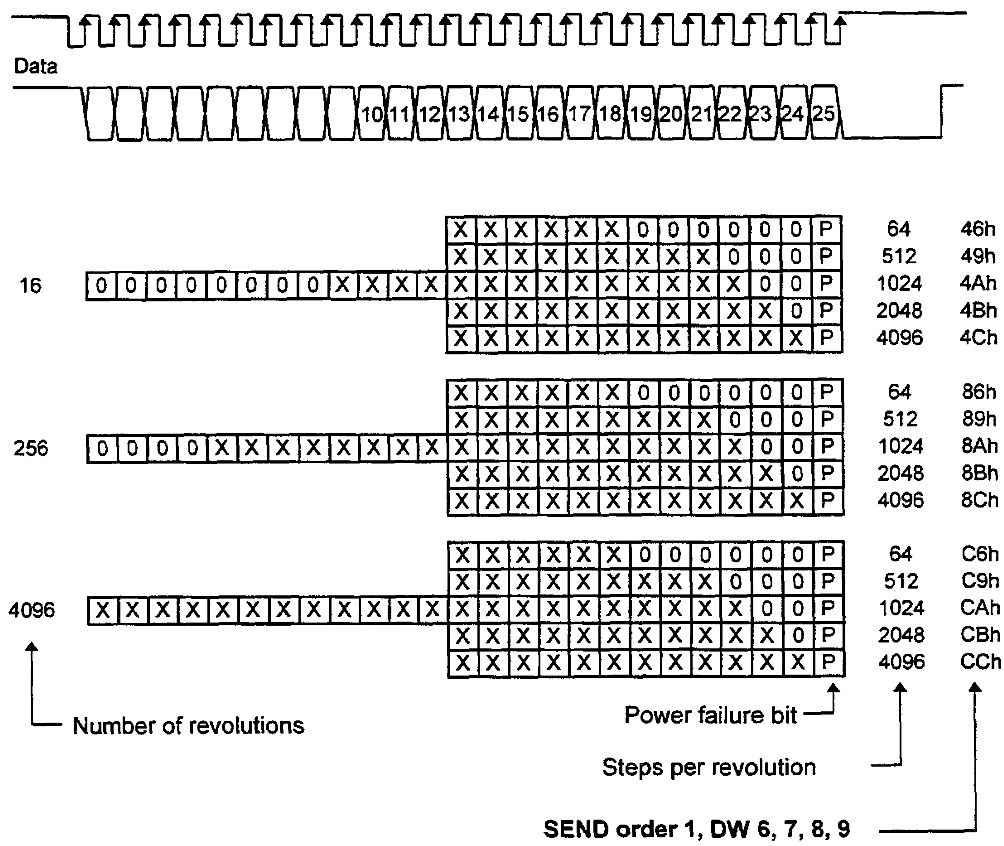


Table 9-1 SSI format for Multiturn encoder

Note

- Only encoders with "christmas tree format" and Gray coding can be used.
- The power failure bit is evaluated by the module and produces an error message in fault state (high level). If the encoder is used without power failure bit, bit 25 = 0 must be sent by the encoder.
- An exchange of TAKT+ and TAKT- or DATA+ and DATA- results in faulty behavior of the encoders.

9.2 Electrical data

Internal power supply	
The 5 V power supply of the module is effected via the SIMATIC S5 bus. The supply for the encoders has to be supplied externally. Direct-current supply with closed-loop control SN 26555, Part 9	
Command value	+ 5 V
Static limits	+ 4.85 V to + 5.25 V
Current consumption	2.3 A

External power supply		
For controlling the digital outputs of the module, + 24 V and M are required. Direct-current supply with open-loop control SN 26555, Part 9		
Command value		+ 24 V
Static limits		+ 20 V to + 30 V
Dynamic limits		
• Lower limit	Value	+ 14.25 V
	Duration	5 ms
	Recovery time	10 s
• Upper limit	Value	+ 35 V
	Duration	500 ms
	Recovery time	50 s

Power supply encoders
The power for the encoders must be supplied externally, in accordance with the instructions of the manufacturer. For connection diagrams, see chapter 11.4.2 and 11.4.3

Signal voltages	
Analog direct-voltage signals SN 26555, Part 1 or DIN IEC 381, Part 2	
Command value range of the analog outputs	- 10 V to + 10 V
Permissible load current	0 mA to 2 mA

Signal voltages	
Binary direct-voltage signals SN 26555, Part 3	
H-signal • Command value • Permissible voltage range for inputs outputs • Permissible current range for inputs outputs Permissible inductive load	 + 24 V + 13 V to + 30 V + 15 V to + 30 V 0 mA to 5 mA 0 mA to 500 mA Damping via freewheeling diode or RC-wiring required
L-signal • Command value • Permissible voltage range for inputs outputs	 + 0 V - 2 V to + 4.5 V 0 V to + 2.5 V

Power consumption	
• Basic module • Incremental encoder module • SSI absolute encoder module • DI/DO module • DSP module	10 W 3 W 2 W 1 W 2 W (not to be used with IP 252MC-DP)

9.3 Mechanical data

Vibrating stress in operation (DIN IEC 68-2-6; SN29010-1, Class 12)	10 Hz to 58 Hz: 0.075 mm excursion 58 Hz to 500 Hz: 9.81 m/s^2 (= 1 g)
Transport stress on the packed device ready for dispatch (DIN IEC 68-2-6; SN29010-2, Class 22)	5 Hz to 9 Hz: 3.5 mm excursion 9 Hz to 500 Hz: 9.81 m/s^2 (= 1 g)
Toppling test of the device itself - i.e. without any packaging (DIN IEC 68-2-31)	Height of fall: 50 mm
Rolling test of the packed device (DIN IEC 68-2-31)	
Weight • IP 252MC, IP 252MC-DSP • Basic module IP 252MC-DP • Incremental encoder module • SSI absolute encoder module • DI/DO module • DSP module	 ca. 9 00 g ca. 3 000 g 110 g 100 g 80 g 110 g (not to be used with IP 252MC-DP)
Dimensions IP 252MC-DP (W x H x D)	ca. 50 x 480 x 290

