



# PROFIBUS S300/S400/S600/S700

## Communication Profile

### Fieldbus Interface

Translation of the original manual.

Edition 12/2010

Keep the manual as a product component during the life span of the product. Pass the manual to future users / owners of the product.

Datei srprof\_e.\*\*\*

**KOLLMORGEN**

## Previous editions

| <b>Edition</b> | <b>Comments</b>   |
|----------------|---|
| 05 / 1999      | Preliminary version   |
| 10 / 1999      | First edition   |
| 06 / 2002      | new layout, several corrections, valid from firmware 3.54   |
| 11 / 2005      | Valid for the S300/S400/S600 series, several corrections, company name changed, front- and back-page new design |
| 12 / 2005      | Language improvements in the english version  |
| 09 / 2006      | New Design  |
| 08 / 2007      | Branding, S700 new, Symbols, Standards  |
| 12 / 2008      | Several corrections, PNU1785 expanded   |
| 07 / 2009      | Product branding  |
| 12 / 2009      | Several minor corrections, Symbols according to ANSI Z535   |
| 12 / 2010      | Company name new  |

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# 1 General

## 1.1 About this manual

This manual describes the wiring, setup, range of functions and software protocol for the SERVOSTAR® 300 (S300), SERVOSTAR® 400 (S400), SERVOSTAR® 600 (S600) and S700.

### S300, S600 and S700:

The expansion card -PROFIBUS- offers PROFIBUS compatible connectivity to these servo amplifiers. The expansion card and its mounting is described in the instructions manual.

### **NOTICE**

**The expansion card for S300 and S700 is different from the card for S600. The text "PROFIBUS DP" on the front label marks the card for S300/S700, the text "PROFIBUS" the card for S600.**

### S400-PROFIBUS:

PROFIBUS functionality is built-in on delivery.

This manual is part of the complete documentation of the digital servo amplifiers. The installation and setup of the servo amplifier, as well as all the standard functions, are described in the corresponding instructions manuals.

### **Other parts of the documentation of the digital servo amplifiers:**

| <u>Title</u>                                | <u>Publisher</u> |
|---|------------------|
| Instructions manual for the Servo Amplifier | Kollmorgen       |
| Online-Help with Object Reference Guide     | Kollmorgen       |

### **Further documentation:**

| <u>Title</u>  | <u>Publisher</u> |
|---|------------------|
| Installation Guideline for PROFIBUS DP/FMS                            | PNO              |
| Profile for Variable Speed Drives                                     | PNO              |
| SINEC Produktinformation S79200-A0737-X-02-7437                       | Siemens          |
| SINEC Installationsanleitungen S79200-A0737-X-01-7419                 | Siemens          |
| SINEC Einführung CP5412 (A2) C79000-G8900-C068                        | Siemens          |
| SINEC DP-Masterbetrieb mit dem COML DP projektieren C79000-G8900-C069 | Siemens          |
| SINEC DP-Programmierschnittstelle C79000-G8900-C071                   | Siemens          |

## 1.2 Target group

This manual addresses personnel with the following qualifications:

|                |   |
|----------------|---|
| Transport :    | only by personnel with knowledge of handling electrostatically sensitive components.                |
| Unpacking:     | only by electrically qualified personnel.   |
| Installation : | only by electrically qualified personnel.   |
| Setup :        | only by qualified personnel with extensive knowledge of electrical engineering and drive technology |
| Programming:   | Software developers, project-planners, experienced PLC programmers with PROFIBUS DP expertise       |

The qualified personnel must know and observe the following standards:  
IEC 60364 and IEC 60664  
accident prevention regulations

### **⚠ WARNING**

**During operation there are deadly hazards, with the possibility of death, severe injury or material damage. The operator must ensure that the safety instructions in this manual are followed. The operator must ensure that all personnel responsible for working with the servo amplifier have read and understood the instructions manual.**

Training courses are available on request.

### 1.3 Use as directed






Please observe the chapter "Use as directed" in the instructions manual for the servo amplifier. The PROFIBUS interface serves only for the connection of the servo amplifier to a master with PROFIBUS connectivity.

The servo amplifiers are components that are built into electrical apparatus or machinery, and can only be setup and operated as integral components of such apparatus or machinery.

**NOTE** We can only guarantee the conformity of the servo amplifier with the following standards for industrial areas when the components that we specify are used, and the installation regulations are followed:

|                          |              |
|--------------------------|--------------|
| EC EMC Directive         | 2004/108/EEC |
| EC Low-Voltage Directive | 2006/95/EEC  |

### 1.4 Symbols used in this manual

| Symbol  | Indication   |
|---|--|
|  | Indicates a hazardous situation which, if not avoided, will result in death or serious injury.   |
|  | Indicates a hazardous situation which, if not avoided, could result in death or serious injury.  |
|  | Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. |
|  | Indicates situations which, if not avoided, could result in property damage.                     |
|  | This is not a safety symbol.<br>This symbol indicates important notes.                           |

### 1.5 Abbreviations used in this manual

The abbreviations used in this manual are explained in the table below.

| Abbrev. | Meaning                                    |
|---------|--|
| AGND    | Analog ground                              |
| BTB/RTO | Ready to operate                           |
| CLK     | Clock signal                               |
| COM     | Serial interface for a PC-AT               |
| DGND    | Digital ground                             |
| DIN     | German Institute for industrial Standards  |
| Disk    | Magnetic storage (diskette, hard disk)     |
| EEPROM  | Electrically erasable programmable memory  |
| EN      | European standard                          |
| IEC     | International Electrotechnical Commission  |
| INC     | Incremental Interface                      |
| LED     | Light-emitting diode                       |
| MB      | Megabyte                                   |
| NI      | Zero pulse                                 |
| NSTOP   | Limit-switch input for CCW rotation (left) |
| PZD     | Process data                               |
| PSTOP   | Limit-switch input for CW rotation (right) |
| RAM     | Volatile memory                            |
| RES     | Resolver                                   |
| ROD     | A quad B encoder                           |
| PLC     | Programmable logic controller              |
| S300    | SERVOSTAR 300                              |
| S400    | SERVOSTAR 400                              |
| S600    | SERVOSTAR 600                              |
| SSI     | Synchronous serial interface               |
| VAC     | AC voltage                                 |
| VDC     | DC voltage                                 |

## 2 Installation / Setup

### 2.1 Installation

#### 2.1.1 Safety notes

**⚠ DANGER** Install and wire up the equipment only while it is not electrically connected. Make sure that the control cabinet is safely isolated (lock-out, warning signs etc.).  
The individual supply voltages will not be switched on until setup is carried out.  
Residual charges in the capacitors can still have dangerous levels several minutes after switching off the supply voltage. Measure the voltage in the intermediate (DC-link) circuit and wait until it has fallen below 40V.  
Power and control connections can still be live, even though the motor is not rotating.

Electronic equipment is basically not failure-proof. The user is responsible for ensuring that, in the event of a failure of the servo amplifier, the drive is set to a state that is safe for both machinery and personnel, for instance with the aid of a mechanical brake.  
Drives with servo amplifiers and PROFIBUS expansion cards are remote-controlled machines. They can start to move at any time without previous warning. Take appropriate measures to ensure that the operating and service personnel is aware of this danger. Implement appropriate protective measures to ensure that any unintended start-up of the machines cannot result in dangerous situations for personnel or machinery. Software limit-switches are not a substitute for the hardware limit-switches in the machine.

**⚠ WARNING** Install the servo amplifier as described in the instructions manual. The wiring for the analog setpoint input and the positioning interface, as shown in the wiring diagram in the instructions manual, is not required.  
Never break any of the electrical connections to the servo amplifier while it is live. This could result in destruction of the electronics.

#### **NOTE**

Because of the internal representation of the position-control parameters, the position controller can only be operated if the final limit speed of the drive does not exceed:  
rotatory  
at sinusoidal<sup>2</sup> commutation: 7500 rpm  
at trapezoidal commutation: 12000 rpm.  
linear  
at sinusoidal<sup>2</sup> commutation: 4 m/s  
at trapezoidal commutation: 6.25 m/s

#### **NOTE**

All the data on resolution, step size, positioning accuracy etc. refer to calculatory values. Non-linearities in the mechanism (backlash, flexing, etc.) are not taken into account. If the final limit speed of the motor has to be altered, then all the parameters that were previously entered for position control and motion blocks must be adapted.

## 2.1.2 Inserting the expansion card (S300, S600 and S700)

**NOTICE**

The expansion card for S300/S700 is different from the card for S600. The text "PROFIBUS DP" on the front label marks the card for S300/S700, the text "PROFIBUS" the card for S600.

To fit the PROFIBUS expansion card into the servo amplifier, proceed as follows:

**NOTE**

- Remove the cover of the option slot (see installation manual of the servo amplifier.)
- Take care that no small items (such as screws) fall into the open option slot.
- Push the expansion card carefully into the guide rails that are provided, without twisting it.
- Press the expansion card firmly into the slot, until the front cover touches the fixing lugs. This ensures that the connectors make good contact.
- Use the screws on the expansion card to secure it in the drive.

### 2.1.2.1 Front view

Shown is the expansion card for S300/S700.



### 2.1.2.2 Setup of Station Address and Baud Rate

During setup it makes sense to use the keypad on the front panel to preset the station addresses for the individual amplifiers (see chapter "Setup" in the instructions manual).

**NOTE**

After changing the station address you must turn the 24V auxiliary supply for the servo amplifier off and on again for the new address to take affect.

Possible ways for setup:

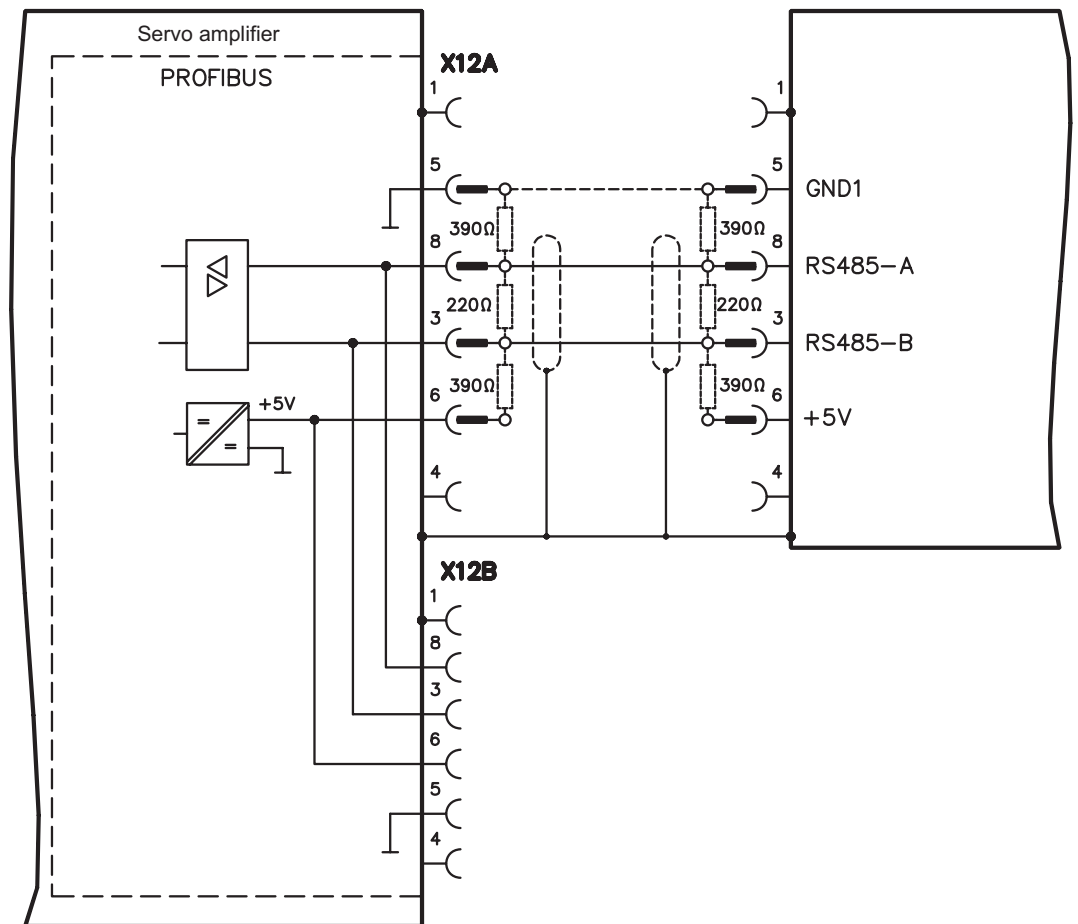
- keypad on the front panel of the servo amplifier (see instructions manual)
- setup software: screen page "CAN / Fieldbus" (see online help)
- serial interface with a sequence of ASCII commands:  
ADDR nn ⇒ SAVE ⇒ COLDSTART (with nn = address)

The Baudrate is defined by the hardware configuration in the master controller. Baudrates up to 12 MBaud are possible. During bus initialization, the master controller sends the amplifier the desired baud rate.

### 2.1.2.3 Connection technology

Cable selection, cable routing, shielding, bus connector, bus termination and transmission times are all described in the "Installation guidelines for PROFIBUS-DP/" from PNO, the PROFIBUS User Organization.