9.4 Climatic environmental conditions

Temperature (DIN IEC 68-2-1 Cold; DIN IEC 68-2-2 Dry heat; DIN IEC 68-2-3 Humid heat) • Operating temperature (SN26551-1, Code B) • Storage temperature (SN26556-2, Code C)	 0 °C to + 55 °C Δ T ≤ 10 K/h - 40 °C to + 70 °C Δ T ≤ 20 K/h
Air pressure • Operation, air pressure min.: • Storage, air pressure max.: air pressure min.:	 860 hPa (below, lower cooling capacity) 1060 hPa 660 hPa

9.5 Stress due to harmful substances

Dust and gases endangering functions	
Type of ventilation	Self-ventilation
Protection class	VDE0106-1 (IEC536) Class III
Protection against impurities and water (DIN40050; IEC529) • Module in SIMATIC S5 rack • Module not inserted	 IP20 IP10

9.6 Electromagnetic compatibility

9.6.1 Interference suppression

Note

The plant operator is responsible for interference suppression of the entire plant (control, drives, machines, etc.).

The IP 252MC fulfills the limit class A (DIN VDE 0871 Part 1 and 2) for frequencies above 10 kHz in the SIMATIC S5.

9.6.2 Resistance to jamming
(applicable standards: IEC 801-2, 3 and 4)

Resistance to jamming against line-guided disturbances (test in acc. with IEC 801-4)	
Direct-voltage supply lines • Test voltage • Test duration	3 kV 1 min
Signal lines (exiting from the device) • Test voltage • Test duration	2.5 kV 1 min

Resistance to jamming against static discharge (test in acc. with IEC 801-2)	
• Test voltage • Test duration	8 kV 10 discharges (with 1 discharge/s)

Resistance to jamming against high-frequency irradiation (test in acc. with IEC 801-3)	
• Test field strength • Test duration	10 V/m (27 MHz to 500 MHz) 11 min/frequency decade

Ordering Data and Documentation

10

10.1 Ordering data

Devices and modules	Order number
IP 252MC synchronization module	
4 axes incremental	6ES5252-4DA11
2 axes incremental, 2 axes absolute	6ES5252-4DB11
4 axes absolute	6ES5252-4DC11
IP 252MC-DP synchronization module	
4 axes incremental	6ES5252-4EA11
2 axes absolute, 2 axes incremental	6ES5252-4EB11
4 axes absolute	6ES5252-4EC11
IP 252MC-DSP synchronization module	
4 axes incremental	6ES5252-4FA11
IP-Link line	6AT1535-2EA00-0AA0

Spare parts	Order number
Basic module IP 252MC	6ES5252-5AA11
Basic module IP 252MC-DP	6ES5252-5EA11
Basic module IP 252MC -DSP	6ES5252-5FA11
Digital input/output module	6ES5252-5BA11
Analog output module	6ES5252-5BB11
Incremental encoder module	6ES5252-5BC11
SSI absolute encoder module	6ES5252-5BD11
IP-Link line	6AT1535-2EA00-0AA0

Accessories	Order number
Function block packages for IP 252MC/IP252MC-DSP: • MC 252/S5 german • MC 252/S5 english • MC 252/S7 german • MC 252/S7 english	 9AC9 201-0AA00 9AC9 201-0AA01 9AC9 201-2AA0 9AC9 201-2AA01
SUB-D connector, consisting of: 25-pin socket, solder-hook terminated, screened housing and screw locking	6ES5750-2AB31
Incremental encoder with RS 422 interface (TTL)	6FX2001-2□□□□ for further details, see Catalog NC, Order No. E86060-K4490-A001-A4
For rotary-current servomotors, incremental encoders incorporated in the motor are also on offer.	
IP-Link line	6AT1535-2EA00-0AA0
Software on disk: • SEND / RECEIVE / CONTROL for – AG 135U/AG 155U with CPU 922/928/928B/948	 6ES5842-7CB01 (single license)

10.2 Documentation

Title	Order number
Brief description IP 252MC, German	6AT1900-0AB01-0AA0
Brief description IP 252MC, English	6AT1900-0AB01-0BA0
Brief description IP 252MC, Italian	6AT1900-0AB01-0EA0
Manual IP 252MC/ IP 252MC-DSP/ IP 252MC-DP, German	6AT1900-0AA81-0AC0
Manual IP 252MC/ IP 252MC-DSP/ IP 252MC-DP, English	6AT1900-0AA81-0BD0
Manual IP 252MC/ IP 252MC-DSP/ IP 252MC-DP, Italian	Upon request

10.3 Further information and reference material

Reference material	Order number
Installation instructions for SIMATIC S5 Automation units of the U-series	contained in the SIMATIC manual
EMC recommendations for SINUMERIK and SIROTEC controls, English	6FC5297-0AD30-0AP0
EMC recommendations, English	6ZB5440-0QX02-0BA4
Proposals for EMC-safe cabinet installation with digital converters (German)	6ES5998-7AB11

10.4 Service

Hotline: Siemens Regional office Cologne
Tel.: +49 221-5760-2031
Fax.: +49 221-5760-2877

Appendix 11

11.1 Slots in the SIMATIC S5 racks and current balance

The IP 252MC synchronization module can only be operated in the following approved SIMATIC S5 racks.

Slot notes

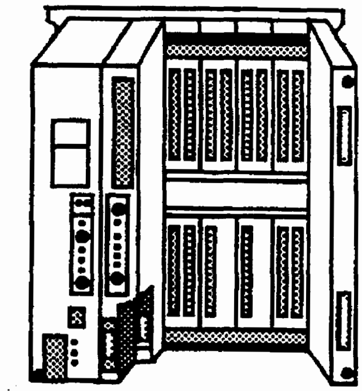
Adaptation casings are an absolute prerequisite for slotting IP modules into the SIMATIC S5-115U module racks. The module width with adaptation casing is represented by a dotted line, the bus connector of the IP module by a small gray rectangle. An IP module must be plugged into a SIMATIC S5 rack in such a way that the gray rectangle lies on a slot designation marked in gray. Preferably, the IP modules should be plugged in the central controller. Operation without a fan is possible.

11.1.1 Approved CPU types

Programmable controller	CPU type	Order number
S5-115U	941B	6ES5 941-7UB11
	942B	6ES5 942-7UB11
	943B	6ES5 943-7UB11
	943B	6ES5 943-7UB21
	944B	6ES5 944-7UB11
	944B	6ES5 944-7UB21
	945	6ES5 945-7UA11
	945	6ES5 945-7UB21
S5-135U	928B	6ES5 928-3UB21
S5-155U	928B	6ES5 928-3UB21
	948	6ES5 948-3UA11
	948	6ES5 948-3UA21

11.1.2 Central controller SIMATIC S5-115U module racks

CR 700-0LB

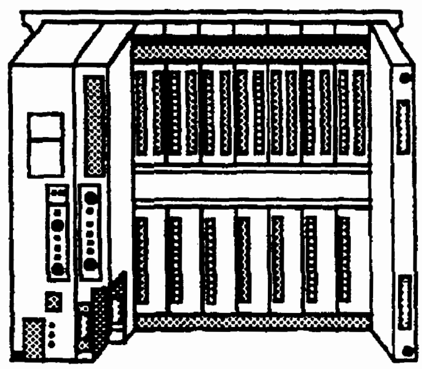


Width and max. current consumption per module

2.3 A

	PS	CPU	Slot designation				IM
			0	1	2	3	
Current supply							
Central module							
IP 252MC							

CR 700-2

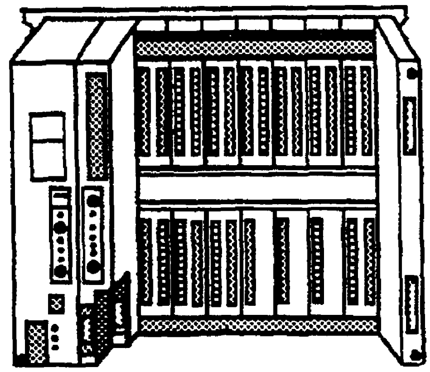


Width and max. current consumption per module

2.3 A

	PS	CPU	Slot designation							IM
			0	1	2	3	4	5	6	
Current supply										
Central module										
IP 252MC										

CR 700-3

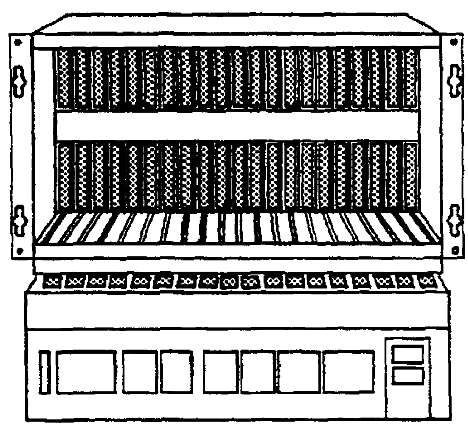


Width and max. current consumption per module

2.3 A

	Slot designation									
	PS	CPU	0	1	2	3	4	5	6	IM
Current supply										
Central module										
IP 252MC										

11.1.3 Central controller SIMATIC S5-135U

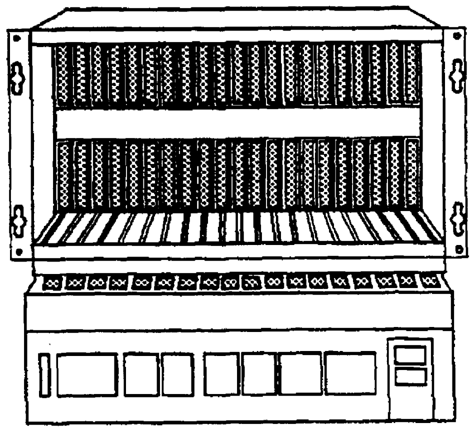


Width and max. current consumption per module

2.3 A

	Slot designation																				
	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
CPU 928B																					
IM 304																					
IP 252MC																					

11.1.4 Central controller SIMATIC S5-155U

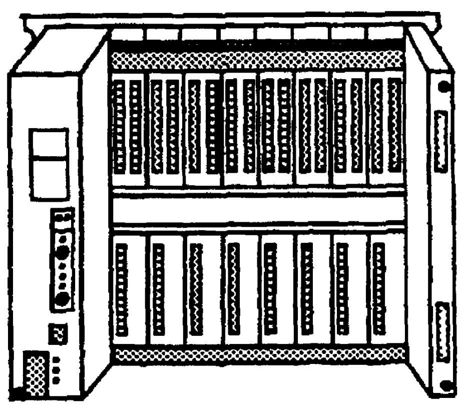


Width and max. current consumption per module

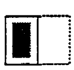
2.3 A

	Slot designation																				
	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
CPU 928B																					
CPU 948																					
IM 304																					
IP 252MC																					

11.1.5 Extension rack ER 701-3



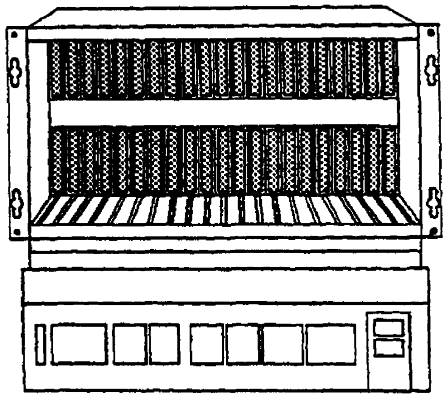
Width and max. current consumption per module



2.3 A

	Slot designation									
	PS	0	1	2	3	4	5	6	7	IM
Current supply										
IM 306										
IM 314										
IP 252MC										