2.1.2.4 Connection diagram

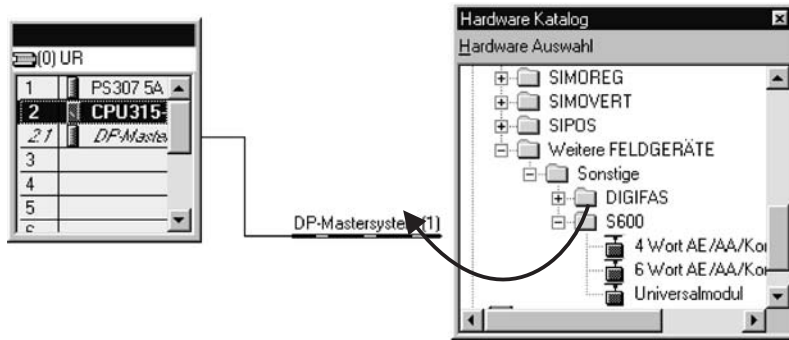


**NOTE** With S600 terminals AGND and DGND (connector X3) must be joined together !

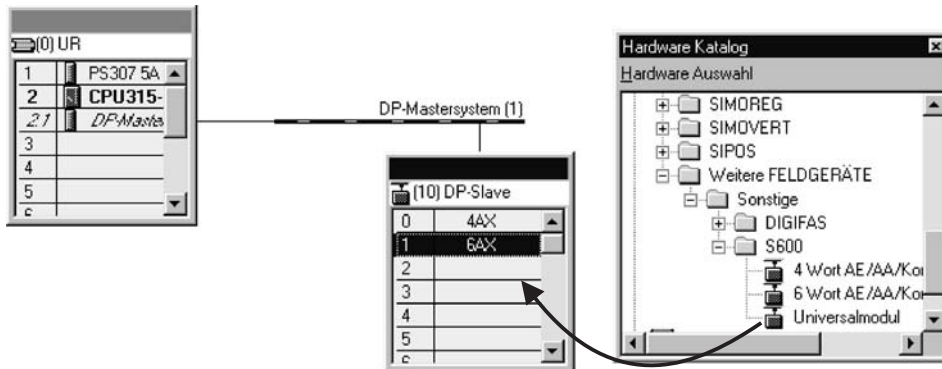
### 2.1.3 Profibus master module setup

#### 2.1.3.1 Configuration of the master controller ( e.g. Siemens S7)

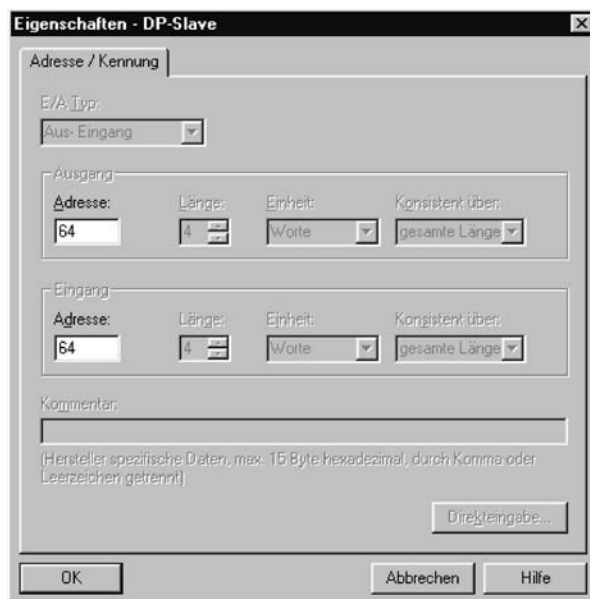
The graphics interface makes it very easy to configure the Siemens S7 for the PROFIBUS network. After you have set up the control layout, configure the interface module that is used as follows: Use our library file **KOLL045D.GSD** to configure the Profibus master for the servo amplifier. The following shows a Siemens PLC. Other machine controllers can also be configured for the Kollmorgen Profibus expansion card. Open the Hardware catalog and drag the symbol for the corresponding field unit onto the representation of the bus system. A window opens automatically for the general parameterization of the field unit (please observe: the S300/S700 are displayed here like a S600). Enter the address of the participant here.



Next, use the same method as above to drag the module from the Hardware catalog into the box for the field unit, whereby the 4-word module must lie in Cell 0 and the 6-word module in Cell 1.



Another window opens, in which you can set the parameters for the module.



## 2.1.4 Standard function block for data exchange with the servo amplifier

Kollmorgen supplies a S7-function block (FB10) for use Siemens PLC that make it possible to handle the servo amplifier control functions very simply.

This function block and its description can be found as a text file on the CDROM and in the download section of our website.

## 2.2 Amplifier setup

### 2.2.1 Guide to setup

**⚠ CAUTION** Only properly qualified personnel with professional expertise in control and drive technology are permitted to setup the servo amplifier.

|   |   |
|---|---|
| <b>Check assembly<br/>+ installation</b>    | Check that all the safety instructions, which are included in both the instructions manual for the servo amplifier and in this manual, have been observed and implemented.  |
| <b>Connect PC,<br/>start setup software</b> | Use the setup software for setting the parameters for the servo amplifier.  |
| <b>⚠ WARNING</b>                            | <b>Make sure that any unintended movement of the drive cannot create a danger to personnel or machinery.</b>  |
| <b>Setup the<br/>basic functions</b>        | Now setup the basic functions of the servo amplifier including tuning the servo loops. This part of setup is described in the online help system of the setup software.   |
| <b>Save<br/>parameters</b>                  | When the optimization is finished, save the controller parameters in the servo amplifier.   |
| <b>Test the<br/>bus connection</b>          | Remove the Enable signal (Terminal X3) and switch off the mains power supply for the servo amplifier.<br>The 24V DC auxiliary voltage remains switched on.<br>Test the installation of the PROFIBUS connection and the interface to the PROFIBUS master.<br>Check the PROFIBUS-DP parameter settings and the station configuration.<br>Check the parameter settings for the PROFIBUS interface module.<br>Check the PLC user program and the parameter settings for the function block. |

## 2.2.2 Important amplifier configuration parameters

The following parameters configure the amplifier for the Profibus interface. They can be set using the setup software for the amplifier.

### **EXTWD (PNU 1658)**

With this parameter, the observation time (watch dog) for the fieldbus-slot communication can be set. The observation is only active, if a value higher than 0 is assigned to EXTWD (EXTWD=0, observation switched off) and the output stage is enabled. If the set time runs out, without the watchdog-timer being newly triggered by the arrival of a telegram, then the warning n04 (response monitoring) is generated and the drive is stopped. The amplifier remains ready for operation and the output stage enabled. Before a new driving command (setpoint) is accepted, this warning must be deleted (function CLRFAULT or INxMODE=14).

### **ADDR (PNU 918)**

With this command, the node address of the amplifier is set. When the address has been changed, all parameters should be saved to the EEPROM and the amplifier switched off and on again.

Since the modular structure of the S400 as a multi-axis system requires its own addressing, there is the additional parameter **ADDRFB (PNU 2012)** for this series, with which a field bus address different from the internal device address (ADDR) can be defined. As long as ADDRFB = 0, ADDR is the bus address. If ADDRFB > 0, then ADDRFB is the bus address. ADDR is set automatically by the S400 master module in descending order.

### **AENA (PNU 1606)**

With this parameter, the state of the software-enable after switch-on can be defined. The software-enable allows an external control to enable/disable the output stage. For amplifiers with analog setpoints (OPMODE=1,3) the software-enable is set automatically after switch-on and the devices are ready for operation immediately (if hardware-enable is present). For all others, software-enable will be set to the value of AENA. The variable AENA also has functionality when resetting the amplifier after an error (by digital input 1 or the CLRFAULT command). If an error can be reset by the software, the software-enable is set to the value of AENA after the error is cleared. In this way the behavior of the amplifier after a software-reset is similar to after the drive is switched on.

### **INPT, INPT0 (PNU 1904)**

With INPT (S300/S700: INPT0) a delay for the in-position message can be set. With the start of a motion task the in-position message is deleted and the monitoring of the position is activated after expiration of the adjusted time. This function is particularly important for positioning procedures within the in-position window. In this case the in-position message is delayed for a defined time.

## 2.2.3 Setup Software

### 2.2.3.1 Screen page PROFIBUS

This screen will only appear, if the PROFIBUS hardware is built into the servo amplifier. The screen page displays the PROFIBUS-specific parameters, the bus status, and the data words in the transmit and receive directions, as seen by the bus-master. This page is helpful when searching for errors and commissioning the bus communication. The picture below shows the S300/S700 screen.

**PROFIBUS - Interface - States**

Watchdog State: Baud Search — Baud Control — DP Control — Communication OK  
 DP State: Wait Param. — Wait Config. — Data Exchange

Ignore Threshold Monitoring

**Input/Output - Buffer**

|          | PKW  |      |           | PZD  |      |      |      |      |      |
|----------|------|------|-----------|------|------|------|------|------|------|
|          | PKE  | IND  | PwE       | STW  | HSW  | PZD3 | PZD4 | PZD5 | PZD6 |
| Output : | 33A2 | 1100 | 0000 0002 | 043F | 0000 | 0000 | 0000 | 0000 | 0000 |
| Input :  | 23A2 | 1100 | 0000 0002 | ZSW  | HIW  | PZD3 | PZD4 | PZD5 | PZD6 |
|          |      |      |           | 2227 | 0000 | FFFE | 55CA | 5400 | 0000 |

Instrument Control

**Baudrate:** The baud rate set by the PROFIBUS master.

**PNO Identno.:** The PNO identification is the number for the servo amplifier from the list of ID-numbers set by the PROFIBUS user organization.

**Address:** Station address of the amplifier (setting see p.8).

**PPO type:** servo amplifier only supports PPO-type 2 of the PROFIDRIVE profile.

**PROFIBUS Interface states:**

Shows the present status of the bus communication. Data can only be transferred across the PROFIBUS when the "Communication OK" message is black (not shown in gray).

**Input:** The last PROFIBUS object received by the master.

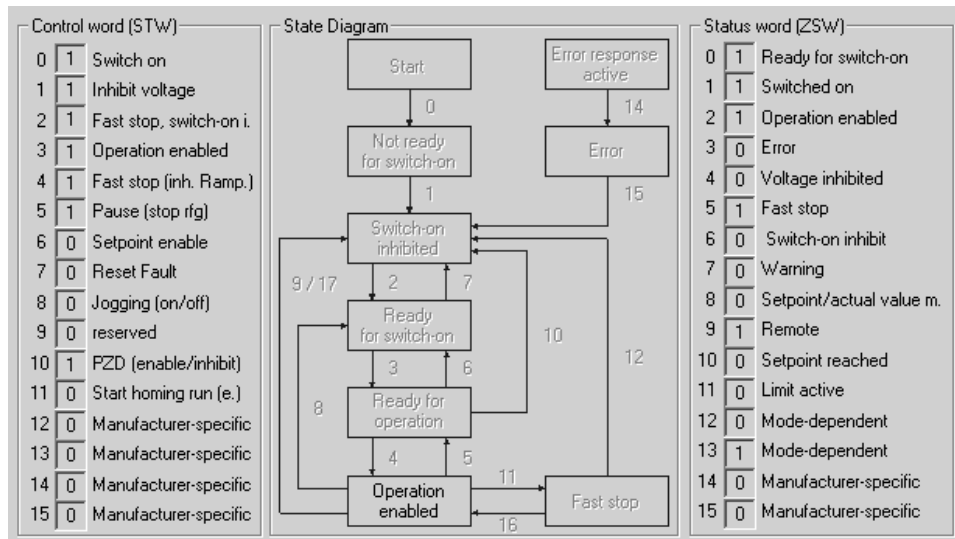
**Output:** The last PROFIBUS object sent by the master.

**NOTE**

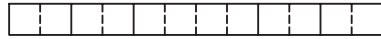
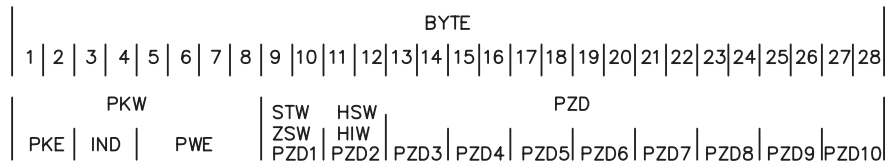
The data for input/output are only transferred, if the threshold monitoring for the servo amplifier has been activated in the master's hardware configuration.

2.2.3.2 Screen page PROFIBUS instrument control

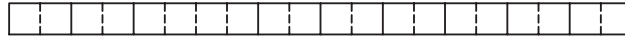
On this screen page the individual bits of the control word (STW) and the status word (ZSW) are shown. The device status resulting from the status word is visualized in the status machine. The current status is shown as black, all others are grey. Additionally the previous status is shown by emphasizing the number of the appropriate arrow. The picture below shows the S300/S700 screen.



### 3 Device Profile



Typ 1 : Octet-String 12



Typ 2 : Octet-String 20

Typ 3 : Octet-String 4 

Typ 4 : Octet-String 12 



Typ 5 : Octet-String 28

Abbreviations

- PKW: Parameter ID value
- PKE: Parameter ID (1st and 2nd octet)
- IND: Index with PPO (3rd octet)
- 4th octet reserved
- PWE: Parameter value (5th to 8th octet)
- PZD: Process data
- STW: Control word
- ZSW: Status word
- HSW: Main setpoint
- HIW: Main actual value

The PROFIBUS-profile PROFIDRIVE includes the following parameter process-data objects (PPO):

The servo amplifier only uses the PPO-type 2 (with 4 words PKW-section and 6 words PZD-section). The PKW-section is used mainly for the transmission of parameters for the servo amplifier, the PZD-section is used principally for handling motion functions.

The telegram can be divided into two sections or data channels:

1. PKW-section (4 words, Bytes 1 to 8)
2. PZD-section (6 words, Bytes 8 to 20)

The PKW data channel can also be termed the service or parameter channel. The service channel only uses confirmed communication services, and is used by the servo amplifier as a parameter channel.

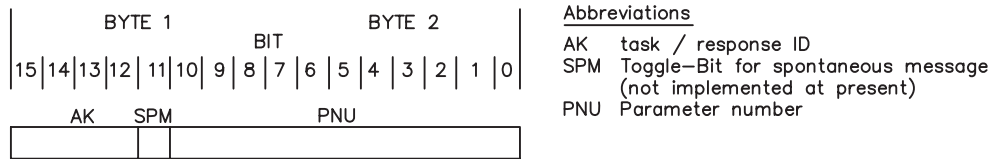
**The PKW channel has no real-time capability.**

The PZD data channel can also be termed the process data channel. The process data channel uses unconfirmed communication services. The response of the servo amplifier to an unconfirmed service can only be seen in the reaction of the amplifier (status word, actual values).

**The PZD channel has real-time capability.**

### 3.1 Parameter channel

#### 3.1.1 Parameter ID (PKE)



Marked lines in the table are valid for the servo amplifier

| Master → Slave |                                  | Slave → Master       |                      |
|----------------|----------------------------------|----------------------|----------------------|
| Task ID        | Function                         | Response ID positive | Response ID negative |
| 0              | no task                          | 0                    | 0                    |
| 1              | request parameter value          | 1,2                  | 7                    |
| 2              | alter parameter value [W]        | 1                    | 7/8                  |
| 3              | alter parameter value [DW]       | 2                    | 7/8                  |
| 4              | request description element      | 3                    | 7                    |
| 5              | alter description element        | 3                    | 7/8                  |
| 6              | request parameter value [A]      | 4,5                  | 7                    |
| 7              | alter parameter value [A/W]      | 4                    | 7/8                  |
| 8              | alter parameter value            | 5                    | 7/8                  |
| 9              | request number of array elements | 6                    | 7                    |
| 10 - 15        | reserved                         |                      |                      |

#### 3.1.1.1 Interpretation of the response IDs

Marked lines in the table are valid for the servo amplifier

| Response ID | Interpretation                           |
|-------------|--|
| 0           | no task                                  |
| 1           | transmit parameter value                 |
| 2           | transmit parameter value                 |
| 3           | transmit description element             |
| 4           | transmit parameter value                 |
| 5           | transmit parameter value                 |
| 6           | transmit number of array elements        |
| 7           | task not possible (with error no.)       |
| 8           | no operating authority for PKW interface |
| 9           | spontaneous message [W]                  |
| 10          | spontaneous message [DW]                 |
| 11          | spontaneous message [A/W]                |
| 12          | spontaneous message [A/DW]               |

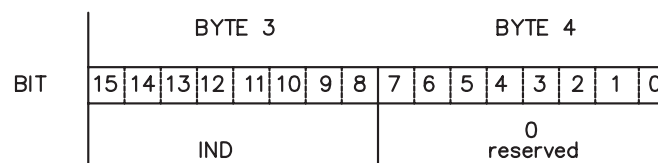
Abbreviations in the tables:

- A: Array
- W: Word
- DW: Double-word

### 3.1.1.2 Response ID 7: Profile specific error numbers

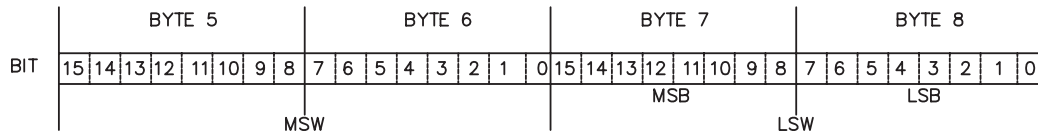
| Error no. | Description  |
|-----------|--|
| 0         | illegal PNU  |
| 1         | parameter value cannot be changed                                |
| 2         | Lower or upper limit violated                                    |
| 3         | Erroneous sub-index  |
| 4         | no array   |
| 5         | Incorrect data type  |
| 6         | setting not allowed (can only be reset)                          |
| 7         | Descriptive element cannot be changed                            |
| 8         | PPO-write, requested in IR, not available                        |
| 9         | descriptive data not available                                   |
| 10        | access group incorrect   |
| 11        | No parameter change rights                                       |
| 12        | Password incorrect   |
| 13        | Text cannot be read in cyclic data transmission                  |
| 14        | Name cannot be read in cyclic data transmission                  |
| 15        | text array not available   |
| 16        | PPO-write missing  |
| 17        | opmode switch over not possible at STW Bit 10 = 1 (PZD enable)   |
| 18        | other error  |
| 19-100    | reserved   |
| 101       | faulty task ID   |
| 102       | software error (command table)                                   |
| 103       | only possible in disabled state                                  |
| 104       | only possible in enabled state                                   |
| 105       | BCC-error in the EEPROM data                                     |
| 106       | only possible after task is stopped                              |
| 107       | wrong value [16,20]  |
| 108       | wrong parameter (OCOPY x [- y] z)                                |
| 109       | wrong motion block no. (0,1..180,192..255)                       |
| 110       | wrong parameter (PTEACH x [y])                                   |
| 111       | EEPROM write error   |
| 112       | wrong value  |
| 113       | BCC-error in motion block  |
| 114       | Object is read only or write only                                |
| 115       | not possible due to operation status (e.g. output stage enabled) |
| >115      | reserve  |

### 3.1.2 Index IND


**NOTE**

An Index (IND) unequal to 0 is used for reading and writing amplifier parameters with PNUs > 1600. See page 31 for further description.

3.1.3 Parameter value PWE



The data for the PNU-variable is contained in the PWE, and is placed flush right (PKE):

4-byte data (double-word)                      PWE 5-8 (PWE 8 LSB)

Commands are transferred right justified with task ID 3. If a command cannot be executed, the response identification AK = 7 signals the error, and an error number is given out. The error numbers are described on page 17.

3.2 The process data channel (PZD)

Cyclical data are exchanged across the PROFIBUS through the process data section of the 20-byte telegram. Each PROFIBUS cycle triggers an interrupt in the servo amplifier and new process data is exchanged and processed. The interpretation of the PZD by the amplifier depends on the operating mode that is set. The operating mode is set through a PROFIBUS parameter (PNU 930, ⇨ p. 23).

In all operating modes, data word 1 of the process data (PZD1) in the direction from control system to servo amplifier is used for instrument control, and in the direction from servo amplifier to control system it has the function of a status indicator for the amplifier.

The interpretation of the process data PZD2 – PZD6 changes depending on the operating mode, as can be seen in Chapter 5.2.

**CAUTION**

When the servo amplifier is switched on, the PROFIDRIVE operating mode that is always set to -126 (safe state). Before changing the operating mode, bit 10 of the control word STW must always be set to 0. The new operating mode only becomes active when bit 10 of the control word is set to 1 (see p. 23).

## 4 Parameter channel (PKW)

The digital servo amplifiers of the servo amplifier series have to be adapted to the circumstances of your machine. The parameters for the controllers are set using either the setup software or via the PROFIBUS.

### 4.1 Read/write an amplifier parameter

Read (AK = 1) or write (AK = 3) amplifier parameters

To read or write an amplifier parameter through PROFIBUS, the corresponding PNU must be used. The parameters that are written to the servo amplifier can be transferred to the *non-volatile* memory by using the command "non-volatile parameter save" (PNU 971).

**Telegram layout:**

|         | <b>Request</b>   | <b>Response</b>   |
|---------|--|---|
| PKE/AK  | 1 (read) / 3 (write)   | 2 (OK) / 7 (error)  |
| PKE/PNU | see 4.2.1  | as transmitted  |
| PWE     | for AK = 3 see p.20ff for data type<br>for AK = 1 data type irrelevant | for AK = 3 returns the PWE of the request<br>for AK = 1 see p.20f for data type |

### 4.2 Summary of the parameter numbers

All the parameter numbers (PNUs) for the servo amplifier are listed in numerical order in the table on page 20ff, with a short description. The parameter numbers in the range 900 – 999 are profile-specific for the PROFIBUS drive profile PROFIDRIVE. Parameter numbers > 999 are manufacturer-specific.

For better understanding, you can look up the ASCII commands which are in the column "ASCII command" in the online help the setup software. A description of all ASCII commands can be found in the ASCII reference lists (referring to the servo amplifier type) located on the product CDROM and on our website.

Parameter numbers >1600 use the object channel (see p.31ff).

#### **NOTE**

In the S400/S600 some amplifier parameters (e.g. GV) have 2 PNU numbers. Both of them can be used to read and write the parameter (e.g. PNU 1200 and PNU 1672).

## 4.2.1 List of the parameters

| PNU  |             | Data type       | Acc | Description                                       | ASCII command |                | PNU (old)<br>S400/S600 |
|--|-------------|-----------------|-----|---|---------------|----------------|------------------------|
| S400/S600  | S300/S700   |                 |     |   | S400/S600     | S300/S700      |                        |
| <b>Profile parameter</b>                           |             |                 |     |   |               |                |                        |
| 904  | 904         | UINT32          | ro  | Number of the supported PPO-write, always 2       | -             | -              | 904                    |
| 911  | 911         | UINT32          | ro  | Number of the supported PPO-read, always 2        | -             | -              | 911                    |
| 918  | 918         | UINT32          | ro  | Participant address on PROFIBUS                   | ADDR          | ADDR           | 918                    |
| 930  | 930         | UINT32          | r/w | Selector for operating mode                       | -             | -              | 930                    |
| 963  | 963         | UINT32          | ro  | PROFIBUS baud rate                                | -             | -              | 963                    |
| 965  | 965         | Octet-String2   | ro  | Number of the PROFIDRIVE profile (0302H)          | -             | -              | 965                    |
| 970  | 970         | UINT32          | wo  | Load default parameter set                        | RSTVAR        | RSTVAR         | 970                    |
| 971  | 971         | UINT32          | wo  | non-volatile parameter save                       | SAVE          | SAVE           | 971                    |
| <b>Manufacturer-specific parameters</b>            |             |                 |     |   |               |                |                        |
| <b>General parameters</b>                          |             |                 |     |   |               |                |                        |
| 1000   | 1000        | Visible String4 | ro  | Instrument ID                                     | -             | -              | 1000                   |
| 1001   | 1001        | UINT32          | ro  | Manufacturer-specific error register              | ERRCODE       | ERRCODE        | 1001                   |
| 1002   | 1002        | UINT32          | ro  | Manufacturer-specific status register             | -             | -              | 1002                   |
| <b>Speed controller parameters</b>                 |             |                 |     |   |               |                |                        |
| 1672   | 1672        | UINT32          | r/w | Kp – gain factor for speed controller             | GV            | GV             | 1200                   |
| 1677   | 1677        | UINT32          | r/w | Tn – integral-action time for speed controller    | GVTN          | GVTN           | 1201                   |
| 1676   |             | UINT32          | r/w | PID – T2 – time constant for speed controller     | GVT2          | ARxPx - Filter | 1202                   |
| 1601   | 1601        | UINT32          | r/w | Setpoint ramp+, speed controller                  | ACC           | ACC            | 1203                   |
| 1634   | 1634        | UINT32          | r/w | Setpoint ramp-, speed controller                  | DEC           | DEC            | 1204                   |
| 1637   | 1637        | UINT32          | r/w | Emergency stop ramp, speed controller             | DECSTOP       | DECSTOP        | 1205                   |
| 1890   | 1890 / 1891 | UINT32          | r/w | Maximum speed                                     | VLIM          | VLIM / VLIMN   | 1206                   |
| 1895   | 1895        | UINT32          | r/w | Overspeed   | VOSPD         | VOSPD          | 1207                   |
| 1642   | 1642        | UINT32          | r/w | Count direction                                   | DIR           | DIR            | 1208                   |
| <b>Position controller parameters</b>              |             |                 |     |   |               |                |                        |
| 1894   | 1894        | UINT32          | r/w | Velocity multiplier for jogging/homing            | VMUL          | VMUL           | 1250                   |
| 1807   | 1807        | UINT32          | r/w | Axis type   | POSCNFG       | POSCNFG        | 1251                   |
| 1798   | 1798        | INTEGER32       | r/w | InPosition window                                 | PEINPOS       | PEINPOS        | 1252                   |
| 1799   | 1799        | INTEGER32       | r/w | Following error window                            | PEMAX         | PEMAX          | 1253                   |
| 1860   | 1860        | INTEGER32       | r/w | Position register 1                               | SWE1          | SWE1           | 1254                   |
| 1862   | 1862        | INTEGER32       | r/w | Position register 2                               | SWE2          | SWE2           | 1255                   |
| 1864   |             | INTEGER32       | r/w | Position register 3                               | SWE3          |                | 1256                   |
| 1866   |             | INTEGER32       | r/w | Position register 4                               | SWE4          |                | 1257                   |
| 1803   | 1803        | UINT32          | r/w | Denominator resolution                            | PGEARO        | PGEARO         | 1258                   |
| 1802   | 1802        | UINT32          | r/w | Numerator resolution                              | PGEARI        | PGEARI         | 1259                   |
| 1814   | 1814        | UINT32          | r/w | Minimum acceleration/braking time                 | PTMIN         | PTMIN          | 1260                   |
| 1669   | 1669        | UINT32          | r/w | Feed-forward factor for position controller       | GPFFV         | GPFFV          | 1261                   |
| 1666   | 1666        | UINT32          | r/w | KV - factor for position controller               | GP            | GP             | 1262                   |
| 1671   |             | UINT32          | r/w | KP - factor for position controller               | GPV           |                | 1263                   |
| 1670   |             | UINT32          | r/w | Tn - integral-action time for position controller | GPTN          |                | 1264                   |
| 1816   | 1816        | UINT32          | r/w | Maximum velocity for positioning mode             | PVMAX         | PVMAX          | 1265                   |
| 1856   | 1856        | UINT32          | r/w | Configuration variable for software switch        | SWCNFG        | SWCNFG         | 1266                   |
| <b>Position data for the position control mode</b> |             |                 |     |   |               |                |                        |
| 1790   | 1790        | INTEGER32       | r/w | Position  | O P           | O P            | 1300                   |
| 1791   | 1791        | INTEGER16       | r/w | Velocity  | O V           | O V            | 1301                   |
| 1785   | 1785        | UINT32          | r/w | Motion task type                                  | O C           | O C            | 1302                   |
| 1783   | 1783        | INTEGER16       | r/w | Starting time (acceleration)                      | O ACC1        | O ACC          | 1304                   |
| 1786   | 1786        | INTEGER16       | r/w | Braking time (deceleration)                       | O DEC1        | O DEC          | 1305                   |
| 1784   |             | INTEGER16       | r/w | Jolt limiting (acceleration)                      | O ACC2        |                | 1306                   |
| 1787   |             | INTEGER16       | r/w | Jolt limiting (deceleration)                      | O DEC2        |                | 1307                   |
| 1788   | 1788        | UINT32          | r/w | Number of next motion task                        | O FN          | O FN           | 1308                   |
| 1789   | 1789        | UINT32          | r/w | Start delay for next motion task                  | O FT          | O FT           | 1309                   |
| 1310   | 1310        | 2 * UINT16      | wo  | Copy a motion task                                | OCOPY         | OCOPY          | 1310                   |
| 1311   |             | special         | r/w | Position, 32 bit floating decimal point format    |               |                | 1311                   |
| 1312   |             | special         | r/w | Velocity, 32 bit floating decimal point format    |               |                | 1312                   |
| 1857   |             | UINT32          | r/w | Configuration variable 2 for software switch      | SWCNFG2       |                | 1267                   |