11.1.6 Extension rack SIMATIC S5-185U



Width and max. current consumption per module

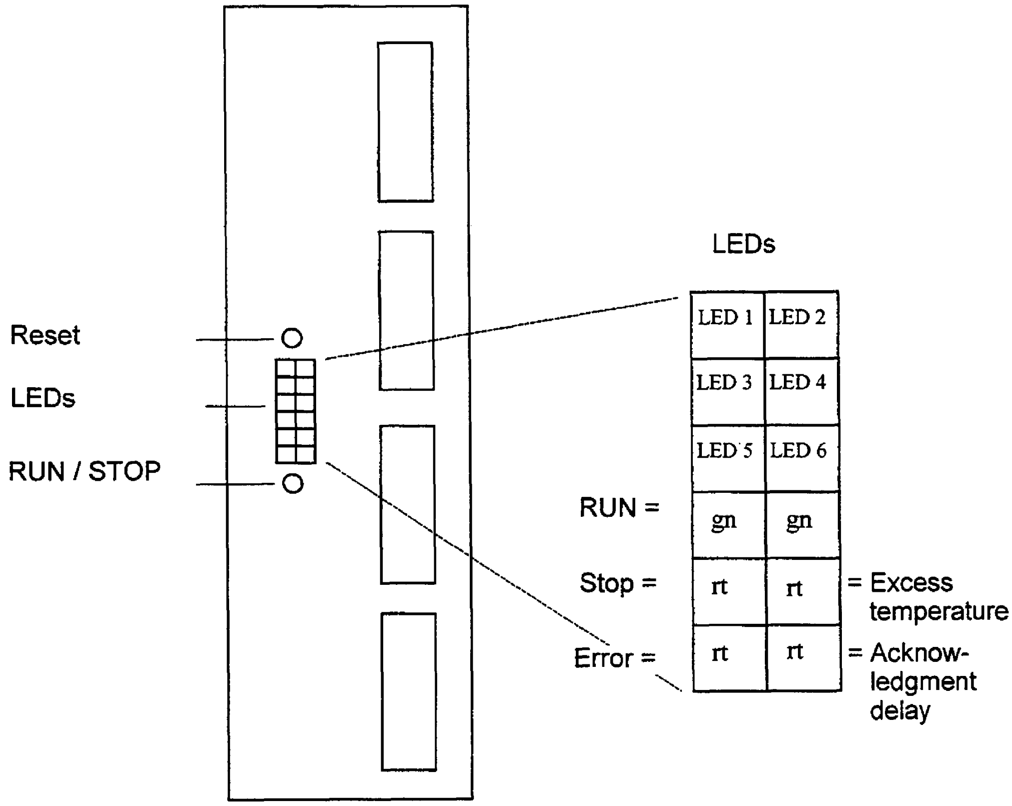
2.3 A

	Slot designation																				
	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
IM 314																					
IP 252MC																					

11.2 Possible DP masters for IP 252MC-DP

S7-300	CPU 315-2DP CPU 614	and compatible with CP 342-5DP
S7-400	CPU 414-2DP	and other compatible CPUs

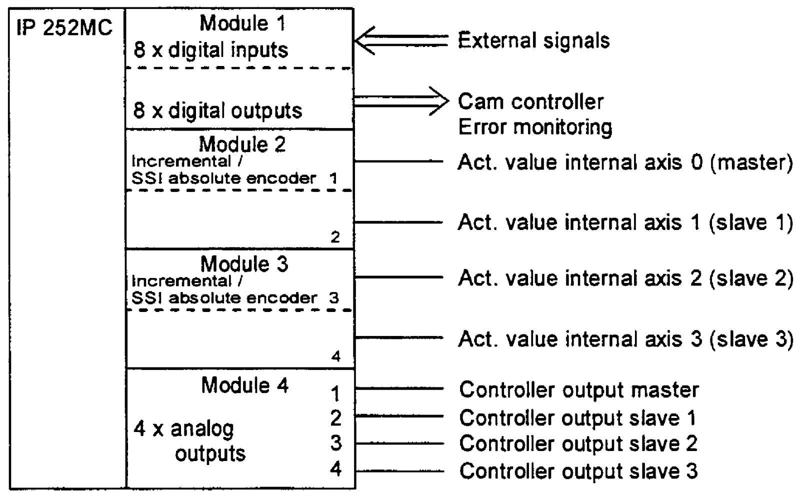
11.3 LED display



Meaning	LED 1	LED 2	LED 3	LED 4	LED 5	LED 6
No start-up or time out for IP-Link	on	on				
Master-IP start-up	on	off				
Slave-IP start-up	off	on				
Stand-alone-IP start-up	off	off				
PROFIBUS-DP coupling active			on			
PROFIBUS-DP okay				on		
DSP in HOLD					on	off
DSP in RUN					off	on

11.4 Peripheral interfaces, connectors, connection

Module arrangement

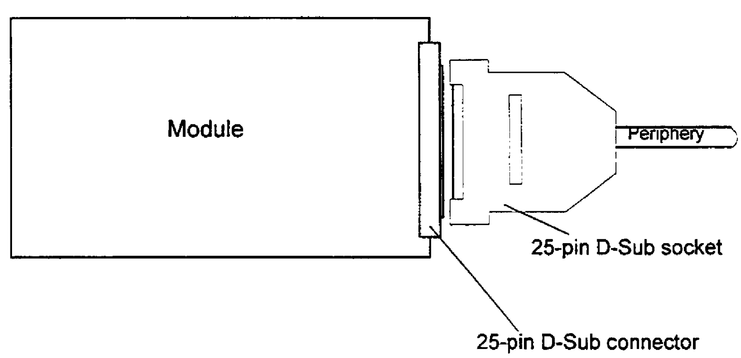


Accessories

Front connectors with 25-pin SUB-D sockets are used for connection to the modules. These front connectors are not included in the delivery of the module and have to be ordered separately.

25-pin D-Sub sockets with metal or connector housing are used for connection from the periphery to the modules for every module.

Front connector to module 1 ... 4



11.4.1 Module 1 (module for digital inputs and outputs DC 24 V)

Connector assignment

Pin No.	Signal
1	
2	DO7
3	DO6
4	DO5
5	DO4
6	+ 24 V / DO4-7
7	Ground / DO4-7
8	DO3
9	DO2
10	DO1
11	DO0
12	+ 24 V / DO0-3
13	Ground / DO0-3
14	DI7
15	DI6
16	Ground / DI6-7
17	DI5
18	DI4
19	Ground / DI4-5
20	DI3
21	DI2
22	Ground / DI2-3
23	DI1
24	DI0
25	Ground / DI0-1

A connector with 25-pin SUB-D socket is required for connection to the module.