| PNU   |           | Data type | Acc | Description   | ASCII command |           | PNU (old) |
|---|-----------|-----------|-----|---|---------------|-----------|-----------|
| S400/S600                                   | S300/S700 |           |     |   | S400/S600     | S300/S700 | S400/S600 |
| <b>Position set-up mode</b>                 |           |           |     |   |               |           |           |
| 1773  | 1773      | UINT32    | r/w | Homing type   | NREF          | NREF      | 1350      |
| 1644  | 1644      | UINT32    | r/w | Homing direction  | DREF          | DREF      | 1351      |
| 1602  | 1602      | UINT32    | r/w | Acceleration ramp (jogging/homing)                                | ACCR          | ACCR      | 1352      |
| 1636  | 1636      | UINT32    | r/w | Braking ramp  | DECR          | DECR      | 1353      |
| 1831  | 1831      | UINT32    | r/w | Reference offset  | ROFFS         | ROFFS     | 1354      |
| 1896  | 1896      | UINT32    | ro  | Homing run velocity   | VREF          | VREF      | 1355      |
| 1889  | 1889      | UINT32    | ro  | Jogging velocity  | VJOG          | VJOG      | 1356      |
| <b>Actual values</b>                        |           |           |     |   |               |           |           |
| 1400  | 1810      | INTEGER32 | ro  | Actual position 20 bits/turn                                      | PRD           | PRD       | 1400      |
| 1401  |           | INTEGER32 | ro  | Speed   |               |           | 1401      |
| 1402  |           | INTEGER32 | ro  | Incremental position, actual value                                |               |           | 1402      |
| 1800  | 1800      | INTEGER32 | ro  | SI-position, actual value   | PFB           | PFB       | 1403      |
| 1815  | 1815      | INTEGER32 | ro  | SI-velocity, actual value   | PV            | PV        | 1404      |
| 1797  | 1797      | INTEGER32 | ro  | SI following error  | PE            | PE        | 1405      |
| 1688  | 1688      | INTEGER32 | ro  | RMS current   | I             | I         | 1406      |
| 1880  | 1880      | INTEGER32 | ro  | SI-speed, actual value  | V             | V         | 1407      |
| 1873  | 1873      | INTEGER32 | ro  | Heatsink temperature  | TEMPH         | TEMPH     | 1408      |
| 1872  | 1872      | INTEGER32 | ro  | Internal temperature  | TEMPE         | TEMPE     | 1409      |
| 1882  | 1882      | INTEGER32 | ro  | DC-bus (DC-link) voltage  | VBUS          | VBUS      | 1410      |
| 1792  | 1792      | INTEGER32 | ro  | Regen power   | PBAL          | PBAL      | 1411      |
| 1689  | 1764      | INTEGER32 | ro  | I2t - loading   | I2T           | MI2T      | 1412      |
| 1876  | 1876      | INTEGER32 | ro  | Running time  | TRUN          | TRUN      | 1413      |
| 1414  |           | special   | ro  | Position, 32 bit floating decimal point format                    |               |           | 1414      |
| 1415  |           | special   | ro  | Velocity, 32 bit floating decimal point format                    |               |           | 1415      |
| <b>Digital I/O configuration</b>            |           |           |     |   |               |           |           |
| 1698  | 1698      | UINT32    | r/w | Function of digital input 1                                       | IN1MODE       | IN1MODE   | 1450      |
| 1701  | 1701      | UINT32    | r/w | Function of digital input 2                                       | IN2MODE       | IN2MODE   | 1451      |
| 1704  | 1704      | UINT32    | r/w | Function of digital input 3                                       | IN3MODE       | IN3MODE   | 1452      |
| 1707  | 1707      | UINT32    | r/w | Function of digital input 4                                       | IN4MODE       | IN4MODE   | 1453      |
| 1699  | 1699      | INTEGER32 | r/w | Auxiliary variable for digital input 1                            | IN1TRIG       | IN1TRIG   | 1454      |
| 1702  | 1702      | INTEGER32 | r/w | Auxiliary variable for digital input 2                            | IN2TRIG       | IN2TRIG   | 1455      |
| 1705  | 1705      | INTEGER32 | r/w | Auxiliary variable for digital input 3                            | IN3TRIG       | IN3TRIG   | 1456      |
| 1708  | 1708      | INTEGER32 | r/w | Auxiliary variable for digital input 4                            | IN4TRIG       | IN4TRIG   | 1457      |
| 1775  | 1775      | INTEGER32 | r/w | Function of digital input 1                                       | O1MODE        | O1MODE    | 1458      |
| 1778  | 1778      | INTEGER32 | r/w | Function of digital input 2                                       | O2MODE        | O2MODE    | 1459      |
| 1776  | 1776      | UINT32    | r/w | Auxiliary variable for digital output 1                           | O1TRIG        | O1TRIG    | 1460      |
| 1779  | 1779      | UINT32    | r/w | Auxiliary variable for digital output 2                           | O2TRIG        | O2TRIG    | 1461      |
| 1852  | 1852      | UINT32    | r/w | State of 4 digital inputs, Enable, 2 digital outputs              | STATIO        | STATIO    | 1462      |
| <b>Analog configuration</b>                 |           |           |     |   |               |           |           |
| 1607  | 1607      | UINT32    | r/w | Configuration of the analog input functions                       | ANCNFG        | ANCNFG    | 1500      |
| 1613  |           | UINT32    | r/w | Configuration monitor function analog output 1                    | ANOUT1        |           | 1501      |
| 1611  | 1611      | UINT32    | r/w | Offset voltage for analog input 1                                 | ANOFF1        | ANOFF1    | 1502      |
| 1617  | 1617      | UINT32    | r/w | Filter time constant for analog input 1                           | AVZ1          | AVZ1      | 1503      |
| 1897  | 1897      | UINT32    | r/w | Scaling factor for velocity, analog input 1                       | VSCALE1       | VSCALE1   | 1504      |
| 1713  | 1713      | UINT32    | r/w | Scaling factor for current, analog input 1                        | ISCALE1       | ISCALE1   | 1505      |
| 1614  |           | UINT32    | r/w | Configuration monitor function analog output 2                    | ANOUT2        |           | 1506      |
| 1612  | 1612      | UINT32    | r/w | Offset voltage for analog input 2                                 | ANOFF2        | ANOFF2    | 1507      |
| 1898  | 1898      | UINT32    | r/w | Scaling factor for velocity, analog input 2                       | VSCALE2       | VSCALE2   | 1508      |
| 1714  | 1714      | UINT32    | r/w | Scaling factor for current, analog input 2                        | ISCALE2       | ISCALE2   | 1509      |
| <b>Motor parameters</b>                     |           |           |     |   |               |           |           |
| 1735  | 1735      | UINT32    | r/w | Brake configuration   | MBRAKE        | MBRAKE    | 1550      |
| 1753  | 1753      | UINT32    | r/w | Motor number from motor database                                  | MNUMBER       | MNUMBER   | 1551      |
| <b>Manufacturer specific object channel</b> |           |           |     |   |               |           |           |
| ≥1600                                       |           |           |     | ⇒ p. 31 and description of the ASCII-commands in the online help. |               |           | ≥1600     |

**Abbreviations in the "Access" column**

| Abbrev. | Description           |
|---------|-----------------------|
| wo      | "write only" access   |
| ro      | "read only" access    |
| r/w     | read and write access |

## 4.2.2 Standard PROFIDRIVE parameters

### 4.2.2.1 PNU 940/911: PPO type write/read

These parameters describe the numbers of the supported PPO-types write und read. Since only PPO-type 2 is supported (see Chapter 3), this parameter is always set to 2.

### 4.2.2.2 PNU 918: PROFIBUS node address

With this parameter the PROFIBUS - node address of the amplifier can be read.

#### S400/S600

The range of addresses can be extended from 1..63 to 1..127 with the ASCII-command MDRV.

Setting up the station address, see page 8.

### 4.2.2.3 PNU 963: baud rate

This parameter defines the index of the baud rate that is used for PROFIBUS communication, and can only be read. The baud rate is given out by the PROFIBUS-master.

The table below shows the indices with the according baud rates (in kBaud):

| Index     | 0     | 1    | 2    | 3    | 4   | 5     | 6     | 7     | 8    | 9   |
|-----------|-------|------|------|------|-----|-------|-------|-------|------|-----|
| Baud rate | 12000 | 6000 | 3000 | 1500 | 500 | 187.5 | 93.75 | 45.45 | 19.2 | 9.6 |

### 4.2.2.4 PNU 965: PROFIDRIVE profile number

This parameter can be used to read out the number of the PROFIDRIVE profile. Profile Number 3, Version 2 is used.

### 4.2.2.5 PNU 970: default parameters

With this parameter you can reject all the parameters that are set and load the manufacturer's default values.

### 4.2.2.6 PNU 971: non volatile saving of parameters

With this parameter you can save all the parameter settings to the EEPROM. To do this, the parameter must have the value PWE = 1 when the transfer takes place.

#### 4.2.2.7 PNU 930: Selection Switch for Operating Mode

The “Selector for operating modes” is defined by the drive profile, and mirrors the operating modes of the drive profile to the operating modes of the servo amplifier. The following table shows a summary of the operating modes:

**NOTE**

If process data are exchanged across the PROFIBUS, then the operating modes of the drive profile must only be selected with PNU 930.

| Operating mode of drive profile | Operating mode servo amplifier (ASCII command “OPMODE”) | Description   |
|---------------------------------|---|---|
| 2                               | 8   | Positioning mode according to PROFIDRIVE profile      |
| 1                               | 0   | Digital speed control according to PROFIDRIVE profile |
| 0                               | -   | reserved  |
| -1                              | 1   | Speed control, analog setpoint                        |
| -2                              | 2   | Torque control, digital setpoint                      |
| -3                              | 3   | Torque control, analog setpoint                       |
| -4                              | 4   | Position control, electronic gearing                  |
| -5                              | 5   | Position control, external trajectory                 |
| -6 to -15                       | -   | reserved  |
| -16                             | -   | ASCII channel for expanded parameterization           |
| -17 to -125                     | -   | reserved  |
| -126                            | -   | Initial settings when amplifier is switched on        |

The individual operating modes are described in chapter 5.2. A change of operating mode can only be undertaken in connection with the control word.

The operating mode must be changed according to the following sequence:

- Inhibit setpoints and process data**  
 Bit 10 in the control word is set to 0, so that no new setpoints will be accepted by the servo amplifier and no new control functions can be initiated. A new operating mode can, however, be selected while a motion function is being performed. The control word is only inhibited to the extent that the servo amplifier can always be switched into a safe state.
- Select the new operating mode with PNU 930**  
 The new operating mode is selected with parameter 930 through the parameter channel, but not yet accepted.
- Set/receive the setpoints and actual values**  
 Enter the corresponding setpoints in the setpoint area of the process data. Here you must take note that the normalization and data formats depend on the operating mode that is selected. The interpretation of the actual values is also altered (see ⇒ p. 15 and p. 37ff). The user program must respond accordingly.
- Enable the setpoints**  
 Bit 10 of STW is set to 1. The setpoints are immediately accepted and processed. The new actual values are output with the appropriate normalization and data format.

**CAUTION**

After switch-on or after a coldstart the servo amplifier is always in the safe operating mode. In the safe operating mode (-126), no motion functions can be initiated via the PROFIBUS. However, it is possible to perform motion functions with the the setup Software. If the operating mode is changed, then motion functions can only be operated via the PROFIBUS. If the operating mode is changed via another communication channel, then the amplifier is emergency braked and the error F21 (Handling error, expansion card) is signaled.

## 4.2.3 Manufacturer specific parameters

### 4.2.3.1 PNU 1000: instrument ID

The instrument ID consists of four ASCII characters, with the contents "Sxyz".

- x stands for the servoamplifier family
- yz stands for the current level of the output stage

### 4.2.3.2 PNU 1001: manufacturer specific error register

The assignment of the error register can be seen in the following table. The explanation of the individual errors can be found in the assembly & installation instructions for the servo amplifier.

| Bit   | Description                                     |
|-------|---|
| 0     | <b>Error F01:</b> Heatsink temperature          |
| 1     | <b>Error F02:</b> Overvoltage                   |
| 2     | <b>Error F03:</b> Following error               |
| 3     | <b>Error F04*:</b> Feedback                     |
| 4     | <b>Error F05:</b> Undervoltage                  |
| 5     | <b>Error F06*:</b> Motor temperature            |
| 6     | <b>Error F07*:</b> Auxiliary voltage            |
| 7     | <b>Error F08:</b> Overspeed                     |
| 8     | <b>Error F09*:</b> EEPROM                       |
| 9     | <b>Error F10*:</b> Flash-EEPROM                 |
| 10    | <b>Error F11*:</b> Mechanical holding brake     |
| 11    | <b>Error F12*:</b> Motor phase                  |
| 12    | <b>Error F13:</b> Internal temperature          |
| 13    | <b>Error F14*:</b> Output stage                 |
| 14    | <b>Error F15:</b> I <sup>2</sup> t max.         |
| 15    | <b>Error F16:</b> Mains supply-BTB              |
| 16    | <b>Error F17*:</b> A/D-converter                |
| 17    | <b>Error F18*:</b> Regen circuit                |
| 18    | <b>Error F19:</b> Mains supply phase            |
| 19    | <b>Error F20*:</b> Expansion card error         |
| 20    | <b>Error F21*:</b> Handling error, plug-in card |
| 21    | <b>Error F22:</b> Earth short                   |
| 22    | <b>Error F23:</b> CAN-Bus off                   |
| 23    | <b>Error F24:</b> Warning                       |
| 24    | <b>Error F25:</b> Commutation error             |
| 25    | <b>Error F26:</b> Limit switch                  |
| 26    | <b>Error F27:</b> AS functionality              |
| 27-30 | <b>Error F28 - F31*:</b> reserved               |
| 31    | <b>Error F32*:</b> System error                 |

When the cause of the error has been cleared, the error state can be canceled by setting Bit 7 in the control word (STW).

The error response of the servo amplifier to the reset will differ, depending on the error that has occurred:

For errors that are marked by an asterisk (\*), setting the reset bit initiates a cold-start of the amplifier, whereby the PROFIBUS communication to this amplifier will also be interrupted for several seconds. Depending on the circumstances, this break in communication may have to be separately handled by the PLC.

For the other errors, the reset leads to a warm start, during which the communication will not be interrupted.

A description of the individual errors and recommendations for removing them can be found in the amplifier's installation manual.

## 4.2.3.3

**PNU 1002: manufacturer specific status register**

The bit assignment can be seen in the following table:

| Bit | Description   |
|-----|---|
| 0   | <b>Warning 1:</b> I <sup>2</sup> t threshold exceeded (set, as long as I <sub>rms</sub> is above the threshold)   |
| 1   | <b>Warning 2:</b> Regen power exceeded (set, as long as the set regen power is exceeded)  |
| 2   | <b>Warning 3:</b> Following error   |
| 3   | <b>Warning 4:</b> Threshold monitoring (field bus) active   |
| 4   | <b>Warning 5:</b> Mains supply phase missing  |
| 5   | <b>Warning 6:</b> Software limit-switch 1 has been activated  |
| 6   | <b>Warning 7:</b> Software limit-switch 2 has been activated  |
| 7   | <b>Warning 8:</b> Faulty motion task has been started   |
| 8   | <b>Warning 9:</b> No reference point was set at the start of the motion task  |
| 9   | <b>Warning 10:</b> PSTOP active   |
| 10  | <b>Warning 11:</b> NSTOP active   |
| 11  | <b>Warning 12:</b> Motor default values were loaded (HIPERFACE® or EnDat® feedback)   |
| 12  | <b>Warning 13:</b> Expansion card is not working properly   |
| 13  | <b>Warning 14:</b> Sine encoder commutation not carried out   |
| 14  | <b>Warning 15:</b> Speed - current table error INxMODE 35   |
| 15  | <b>Warning 16:</b> Reserve  |
| 16  | Motion task active (is set as long as a position control task is active - motion task, jogging, homing).  |
| 17  | Reference point set (is set after a homing run, or when an absolute position (multi-turn) encoder is used. This is canceled when the amplifier is switched on, or when a homing run is started.   |
| 18  | Actual position = home position (is set as long as the reference switch is activated).  |
| 19  | InPosition (is set as long as the difference between the target position for a motion task and the actual position is smaller than PEINPOS. The InPosition signal is suppressed if a following task is started at the target position.  |
| 20  | Position latch set (positive edge) – this is set if a rising edge is detected on the INPUT2 (IN2MODE=26) that is configured as a latch. This is canceled if the latched position is read out (LATCH16/LATCH32)  |
| 21  | —   |
| 22  | Position 1 reached (is set if the configured condition for this signal (SWCNFG, SWE1, SWE1N) is met. Depending on the configuration, this bit is set on exceeding SWE1, or going below SWE1, on reaching the InPosition window SWE1...SWE1N or on leaving the InPosition window SWE1...SWE1N. |
| 23  | Position 2 reached (see above)  |
| 24  | Position 3 reached (see above)  |
| 25  | Position 4 reached (see above)  |
| 26  | Initialization completed (is set if the internal initialization of the amplifier is completed).   |
| 27  | —   |
| 28  | Speed = 0 (is set as long as the motor speed is below the standstill threshold VELO).   |
| 29  | Safety relay has been triggered (is set as long as the safety relay is open AS)   |
| 30  | Output stage enabled (is set when software and hardware enables are set).   |
| 31  | Error present (is canceled when the amplifier is switched on, or if the function "Cancel error" is called.  |

**In the process data, Bits 16 to 31 of the manufacturer-specific status register are given out.**  
Warnings 3 and 4 can be reset through Bit 13 in the control word.

**4.2.4 Position control parameters**

**4.2.4.1 PNU 1894: velocity multiplier**

This parameter is used to enter a multiplier for the jogging/homing velocity. In Positioning opmode, the velocity for jogging/homing is set through PZD2 jogging/homing is started using bit 8/ bit 11 in the control word (STW).

The actual jog velocity is calculated according to the following formula:

$$V_{Jog,vel. (32Bit)} = V_{Jog,PZD2 (16Bit)} \times velocity\ multiplier(16Bit)$$

The default value for PNU 1894 is 1.

**4.2.4.2 PNU 1807: axis type**

This parameter is used to define the axis type.

| Value | S300/S700   | S400        | S600        |
|-------|-------------|-------------|-------------|
| 0     | Linear axis | Linear axis | Linear axis |
| 1     | Modulo axis | Rotary axis | Rotary axis |
| 2     |             | Modulo axis | Modulo axis |

**4.2.5 Position data for the position control mode**

**4.2.5.1 PNU 1790: position**

Since the servo amplifier calculates all positioning operations internally only on an incremental basis, there are limitations on the usable range of values for distances that are given in SI (user) units.

The range for the incremental position covers the values from  $-2^{31}$  to  $(2^{31}-1)$ .

The resolution that is determined by the PGEARO (PNU1803 ind1) and PGEARI (PNU1802 ind1) parameters and the variable PRBASE fix the sensibly usable range for positioning operations.

The variable PRBASE determines, through the equation  $n = 2^{PRBASE}$ , the number of increments per motor turn. The value of PRBASE can only be 16 or 20.

PGEARO contains the number of increments that must be traversed when the distance to be moved is PGEARI. The default values for PGEARO correspond to one turn.

The number of turns that can be covered are given as follows:

-2048..+2047 for PRBASE=16 and -32768..+32767 for PRBASE=20

The sensibly usable position range is derived as follows:

$$\begin{aligned}
 & -2^{31} * \frac{PGEARI}{PGEARO} \dots (2^{31} - 1) * \frac{PGEARI}{PGEARO} && \text{for PGEARI} \leq \text{PGEARO} \text{ or} \\
 & -2^{31} \dots (2^{31} - 1) && \text{for PGEARI} > \text{PGEARO}
 \end{aligned}$$

**4.2.5.2 PNU 1791: velocity**

The usable range for the velocity is not limited by the available data area. It is limited by the maximum applicable speed  $n_{max}$ , which is given by the speed parameter VLIM as the final limit speed for the motor.

The maximum velocity is thus given by:

$$n_{SI,max} = n_{max} \times \frac{PGEARI}{PGEARO} \times 2^{PRBASE} \quad \text{with } n_{max} \text{ in turns/second}$$

or, in incremental units, as:

$$v_{incr,max} = n_{max} \times 2^{PRBASE} \times \frac{250ms}{1sec} = \frac{n_{max}}{4000} \times 2^{PRBASE} \quad \text{with } n_{max} \text{ in turns/second}$$

### 4.2.5.3 PNU 1785: motion task type

| Bit | Value | Meaning   |
|-----|-------|---|
| 0   | 0     | The position value that is given is evaluated as an absolute position.  |
|     | 1     | The position value that is given is evaluated as a relative traversing distance. The two following bits then determine the type of relative motion.                               |
| 1   | 0     | If Bit 1 and Bit 2 are set to 0 and Bit 0 set to 1, then the relative motion task is performed according to the "InPosition" bit.   |
|     | 1     | The new target position is given by the old target position plus the traversing distance. Bit 1 has priority over Bit 2.  |
| 2   | 0     | If Bit 1 and Bit 2 are set to 0 and Bit 0 set to 1, then the relative motion task is performed according to the "InPosition" bit.   |
|     | 1     | The new target position is given by the actual position plus the traversing distance.   |
| 3   | 0     | no following task available   |
|     | 1     | There is a following task, but it must be defined through parameter O_FN, PNU 1788  |
| 4   | 0     | Change over to next motion task, with braking to 0 at the target position.  |
|     | 1     | Change over to next motion task, without standstill at the target position. The type of velocity transition is determined by Bit 8.   |
| 5   | 0     | Change over to next motion task, without evaluating inputs.   |
|     | 1     | A following motion task is started by a correspondingly configured input.   |
| 6   | 0     | Start the next motion task by Input State = low or if bit 7 = 1 after the delay set in PNU 1789.  |
|     | 1     | Start the next motion task by Input State = high or if bit 7 = 1 after the delay set in PNU 1789.   |
| 7   | 0     | The next motion task is started immediately.  |
|     | 1     | The next motion task is started after the delay time set by PNU 1789 or, if Bit 6 = 1, previously by a corresponding input signal.  |
| 8   | 0     | Only for following motion tasks and Bit 4 = 1: from the target position for the previous motion task onwards, the velocity is altered to the value for the following motion task. |
|     | 1     | The change of velocity is made so that the velocity at the target position of the previous motion task matches the value given for the following motion task.                     |
| 9   |       |   |
| 10  | -     | reserved  |
| 11  |       |   |
| 12  | 0     | Accelerations are calculated according to the run-up/acceleration and run-down/braking times for the motion task.   |
|     | 1     | the deceleration/acceleration ramps are interpreted in mm/s <sup>2</sup>  |
| 13  | 0     | The target position and target velocity of a motion task are interpreted as increments.   |
|     | 1     | The target position and target velocity are recalculated as increments before the start of the motion task. The parameters PGEAR1 and PGEARO are used for this purpose.           |
| 14  | 0     | The programmed velocity is used as the velocity for the motion task.  |
|     | 1     | The velocity for the motion task is determined by the voltage present on analog input 1 at the start of the motion task.  |
| 15  | -     | reserved  |
| 16  | 0     | S300/S700 only: a motion task with trapezoid profile is started   |
|     | 1     | S300/S700 only: a table motion task (sin <sup>2</sup> profile) is started. Bit 9 must be set to 0.  |

Bits 0 to 15 are transmitted as motion task type in PZD 6 (mode "positioning") with direct motion tasks.

Bit 16 is not affected by the motion task type transmitted with the process data in PZD 6 and therefore must be written with PNU 1785 to the parameter channel.

### 4.2.5.4 PNU 1783: acceleration time

This parameter defines the total time or rate (depending on the type of units selected for acceleration) to reach the target velocity for the motion task.

**4.2.5.5 PNU 1784: acceleration jolt limiting**

For S400/S600 only. This parameter defines the form of the acceleration ramp. If a value  $\neq 0$  is entered here, then a  $\sin^2$ -ramp (S-curve) is used to reach the target velocity. To employ sine<sup>2</sup>-ramps, the configuration variable SPSET has to be set to 2 (via the ASCII-channel or the ASCII-terminal in the setup software) and to be saved.

**4.2.5.6 PNU 1786: deceleration time**

This parameter defines the total time or rate (depending on the type of units selected for deceleration) to reduce the velocity to 0 at the target position.

**4.2.5.7 PNU 1787: deceleration jolt limiting**

For S400/S600 only. This parameter defines the form of the braking/deceleration ramp. If a value  $\neq 0$  is entered here, then a  $\sin^2$ -ramp (S-curve) is used for braking/deceleration.

**4.2.5.8 PNU 1788: next motion task**

S400/S600:

The motion task number of the motion task to be started can be from 1 to 180 (motion tasks in EEPROM) or 192 to 255 (motion tasks in RAM).

S300/S700:

The motion task number of the motion task to be started can be from 1 bis 200 (motion tasks in EEPROM) or 201 .. 300 (motion tasks in RAM).

**4.2.5.9 PNU 1789: start delay**

This parameter is used to set a delay time before the start of a motion task.

**4.2.5.10 PNU 1310: copy motion task**

This parameter can be used to copy motion tasks. The source motion task must be entered in the high-value portion of PWE (PZD 5 & 6) and the target motion task must be entered in the low-value portion of PWE (PZD 7 & 8).

**4.2.5.11 PNU 1311: position, 32 bit floating decimal point format**

For S400/S600 only. With this object the target position for motion task 0 (direct motion task, see ASCII – command O\_P) can be set in 32 Bit Floating decimal point format (IEEE).

Right of decimal point positions will be truncated. This objekt is, aside from the data format, identical PNU 1790. The defaults are indicated in micrometers.