DI 0	External synchronization internal axis 1 (slave1)	Triggering an interrupt
DI 1	External synchronization internal axis 2 (slave2)	Triggering an interrupt
DI 2	External synchronization internal axis 3 (slave3)	Polling
DI 3	Start / stop master	Polling
DI 4	Free	
DI 5	Start start/stop operation internal axis (slave 1)	Polling
DI 6	Start start/stop operation internal axis 2 (slave 2)	Polling
DI 7	Start start/stop operation internal axis 2 (slave 3)	Polling

DO 0 parameterizable, please see SEND order 1, DW 2, 3, 4, 5

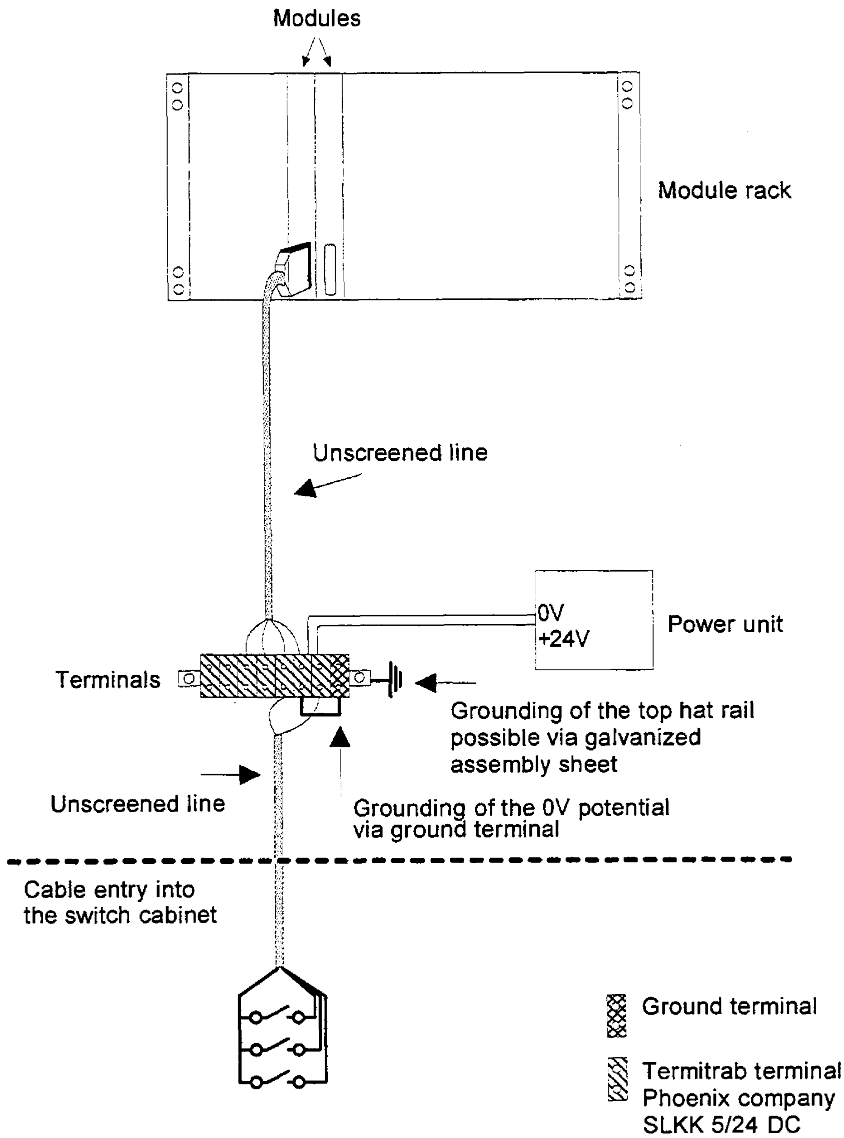
•

•

•

DO 7 parameterizable, please see SEND order 1, DW 2, 3, 4, 5

Connection module 1



11.4.2 Modules 2, 3 for SSI absolute encoder

Connector assignment

Pin No.	Signal	
1	GND	
2		
3		
4		
5		
6		
7	GND	
8		
9		
10	TAKT1 +	(RS422)
11	TAKT1 -	(RS422)
12	DATA1 +	(RS422)
13	DATA1 -	(RS422)
14	TAKT2 +	(RS422)
15	TAKT2 -	(RS422)
16	DATA2 +	(RS422)
17	DATA2 -	(RS422)
18		
19		
20		
21		
22		
23		
24		
25	V_{CC}	

A connector with 25-pin SUB-D socket is required for connection to the module.

Note

If DATA inputs are not used, the negated inputs (DATA-) must be connected with GND and the ones not negated (DATA+) with V_{CC}.

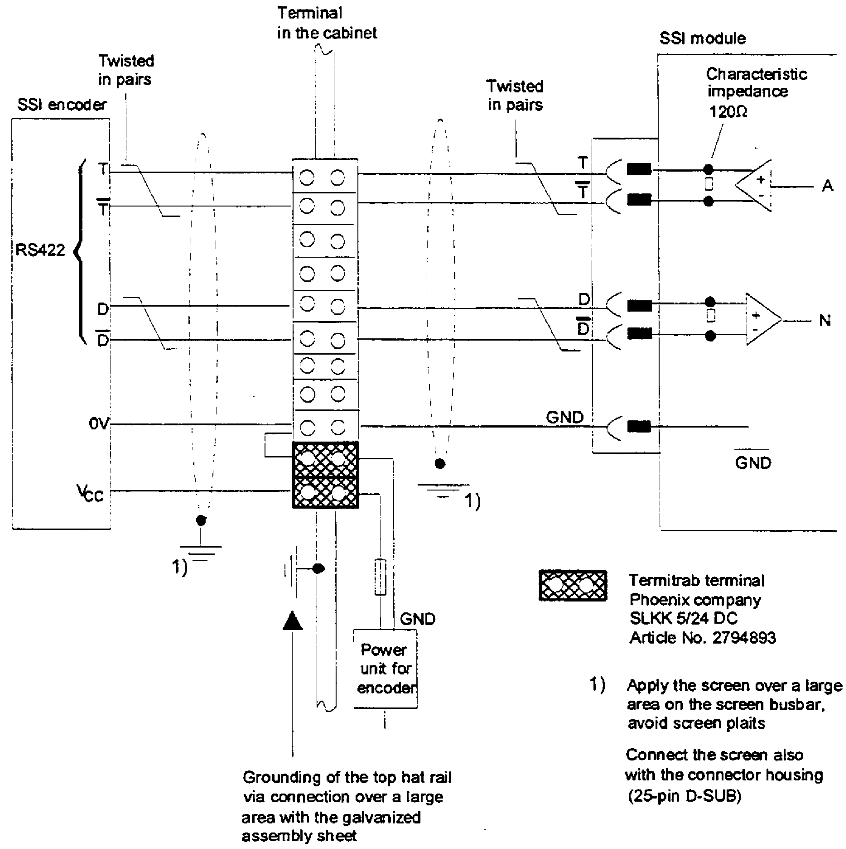
Unused TAKT inputs remain open.