**Use:**

Controls that support only 16 Bit integer and 32 Bit floating decimal point.

**4.2.5.12 PNU 1312: velocity, 32 bit floating decimal point format**

For S400/S600 only. With this object the velocity for motion task 0 (direct motion task, see ASCII – command O\_V) can be set in 32 Bit Floating decimal point format (IEEE).

Right of decimal point positions will be truncated. This objekt is, aside from the data format, identical PNU 1791.

**Use:**

Controls that support only 16 Bit integer and 32 Bit floating decimal point.

**4.2.6 Setup mode: position****4.2.6.1 PNU 1773: homing type**

This parameter can be used to determine which type of homing run should be applied. The assignment can be seen in the following table:

| PWE | Type of homing run                               |
|-----|--|
| 0   | Reference point at the present position          |
| 1   | Initiator with resolver zero mark                |
| 2   | Hardware limit-switch resolver zero mark         |
| 3   | Initiator without resolver zero mark             |
| 4   | Hardware limit-switch without resolver zero mark |
| 5   | Zero mark / feedback unit                        |
| 6   | Reference point at the actual position           |
| 7   | Hardware limit-switch with resolver zero mark    |
| 8   | Absolute SSI-position                            |
| 9   | Move to Mechanical Stop                          |

**4.2.6.2 PNU 1644: homing direction**

This parameter can be used to determine the direction of motion for homing runs. If set equal 0, then the direction of motion is negative; for a value 1 it is positive, and for a 2 it depends on the distance to the reference point in the direction in which the homing run started.

**4.2.7 Actual values****4.2.7.1 PNU 1401: speed**

For S400/S600 only.

The parameter value is the actual speed of the motor in increments / 250  $\mu$ sec, which are the amplifier's internal units.

**4.2.7.2 PNU 1402: incremental position, actual value**

For S400/S600 only.

The parameter value is the actual position value in increments.

**4.2.7.3 PNU 1800: actual position value in SI (User) units**

The parameter value is the actual SI (user unit) position value.

**4.2.7.4 PNU 1414: actual position, 32 bit floating decimal point format**

For S400/S600 only. With this object the actual position (see ASCII-command PFB) can be read in a 32 Bit Floating decimal point format (IEEE).

Right of decimal point positions will be truncated. This object is, aside from the data format, identical to PNU1800.

**Use:**

PLC Controls that support only 16 Bit integer and 32 Bit floating decimal point.

**4.2.7.5 PNU 1415: actual velocity, 32 bit floating decimal point format**

For S400/S600 only. With this object the actual velocity (see ASCII-command PV) can be read in a 32 Bit Floating decimal point format (IEEE).

Right of decimal point positions will be truncated. This object is, aside from the data format, identical to PNU1815.

**Use:**

PLC Controls that support only 16 Bit integer and 32 Bit floating decimal point.

**4.2.8 Digital I/O configuration**

All settings for the digital inputs and outputs only become effective after being saved in the EEPROM and then switching off and on again, or making a cold start of the servo amplifier. Details on each configuration setting can be seen in the user manual for the setup software.

**4.2.8.1 PNUs 1698/1701/1704/1707: digital input configuration**

This parameter can be used to configure the digital inputs 1 to 4 individually.

The configurable functions depend on the used amplifier and are described in the ASCII Object Reference.

**4.2.8.2 PNUs 1775/1778: digital output configuration**

These parameters can be used to configure the two digital outputs individually. The configurable functions depend on the used amplifier and are described in the ASCII Object Reference.

**4.2.9 Analog configuration**

All settings for the analog inputs and outputs only become effective after being saved in the EEPROM and then switching off and on again, or making a cold start of the servo amplifier. The significance of the functions can be seen in the user manual for the setup Software.

**4.2.9.1 PNU 1607: analog input configuration**

This parameter can be used to configure the two analog inputs together. The configurable functions depend on the used amplifier and are described in the ASCII Object Reference.

**4.2.9.2 PNU 1613/1614: analog output configuration**

With S400/S600 only. This parameter can be used to configure the two analog outputs individually.

| PWE | Function |
|-----|----------|
| 0   | Off      |
| 1   | n act    |
| 2   | l act    |
| 3   | n setp   |
| 4   | l setp   |
| 5   | S_fault  |
| 6   | Slot     |

## 4.2.10

**Manufacturer specific object channel (from PNU 1600)**

With PNUs>1600 you can programm each ASCII-parameter/command of the servo amplifier. The PNU can be calculated by the object number with a specific offset (ASCII command reference list: DPR).

All PNUs described in this manual can be reached with index=1. In the ASCII reference list you find for every parameter the PNU and the referring index. More functions of the object channel can be used with the indices listed below.

The offset and the indices that must be used depend on the object number:

| Objekt number | Offset | PNUs         | Index                     |
|---------------|--------|--------------|---------------------------|
| 0 ...447      | 1600   | 1600 ...2047 | 00h ...08h (1 ... 8dez)   |
| 448 ...847    | 1200   | 1648 ...2047 | 10h ...18h (16 ... 24dez) |
| 848 ...1047   | 800    | 1648 ...2047 | 20h ...28h (32 ...40dez)  |

|                   |  |
|-------------------|--|
| Index             | 0/10h/ 20h depending on the object no. (see above) |
| short description | Number of entries                                  |
| Unit              | —  |
| Access            | ro   |
| Data type         | UNSIGNED8  |
| Value range       | 8  |
| EEPROM            | —  |

|                   |  |
|-------------------|--|
| Index             | 1/11h/ 21h depending on the object no. (see above) |
| short description | read/write a parameter                             |
| Unit              | see corresponding ASCII-command                    |
| Access            | see corresponding ASCII-command                    |
| Data type         | see corresponding ASCII-command                    |
| Value range       | see corresponding ASCII-command                    |
| Default value     | —  |
| EEPROM            | see corresponding ASCII-command                    |

|                   |  |
|-------------------|--|
| Index             | 2/12h/ 22h depending on the object no. (see above) |
| short description | read lower limit                                   |
| Unit              | see corresponding ASCII-command                    |
| Access            | Read only  |
| Data type         | see corresponding ASCII-command                    |
| Value range       | see corresponding ASCII-command                    |
| Default value     | —  |
| EEPROM            | —  |

|                   |  |
|-------------------|--|
| Index             | 3/13h/ 23h depending on the object no. (see above) |
| short description | read upper limit                                   |
| Unit              | see corresponding ASCII-command                    |
| Access            | Read only  |
| Data type         | see corresponding ASCII-command                    |
| Value range       | see corresponding ASCII-command                    |
| Default value     | —  |
| EEPROM            | —  |

|                   |  |
|-------------------|--|
| Index             | 4/14h/ 24h depending on the object no. (see above) |
| short description | read default value                                 |
| Unit              | see corresponding ASCII-command                    |
| Access            | Read only  |
| Data type         | see corresponding ASCII-command                    |
| Value range       | see corresponding ASCII-command                    |
| Default value     | —  |
| EEPROM            | —  |

|                   |  |
|-------------------|--|
| Index             | 5/15h/ 25h depending on the object no. (see above) |
| short description | read object format                                 |
| Unit              | —  |
| Access            | Read only  |
| Data type         | see corresponding ASCII-command                    |
| Value range       | see corresponding ASCII-command                    |
| Default value     | —  |
| EEPROM            | —  |

**Description:**

The following object formats are possible:

- 0 Function (no parameters – write only)
- 1 Function (32-Bit parameter)
- 2 Function (32-Bit parameter with weighting 3)
- 3 8-Bit integer
- 4 8-Bit unsigned integer
- 5 16-Bit integer
- 6 16-Bit unsigned integer
- 7 32-Bit integer
- 8 32-Bit unsigned integer
- 9 32-Bit integer (weighting 3)

|                   |  |
|-------------------|--|
| Index             | 6/16h/ 26h depending on the object no. (see above) |
| short description | read object control data                           |
| Unit              | —  |
| Access            | Read only  |
| Data type         | UNSIGNED32   |
| Value range       | 0 ... $2^{32} - 1$                                 |
| Default value     | —  |
| EEPROM            | —  |

**Description:**

- 0x00010000 when altered, the variable has to be saved and the amplifier reset
- 0x00020000 variable will be saved in the serial EEPROM
- 0x00200000 variable is read-only, must not be written via PROFIBUS

|                   |                           |
|-------------------|---------------------------|
| Index             | 7/17h/ 27h and 8/18h/ 28h |
| short description | reserved                  |
| Unit              | —                         |
| Access            | Read only                 |
| Data type         | UNSIGNED32                |
| Value range       | 0 ... $2^{32} - 1$        |
| Default value     | —                         |
| EEPROM            | —                         |

**NOTE**

Objects with format 0 (index 5) must not be accessed reading (response identification = 1)

## 5 Process data channel

The process data channel is used for real-time communication. This channel is divided into two telegram sections:

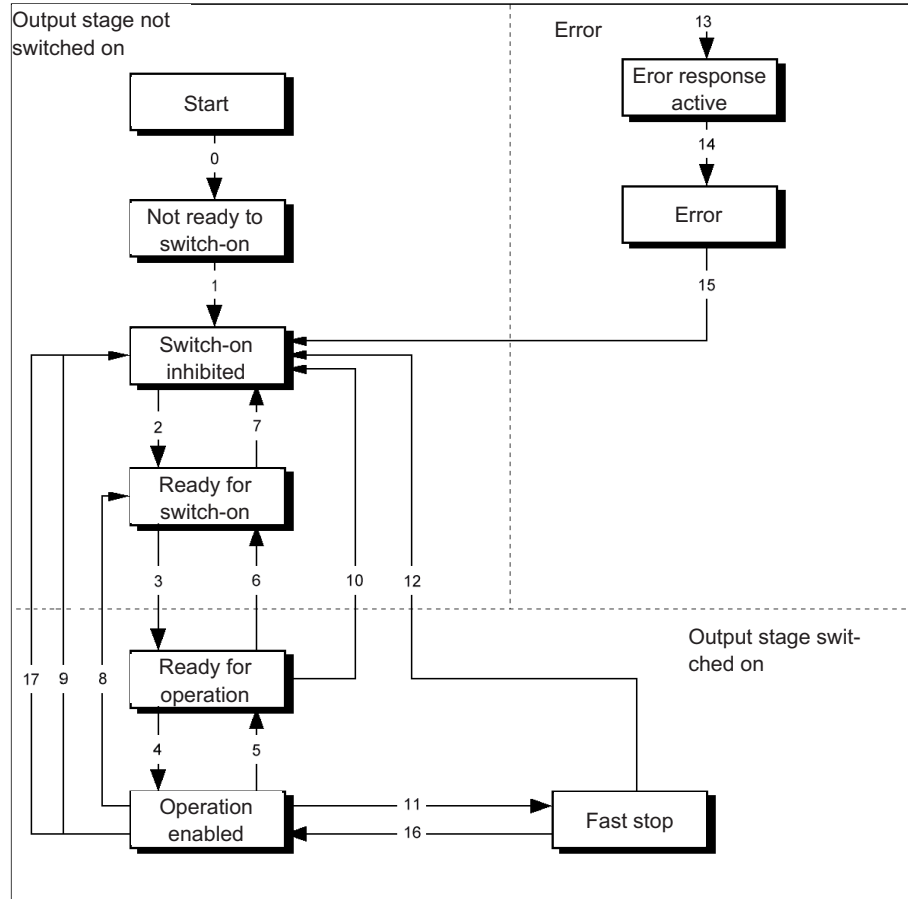
- PZD1: Control word (STW) /Status word (ZSW) – instrument control  
The control word and the status word are used to control the amplifier and monitor the amplifier's status.
- PZD2-6: Setpoint / actual values depending on the operating mode.  
Setpoints and actual values such as position, velocity and current are exchanged in this section.

The availability of a process data channel is determined in the PROFIDRIVE drive profile. The data that can be transferred is defined according to the operating mode (see "Setting the operating mode s" chapter 4.2.2.7). The process data that are used are determined in such a way that the real-time capability of this channel is optimally used.

In this chapter the instrument control is described first, and then the functions and details of each operating mode .

### 5.1 Instrument control

The control of the amplifier through PROFIBUS is described with the aid of the status machine shown below. The status machine is defined in the drive profile by a flow diagram valid for all operating modes. The following diagram shows different amplifier states for the servo amplifier.



The following table describes the amplifier states and the transitions.

#### States of the status machine

| State                              | Description  |
|------------------------------------|--|
| <b>Not ready for switch-on</b>     | servo amplifier is not ready for switch-on. No operation readiness (BTB) is signaled from the amplifier software.  |
| <b>Switch-on inhibited</b>         | servo amplifier is ready for switch-on. Parameters can be transferred, DC bus link can be switched on, motion functions cannot be carried out yet.   |
| <b>Ready for switch-on</b>         | DC bus link voltage must be switched on. Parameters can be transferred, motion functions cannot be carried out yet.  |
| <b>Ready for operation</b>         | DC bus link voltage must have been switched on. Parameters can be transferred, motion functions cannot be carried out yet. Output stage is switched on (enabled).  |
| <b>Operation enabled</b>           | No error present. Output stage is switched on, motion functions are enabled.   |
| <b>Fast stop activated</b>         | Drive has been stopped, using the emergency stop ramp. Output stage is switched on (enabled), motion functions are enabled.  |
| <b>Error response active/error</b> | If an amplifier error occurs, the servo amplifier changes to the amplifier state "Error response active". In this state, the power stage is switched off immediately. After this error response has taken place, it changes to the state "Error". This state can only be terminated by the bit-command "Error-reset". To do this, the cause of the error must have been removed (see ASCII command ERRCODE). |

## Transitions of the status machine

| Transition | Description |   |
|------------|-------------|---|
| 0          | Event       | Reset / 24V supply is switched on   |
|            | Action      | Initialization started  |
| 1          | Event       | Initialization successfully completed, servo amplifier switch-on inhibit  |
|            | Action      | none  |
| 2          | Event       | Bit 1 (inhibit voltage) and Bit 2 (fast stop) are set in the control word (command: shutdown). DC bus link voltage is present.                    |
|            | Action      | none  |
| 3          | Event       | Bit 0 (switch-on) is also set (command: switch-on)  |
|            | Action      | Output stage is switched on (enabled). Motor has torque.  |
| 4          | Event       | Bit 3 (operation enabled) is also set (command: operation enable)   |
|            | Action      | Motion functions are enabled, depending on the operating mode that is set.  |
| 5          | Event       | Bit 3 is canceled (command: inhibit)  |
|            | Action      | Motion functions are disabled.<br>Motor is braked, using the relevant ramp (depends on operating mode).   |
| 6          | Event       | Bit 0 is canceled (ready for switch-on).  |
|            | Action      | Output stage is switched off (disabled). Motor has no torque.   |
| 7          | Event       | Bit 1 or Bit 2 is canceled.   |
|            | Action      | (Command: "Fast stop" or "Inhibit voltage")   |
| 8          | Event       | Bit 0 is canceled (operation enabled -> ready for switch-on)  |
|            | Action      | Output stage is switched off (disabled) - motor has no torque.  |
| 9          | Event       | Bit 1 is canceled (operation enabled -> switch-on inhibited)  |
|            | Action      | Output stage is switched off (disabled) - motor has no torque.  |
| 10         | Event       | Bit 1 or 2 are canceled (ready for operation -> switch-on inhibited)  |
|            | Action      | Output stage is switched off (disabled) - motor has no torque.  |
| 11         | Event       | Bit 4 is canceled (operation enabled -> fast stop)  |
|            | Action      | Drive is stopped, using the emergency ramp. The output stage remains enabled. Setpoints are canceled (e.g motion block number, digital setpoint). |
| 12         | Event       | Bit 1 is canceled (fast stop -> switch-on inhibited)  |
|            | Action      | Output stage is switched off (disabled) - motor has no torque.  |
| 13         | Event       | Error response active   |
|            | Action      | Output stage is switched off (disabled) - motor has no torque.  |
| 14         | Event       | Error   |
|            | Action      | none  |
| 15         | Event       | Bit 7 is set (error -> switch-on inhibited)   |
|            | Action      | Acknowledge error (depending on error – with/without reset)   |
| 16         | Event       | Bit 4 is set (fast stop -> operation enabled)   |
|            | Action      | Motion function is enabled again.   |
| 17         | Event       | Bit 2 is canceled   |
|            | Action      | Switch-on inhibited, output stage disabled  |

The state transitions are affected by internal events (e.g. switching off the DC-link voltage) and by the flags in the control word (Bits 0, 1, 2, 3, 7).

5.1.1 Control word (STW)

With the aid of the control word, you can switch from one amplifier state to another. In the diagram for the state machine you can see which instrument states can be reached by which transitions. The momentary amplifier state can be taken from the status word.

Several states may be passed through during one telegram cycle, e.g.

Ready for switch on → Ready for operation → Operation enabled.

The bits in the control word can be (operating-) **mode-dependent** or **mode-independent**.

The following table describes the bit assignment in the control word.

| Bit | Name                           | Commentary  |
|-----|--------------------------------|---|
| 0   | Switch on                      | —   |
| 1   | Inhibit voltage                | —   |
| 2   | Fast stop, switch-on inhibited | 1 -> 0 drive decelerates using emergency ramp, axis is disabled (See also ASCII-commands STOPMODE and DECDIS)   |
| 3   | Operation enabled              | —   |
| 4   | Fast stop (inhibit rfg)        | 1 -> 0 drive decelerates using emergency ramp, the amplifier remains enabled  |
| 5   | Pause (stop rfg)               | Operating mode dependent, 1 -> 0 stops motion   |
| 6   | Setpoint enable                | Operating mode dependent (see table below)  |
| 7   | Reset Fault                    | only effective with errors  |
| 8   | Jogging (on/off)               | Operating mode dependent (see table below)  |
| 9   | reserved                       | —   |
| 10  | PZD (enable/inhibit)           | —   |
| 11  | Start homing run (edge)        | Operating mode dependent (see table below)  |
| 12  | Manufacturer-specific          | reset the position  |
| 13  | Manufacturer-specific          | acknowledge warnings  |
| 14  | Manufacturer-specific          | only position opmode: Bit14 = 1: PZD section is interpreted as direct motion block (velocity 32-bit, position 32-bit, motion block type 16-bit Bit14 = 0: PZD section (HSW) is interpreted as motion block number |
| 15  | Manufacturer-specific          | Operating mode dependent, digital speed   |

Depending on the bit combination in the control word, a corresponding control command is defined. The following table shows the bit combinations and also determines the priorities of the individual bits, in case several bits are altered in one telegram cycle.

| Command                               | Bit 13 | Bit 7 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Transitions  |
|---------------------------------------|--------|-------|-------|-------|-------|-------|-------|--------------|
| Shutdown                              | X      | X     | X     | X     | 1     | 1     | 0     | 2, 6, 8      |
| Switch-on                             | X      | X     | X     | X     | 1     | 1     | 1     | 3            |
| Inhibit voltage                       | X      | X     | X     | X     | X     | 0     | X     | 7, 9, 10, 12 |
| Fast stop (amplifier is disabled)     | X      | X     | X     | X     | 0     | 1     | X     | 7, 10,11->12 |
| Fast stop (amplifier remains enabled) | X      | X     | 0     | 1     | 1     | 1     | 1     | 11           |
| Inhibit operation                     | X      | X     | X     | 0     | 1     | 1     | 1     | 5            |
| Enable operation                      | X      | X     | 1     | 1     | 1     | 1     | 1     | 4, 16        |
| Reset error                           | X      | 1     | X     | X     | X     | X     | X     | 15           |
| Acknowledge warnings                  | 1      | X     | X     | X     | X     | X     | X     | -            |

Bits labeled with X are irrelevant.

Opmode-dependent bits in the control word:

| Mode            | Bit 5   | Bit 6  | Bit 8         | Bit 11       |
|-----------------|---|--|---------------|--------------|
| Position        | <b>Motion block:</b><br>The parameter that is set in the motion block is used.<br><b>Setup operation:</b><br>The parameter that is set as a ramp for homing and jogging is used | Start a motion task with every transition edge (toggle bit). | Start jogging | Start homing |
| Digital speed   | Drive brakes, using the preset speed ramp.  | Setpoint enable, start movement                              | reserved      | reserved     |
| Digital current | reserved  | Setpoint enable, start movement                              | reserved      | reserved     |
| Analog speed    | reserved  | reserved   | reserved      | reserved     |
| Analog current  | reserved  | reserved   | reserved      | reserved     |
| Trajectory      | reserved  | reserved   | reserved      | reserved     |

Priority of the Bits 6, 8, 11 in position-control mode: 6 (high), 11, 8 (low).

### 5.1.2 Status word (ZSW)

With the help of the status word, the amplifier state can be represented and a transmitted control word can be verified.

If the amplifier does not react to changes of the control word (STW) as expected, the marginal conditions like (enable of the output stage – hardware + software, application of the DC bus link voltage) must be checked.

The bits in the status word can be **mode-dependent** or **mode-independent**.

The following table describes the bit assignment in the status word.

| Bit | Name                               | Commentary   |
|-----|------------------------------------|--|
| 0   | Ready for switch-on                | ---  |
| 1   | Switched on                        | ---  |
| 2   | Operation enabled                  | ---  |
| 3   | Error                              | see ASCII command ERRCODE                                  |
| 4   | Voltage inhibited                  | ---  |
| 5   | Fast stop                          | ---  |
| 6   | Switch-on inhibit                  | ---  |
| 7   | Warning                            | see ASCII command STATCODE                                 |
| 8   | Setpoint / actual value monitoring | only in position-control opmode: following error indicator |
| 9   | Remote                             | not supported, fixed to 1                                  |
| 10  | Setpoint reached                   | only in position mode: In Position                         |
| 11  | Limit active                       | not supported at present                                   |
| 12  | Depends on mode                    | used in ASCII-mode   |
| 13  | Depends on mode                    | used in ASCII-mode   |
| 14  | Manufacturer-specific              | used in ASCII-mode   |
| 15  | Manufacturer-specific              | reserved   |

States of the status machine:

| State                   | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|
| Not ready for switch-on | 0     | X     | X     | 0     | 0     | 0     | 0     |
| Switch-on inhibit       | 1     | X     | X     | 0     | 0     | 0     | 0     |
| Ready for switch-on     | 0     | 1     | X     | 0     | 0     | 0     | 1     |
| Ready for operation     | 0     | 1     | X     | 0     | 0     | 1     | 1     |
| Operation enabled       | 0     | 1     | X     | 0     | 1     | 1     | 1     |
| Error                   | 0     | X     | X     | 1     | X     | X     | X     |
| Error response          | 0     | X     | X     | 1     | 0     | 0     | 0     |
| Fast stop active        | 0     | 0     | X     | 0     | 1     | 1     | 1     |

## 5.2 Operating modes

The selection of a new operating mode is described in detail on p. 23. This procedure must be followed for proper amplifier operation.

### **CAUTION**

**Appropriate precautionary measures against damage caused by faulty presentation of data formats or normalization of the setpoints must be taken by the user.**

The possible operating modes are described below. PROFIBUS operating modes with a positive number (1,2) are defined in the drive profile. Operating modes with a negative number (-1,-2...) are labeled in the drive profile as being manufacturer-specific modes.

5.2.1 Positioning (operating mode 2)

| Direction               | PZD 1 | PZD 2                          | PZD 3                    | PZD 4 | PZD 5                        | PZD 6 |
|-------------------------|-------|--------------------------------|--------------------------|-------|------------------------------|-------|
| Controller to Amplifier | STW   | motion task no. or $v_{cmd}^*$ | -                        | -     | -                            | -     |
| Amplifier to Controller | ZSW   | $n_{act}$ (16-bit)             | actual position (32-bit) |       | manufacturer-specific status | -     |

\*: for jogging/homing

Alternative assignment when STW Bit 14=1 (Direct Motion Task):

| Direction               | PZD 1 | PZD 2                                  | PZD 3                    | PZD 4                      | PZD 5                        | PZD 6             |
|-------------------------|-------|--|--------------------------|----------------------------|------------------------------|-------------------|
| Controller to Amplifier | STW   | direct motion task: $v_{cmd}$ (32-bit) |                          | position setpoint (32-bit) |                              | motion block type |
| Amplifier to Controller | ZSW   | $n_{act}$ (16-bit)                     | actual position (32-bit) |                            | manufacturer-specific status | -                 |

Motion task number

The motion task number of the motion task to be started can lie in the range 1 to 180 (motion tasks in EEPROM) or 192 to 255 (motion tasks in RAM).

Speed Setpoint ( $v_{cmd}$ )

This is just when jogging or homing is selected. PNU 1894 provide the scaling for this value. See chapter 4.2.4.1 for more detail.

Actual speed (16-bit)

The representation of the 16-bit actual speed value is normalized to the parameter for overspeed VOSPD  $n_{act16} = \frac{n_{act}}{VOSPD} \times 2^{15}$

Actual position (32-bit)

The range for the incremental position covers values from  $-2^{31}$  to  $(2^{31}-1)$ , whereby one turn corresponds to  $2^{PRBASE}$  increments. Position is always reported in internal units. Reporting in User Units (SI) is not supported.

Manufacturer-specific status

In the process data, the upper 16 bits of the manufacturer-specific status register (PNU 1002) are made available. The numbering starts again from 0. Details of the status register bits can be found in the table in chapter 4.2.3.3.

Speed setpoint for a direct motion task

The usable range for the speed is not limited by the available data area. It is limited by the maximum achievable speed  $n_{max}$ , which is given by the speed parameter VLIM as the final limit speed for the motor. Maximum speed is derived from the following formula:

$$v_{SI,max} = n_{max} \times \frac{PGEARI}{PGEARO} \times 2^{PRBASE} \text{ or, as an incremental value, from:}$$

$$v_{incr,max} = n_{max} \times 2^{PRBASE} \times \frac{250\mu s}{1sec} = \frac{n_{max}}{4000} \times 2^{PRBASE}, \text{ in each case with } n_{max} \text{ in revs/sec}$$

Position setpoint for a direct motion task

The servo amplifier calculates all position values internally on an incremental basis only, so there are limitations on the usable range of values for distances that are given in SI (user) units. The range for the incremental position covers the values from  $-2^{31}$  to  $(2^{31}-1)$ . The resolution that is determined by the PGEARO (PNU1803) and PGEARI (PNU1802) parameters and the variable PRBASE fix the usable range for position values. The variable PRBASE determines, through the equation  $n = 2^{PRBASE}$ , the number of increments per motor turn. The value of PRBASE can only be 16 or 20. PGEARO contains the number of increments that must be traversed when the distance to be moved is PGEARI. The default values for PGEARO are 1048576 (PRBASE = 20) or 65536 (PRBASE = 16) and correspond to one turn. Number of turns that can be covered : -2048..+2047 for PRBASE=16 and -32768..+32767 for PRBASE=20

The sensibly usable position range is derived as follows:

$$-2^{31} * \frac{PGEARI}{PGEARO} \dots (2^{31} - 1) * \frac{PGEARI}{PGEARO} \quad \text{for } PGEARI \leq PGEARO, \text{ or}$$

$$-2^{31} \dots (2^{31} - 1) \quad \text{for } PGEARI > PGEARO$$

Motion block type

The various types of motion block are described in chapter 4.2.5.3.