The RS422 inputs are already terminated with 120 ohms and 10 nF.
V_{CC} from the encoder module must not be used for supplying the encoders, it only serves the high-impedance assigning of unnecessary signals!

Caution

Pins that are not described must not be assigned.
Risk of destruction !

Connection SSI absolute encoder



11.4.3 Modules 2, 3 for incremental encoder

Connector assignment

Pin No.	Signal	
1	GSYNC1	DC 24 V
2	GSYNC2	DC 24 V
3	A1	
4	B1	
5	N1	
6		
7	B2	
8	N2	
9		
10	A2	
11	V_{CC}	
12		
13		
14	M-GSYNC	1,2
15	A1-N	
16	B1-N	
17	N1-N	
18		
19	B2-N	
20	N2-N	
21		
22	A2-N	
23		
24		
25	GND	

A connector with 25-pin SUB-D socket is required for connection to the module.

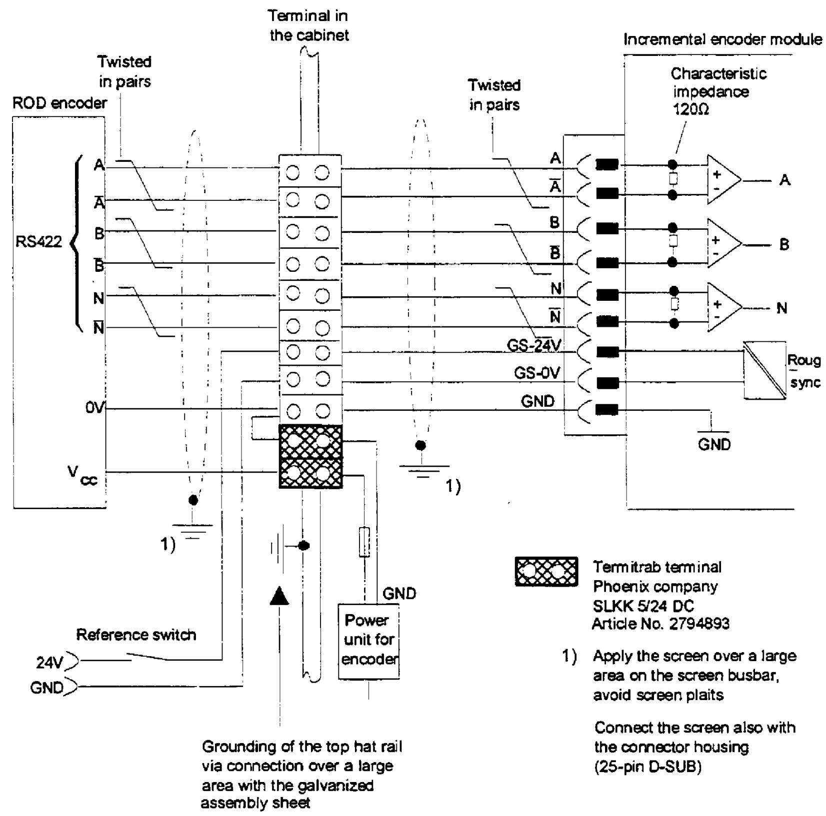
Note

If inputs are not used, the negated inputs must be connected with GND (Pin 25) and the ones not negated with V_{CC} (Pin 11).
V_{CC} from the encoder module must not be used for supplying the encoders, it only serves the high-impedance assigning of unnecessary signals!

Caution

Pins that are not described must not be assigned.
Risk of destruction !

Connection incremental encoder



11.4.4 Module 4 (analog module), command values for frequency converter

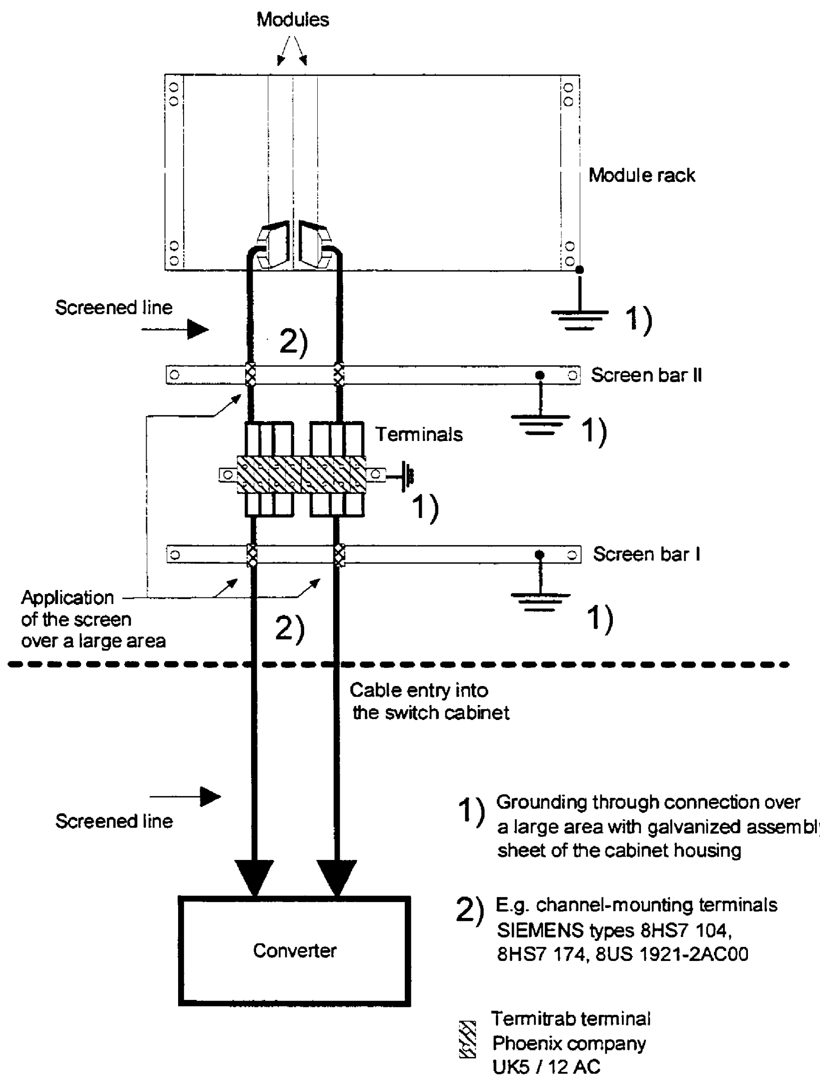
Connector assignment

Pin No.	Signal
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	AAGND
12	AA0
13	AA1
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	AA2
24	AA3
25	AAGND

AA0 ... AA3 -> Analog outputs to the internal axis 0 ... 3
AAGND -> Signal reference point for analog outputs

A connector with 25-pin SUB-D socket is required for connection to the module.

Connection analog module



11.4.5 Auxiliary connector for IP 252MC-DP

Connector assignment Profibus-DP connector

Pin No.	Signal
1	
2	
3	Signal B
4	RTS
5	0 V floating
6	+ 5.2 V floating
7	
8	Signal A
9	

9-pin, Sub-D socket connector

Connector assignment supply connector

Pin No.	Signal
1	Internal assignment [1)]
2	Internal assignment [1)]
3	Internal assignment [1)]
4	Internal assignment [1)]
5	Internal assignment [1)]
6	Internal assignment [1)]
7	GND
8	Internal assignment [1)]
9	+ 24 V

[1)] Internally occupied connection pins must not be assigned !

9-pin, COMBICON, grid 5.08, Phoenix company

Service connector

The service connector (15-pin Sub-D connector, socket) allows connection of a programmer with an IP 252MC-specific software (not included in the delivery and usually not required) for loading customer-specific software amongst other things.

11.4.6 IP-Link line / connector

The IP-Link line connects two IP 252MC modules which must be placed on adjacent slots.

Every additional IP-Link line is plugged piggyback style onto the last IP-Link connector each.

The IP-Link line consists of:

- 15-pin Sub-D connector (pin)
- 15-pin Sub-D connector (pin) and coupling (socket)

  for plugging
  - the next IP-Link module (pin)
  - further IP-Link lines (socket)
- Round line

Please see chapter 10 for order numbers.

11.5 General installation recommendations

When applying electronic elements in automation technology, special attention must be paid to the electromagnetic resistance to jamming. Typical sources of interference such as relays, fluorescent lamps, frequency converters, HF generators, collector rotors, and controllers generate high-frequency signals which are coupled to the module directly, inductively or capacitively and may cause an interference or the destruction of the module.

Increasing the resistance to jamming

The following points have to be observed when mounting electronic components in a switch cabinet:

- Use a galvanized assembly sheet as grounding for module rack, mains filter, screen busbars and other components.
- Grounding connections have to be short and over a large area
- Fasten cables with screen over a large area on the screen busbar
- Lay lines with high interference potential separately
- Connect the relay with freewheeling diodes or RC elements
- Spatially separate the module and the wiring of modules with high interference emission
- Reduce mains interferences through filters: arrange them as close as possible to the cabinet entry point
- Ground power units with the M-side as close as possible in front of the module via ground terminal
- Mount entry terminals and screen busbars immediately behind the cable entry in the switch cabinet
- Connect all cabinet parts with each other over a large area and with good conductivity, or assemble them with contact disks, unless they are directly welded together
- Analog modules excepted, always apply the screen on either end (on ground) with potential equalization line
- For analog modules, apply the screen on one end in the control cabinet

For further information on the layout, please see SIEMENS directive **"EMC Measures to Increase the Interference Resistance of Process Control and Communication Systems"**.
(Order No. AR 435-220 English)

Note

The modular technology module is an installation of class A. This installation may cause radio interferences in residential areas. In such case, the user can be asked to take appropriate measures at his own expense.

11.5.1 Potential equalization / grounding

Principle

All control components (PLC, expansion rack, drive actuators, etc.), which are connected with signal lines, must also be connected with potential equalization lines for a fault-free operation of the control.

Exception

Components which are coupled by means of optical waveguides do not require any potential equalization lines.

Observe the EMC recommendations when laying the potential equalization lines in strongly networked system configurations.

Grounding

For a fault-free operation, a perfect grounding for the discharge of external interferences is absolutely necessary. Make sure that the grounding lines are laid without loops and that they have the necessary cross section.

11.5.2 Safety regulations

DIN 40700
DIN 40719

When making wiring diagrams, observe DIN 40700 to 40719 and the applicable rules.

VDI 0113 Part 1

For safety functions such as emergency stop device, axis end limitation, etc., make sure that the valid regulations DIN VDI 0113 Part 1 are observed. For "protection in case of fault", the electric circuits must be provided with contact and must be redundant in part.

Danger

Switch-on of the system with the drive unit and the EMERGENCY STOP chain must be implemented in the hardware. EMERGENCY STOP reactions must not be implemented by the software alone !

The following protective features have to be realized in the circuit configuration of drives which might cause dangerous movements:

Protective features

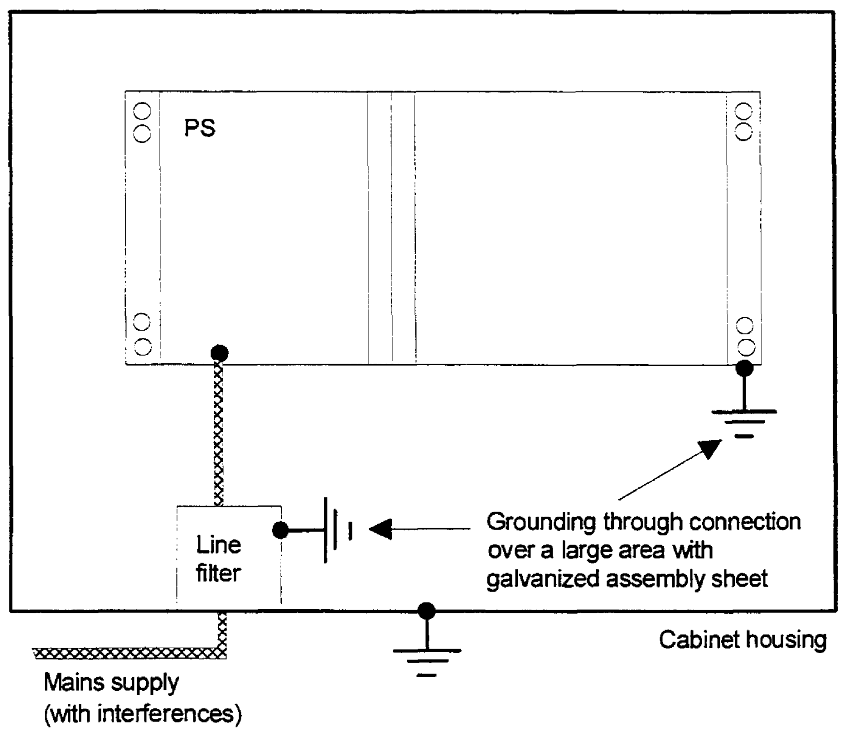
- After EMERGENCY STOP, stop the system in the best possible way
- Protection against unintentional restart after EMERGENCY STOP
- Secure stop of the operation after switch-off
- Recognition of the first error
- Preventing a defective machine from being used

Safety devices such as protective wire grids and the resulting shutoffs must, at all costs, be considered in the planning.

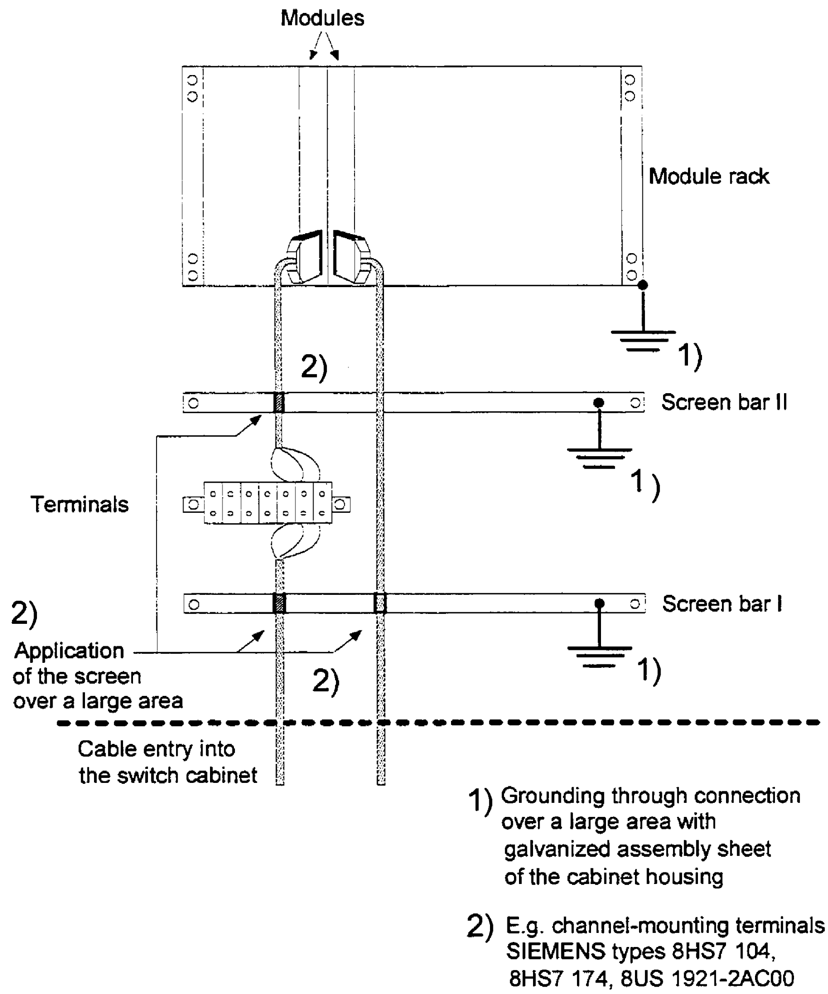
Caution

Withdraw or plug in modules, cables and current supply lines only when the control or the system is switched off. Signal voltages (on the interfaces) and current supplies may only be applied when the module is plugged in. Otherwise, the module may be destroyed !

11.5.3 Line filter



11.5.4 Application of the screen



11.6 Abbreviations

A	
AC	Alternating current
ANZW	Display value
AO	Analog output
B	
BASP	Command output blocking (signal of SIMATIC S5)
C	
CPU	Central processing unit (central module)
D	
DB	Data block
DC	Direct current
DI	Digital input
DO	Digital output
DP	Distributed periphery
DPR	Dual-Port-RAM
DW	Data word
E	
EEC	Electrostatic endangered components
EMC	Electromagnetic compatibility
F	
FB	Printed circuit module
G	
GND	Ground

H

HF	High frequency

I

IM	Interface module
IP	Intelligent I/O module

K

1 Kbyte	1024 bytes
1 kbit/s	1000 bit/s

L

LSB	Low significant bit

M

M	Motor

O

OB	Organization block
OM	Operating mode

P

PAFE	Parameter fault
PG	Programmer
PLC	Programmable logic controller
PS	Power supply

S

SINEC L2	PROFIBUS
SPS	Standard plug-in station
SSI	Synchronous serial interface for absolute encoder

Index

P

R

S