### 5.2.2 Digital speed (operating mode 1)

| Direction               | PZD 1 | PZD 2     | PZD 3 | PZD 4                                 | PZD 5                     | PZD 6 |
|-------------------------|-------|-----------|-------|---------------------------------------|---------------------------|-------|
| Controller to Amplifier | STW   | $n_{cmd}$ | -     | -                                     | -                         | -     |
| Amplifier to Controller | ZSW   | $n_{act}$ | -     | incremental actual position<br>32-bit | manuf.-specific<br>status |       |

Alternative assignment of the process data sections with STW Bit 14=1:

| Direction               | PZD 1 | PZD 2              | PZD 3 | PZD 4                                 | PZD 5                     | PZD 6 |
|-------------------------|-------|--------------------|-------|---------------------------------------|---------------------------|-------|
| Controller to Amplifier | STW   | $n_{cmd}$ (32-bit) | -     | -                                     | -                         | -     |
| Amplifier to Controller | ZSW   | $n_{act}$ (32-bit) | -     | incremental actual position<br>32-bit | manuf.-specific<br>status |       |

Alternative assignment of the process data sections with STW Bit 15=1:

| Direction               | PZD 1 | PZD 2     | PZD 3 | PZD 4                                   | PZD 5                     | PZD 6 |
|-------------------------|-------|-----------|-------|---|---------------------------|-------|
| Controller to Amplifier | STW   | $n_{cmd}$ | -     | -                                       | -                         | -     |
| Amplifier to Controller | ZSW   | $n_{act}$ | -     | position (20 bits/turn and 16<br>turns) | manuf.-specific<br>status |       |

#### Actual speed $n_{act}$ (16-bit)

The representation of the 16-bit actual speed value is normalized to the parameter for the overspeed  $VOSPD$   $n_{act16} = \frac{n_{act}}{VOSPD} \times 2^{15}$

#### Actual position (32-bit)

The range for the incremental position covers values from  $-2^{31}$  to  $(2^{31}-1)$ . Here one turn corresponds to  $2^{PRBASE}$  increments. Reporting the information in User Units (SI) is not supported.

#### Manufacturer-specific status

In the process data (PZD5), the upper 16 bits of the manufacturer-specific status register (PNU 1002) are made available. The numbering starts again from 0. The significance of the status register bits can be seen in the table in Chapter 4.2.3.3.

#### Speed setpoint $n_{cmd}$ (16-bit)

The 16-bit speed setpoint is normalized to the parameter for the overspeed  $VOSPD$ .

$$n_{cmd16} = \frac{n_{cmd}}{VOSPD} \times 2^{15}$$

#### Position

The actual position value is an incremental value with a resolution of 24 bits. Her one turn corresponds to  $2^{PRBASE}$  increments. So  $2^{24 - PRBASE}$  turns can be represented.

#### Speed values $n_{act}$ (32-bit)

The digital speed values are converted according to the formula.

$$n_{cmd/act} \text{ (in rpm)} = n_{cmd/act, dig.} \times \frac{60 \times 4000}{32 \times 2^{PRBASE} \times 128}$$

with  $2^{PRBASE}$  = Increments per Motor turn, 60s/min,  
4000 = Number of position controller cycles / sec.

### 5.2.3 Analog speed (operating mode -1)

In this operating mode the control word (STW) can only be used to enable and disable the amplifier.

| Direction               | PZD 1 | PZD 2     | PZD 3 | PZD 4                                 | PZD 5                     | PZD 6 |
|-------------------------|-------|-----------|-------|---------------------------------------|---------------------------|-------|
| Controller to Amplifier | STW   | -         | -     | -                                     | -                         | -     |
| Amplifier to Controller | ZSW   | $n_{act}$ | -     | incremental actual position<br>32-bit | manuf.-specific<br>status |       |

5.2.4 Digital torque (operating mode -2)

| Direction               | PZD 1 | PZD 2     | PZD 3  | PZD 4 | PZD 5                  | PZD 6 |
|-------------------------|-------|-----------|--|-------|------------------------|-------|
| Controller to Amplifier | STW   | $I_{cmd}$ | -  | -     | -                      | -     |
| Amplifier to Controller | ZSW   | $I_{act}$ | incremental actual position (32-bit, value range 24-bit) |       | manuf.-specific status | -     |

**Actual position (32-bit)**

The range for the incremental position covers values from  $-2^{31}$  to  $(2^{31}-1)$ . Here one turn corresponds to  $2^{PRBASE}$  increments.

**Manufacturer-specific status**

In the process data, the upper 16 bits of the manufacturer-specific status register (PNU 1002) are made available. The numbering starts again from 0. The significance of the status register bits can be seen in the table in Chapter 4.2.3.3.

**Digital current values (16-bit)**

The digital current values are converted:  $I[mA] = \frac{\text{digital current setpoint}}{3280} \times DIPEAK [mA]$   
(DIPEAK = amplifier peak current)

5.2.5 Analog torque (operating mode -3)

In this operating mode the control word (STW) can only be used to enable and disable the amplifier.

| Direction               | PZD 1 | PZD 2          | PZD 3  | PZD 4 | PZD 5                  | PZD 6 |
|-------------------------|-------|----------------|--|-------|------------------------|-------|
| Controller to Amplifier | STW   | -              | -  | -     | -                      | -     |
| Amplifier to Controller | ZSW   | $I_{act} = IQ$ | incremental actual position (32-bit, value range 24-bit) |       | manuf.-specific status | -     |

5.2.6 Electronic gearing (operating mode -4)

| Direction               | PZD 1 | PZD 2     | PZD 3                    | PZD 4 | PZD 5         | PZD 6 |
|-------------------------|-------|-----------|--------------------------|-------|---------------|-------|
| Controller to Amplifier | STW   | -         | -                        | -     | -             | -     |
| Amplifier to Controller | ZSW   | $n_{act}$ | actual position (32-bit) |       | manuf. status | -     |

**Actual speed (16-bit)**

The representation of the 16-bit actual speed value is normalized to the parameter for the overspeed VOSPD  $n_{act16} = \frac{n_{act}}{VOSPD} \times 2^{15}$

**Actual position (32-bit)**

The range for the actual position covers values from  $-2^{31}$  to  $(2^{31}-1)$ . Here one turn corresponds to  $2^{PRBASE}$  increments.

**Manufacturer-specific status**

In the process data, the upper 16 bits of the manufacturer-specific status register (PNU 1002) are made available. The numbering starts again from 0. The significance of the status register bits can be seen in the table in Chapter 4.2.3.3.

5.2.7 Trajectory (operating mode -5)

| Direction               | PZD 1 | PZD 2     | PZD 3                                | PZD 4 | PZD 5         | PZD 6 |
|-------------------------|-------|-----------|--------------------------------------|-------|---------------|-------|
| Controller to Amplifier | STW   | -         | -                                    | -     | -             | -     |
| Amplifier to Controller | ZSW   | $n_{act}$ | incremental actual position (32-bit) |       | manuf. status | -     |

**Actual speed (16-bit)**

The representation of the 16-bit actual speed value is normalized to the parameter for the overspeed VOSPD  $n_{act16} = \frac{n_{act}}{VOSPD} \times 2^{15}$

**Actual position (32-bit)**

The range for the actual position covers values from  $-2^{31}$  to  $(2^{31}-1)$ . Here one turn corresponds to  $2^{PRBASE}$  increments.

### 5.2.8 ASCII channel (operating mode -16)

| Direction               | PZD 1 | PZD 2                  | PZD 3 | PZD 4 | PZD 5 | PZD 6 |
|-------------------------|-------|------------------------|-------|-------|-------|-------|
| Controller to Amplifier | STW   | 10 bytes of ASCII-data |       |       |       |       |
| Amplifier to Controller | ZSW   | 10 bytes of ASCII-data |       |       |       |       |

The operating mode "ASCII-channel" is used for parameterizing the servo amplifier.

With this channel, just as with any terminal program, ASCII data can be exchanged with the servo amplifier via the RS232 interface. The control of the communication is performed by handshake bits in the control and status words.

The assignment is as follows:

**Bit 12: Control word**  
Any transition edge on this bit informs the servo amplifier that valid ASCII data are available in its process data input section, i.e. that with effect from this moment valid data must have been entered into the PZD transmission section PZD 2 - PZD 6 by the control system.

**Status word**

The servo amplifier confirms that it has accepted the ASCII data, by a transition edge on this bit.

**Bit 13: Status word**  
The servo amplifier uses a "1" in this bit to signal that the ASCII buffer now contains valid data. A transition edge of Bit 14 in the control word STW can be used to make the servo amplifier write the buffer contents to the PZD reception section of the bus-master.

**Bit 14: Control word**  
Any transition edge on this bit requests the servo amplifier to write the contents of its filled ASCII buffer to the receive process data of the bus master

**Status word**

The servo amplifier uses a transition edge on this bit to signal that the ASCII buffer data have been written to the process data.

**When transmitting ASCII data, you must observe:**

1. Every ASCII command must be terminated by the "CR LF" character sequence.
2. If the ASCII command (with CR LF) is shorter than the 10 characters that are available, then the rest of the telegram must be filled up with bytes with a content 0x00.
3. ASCII commands that are longer than 10 characters must be divided into more than one telegram, whereby a maximum of 30 characters can be sent before the buffer must be read out once.

**When evaluating the responses to the transmitted ASCII command, you must observe:**

1. The ASCII response is always terminated by an "End of Text" (EOT = 0x04) character.
2. Response telegrams can include less than 10 bytes of user data, without the response being concluded. The telegram must then be filled up with bytes with the value 0x00.
3. After reading out the buffer, Bit 13 of the status word is reset to "0", until the buffer is filled again.  
The designation of the end of the ASCII response is in all cases "End of Text".

### 5.2.9 Operating mode after switch-on (operating mode -126)

In this state, it is possible to control the state machine, but motion functions cannot be initiated (see page 23).

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## 6 Appendix

### 6.1 Example telegrams

All examples are valid for all servo amplifiers.

#### 6.1.1 Zero telegram (for initialization)

At the beginning of PROFIBUS communication via the parameter channel and after communication errors, a zero telegram should be sent:

| Byte 1    | 2         | 3         | 4         | 5         | 6         | 7         | 8         |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 0000 0000 | 0000 0000 | 0000 0000 | 0000 0000 | 0000 0000 | 0000 0000 | 0000 0000 | 0000 0000 |
| PKE       |           | IND       |           | PWE       |           |           |           |

The servo amplifier answers, by likewise setting the first 8 byte of the telegram (PKW) to zero.

#### 6.1.2 Setting the Opmode

After switch-on or a reset (coldstart) the servo amplifier is in the PROFIBUS operating mode -126, in which it cannot perform any motion functions. For example to carry out positioning operations (motion tasks, jogging, homing), it must be set to the position-control mode.

The procedure to do this is as follows:

- a) Set the control word Bit 10 (PZD1, Bit 10) to 0.  
This invalidates the process data for the servo amplifier.

| Byte 9    | 10        | 11        | 12        |
|-----------|-----------|-----------|-----------|
| xxxx x0xx | xxxx xxxx | xxxx xxxx | xxxx xxxx |
| STW       |           | HSW       |           |

- b) Transmit PNU 930 through the parameter channel to set the operating mode.

| Byte 1    | 2         | 3         | 4         | 5         | 6         | 7         | 8         |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 0011 0011 | 1010 0010 | xxxx xxxx | xxxx xxxx | 0000 0000 | 0000 0000 | 0000 0000 | 0000 0010 |
| PKE       |           | IND       |           | PWE       |           |           |           |

The bits in the PKE section of the PKW have the following significance:

Bit 0 to 10 = PNU 930, Bit 12 to 15 = AK 3 (see also Chapter 3.1.1)

The servo amplifier sends a response telegram with AK = 2 and mirrors (identical) the values for the PNU (parameter number) and PWE (parameter value).

- c) Switch on the new operating mode by setting the control word (STW) Bit 10 to 1.  
This validates the process data.

If, for example, point a) is not observed, the servo amplifier transmits a negative answer: (response ID=7)

| Byte 1    | 2         | 3         | 4         | 5         | 6         | 7         | 8         |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 0111 0011 | 1010 0010 | 0000 0000 | 0000 0000 | 0000 0000 | 0000 0000 | 0000 0000 | 0001 0001 |
| PKE       |           | IND       |           | PWE       |           |           |           |

And the number that is transferred in the PWE section represents the error number, and can be looked up in the table in Chapter 3.1.1.2. In this case, error no. 17, "Task impossible because of operating state" will be signaled.

### 6.1.3 Enable the servo amplifier

The hardware enable signal (24V) must be applied, as a precondition for enabling the servo amplifier via the PROFIBUS. The enable through PROFIBUS can be made by setting the bit combination for the "Operation enabled" state in the control word (STW).

| Byte 9    | 10        | 11        | 12        |
|-----------|-----------|-----------|-----------|
| xxx0 x1xx | 0011 1111 | xxxx xxxx | xxxx xxxx |
| STW       |           | HSW       |           |

The servo amplifier then reports back the corresponding state in its status word (ZSW), or indicates a warning or error message.

| Byte 9    | 10        | 11        | 12        |
|-----------|-----------|-----------|-----------|
| xxxx xx1x | 0010 0111 | xxxx xxxx | xxxx xxxx |
| ZSW       |           | HSW       |           |

### 6.1.4 Start jog mode (on positioning opmode)

Jog mode is started in a similar manner to homing. To start, Bit 8 STW must be set. The jog velocity is given by the product of the 16-bit main setpoint in PZD2 and the multiplier defined by PNU 1894. The sign of the main setpoint determines the direction of movement.

It is not necessary to have a reference point set for jogging.

### 6.1.5 Set reference point



**Take care that the position of the reference point permits the following positioning operations. The parameterized software limit-switches in the servo amplifier may not be effective. The axis could then drive up to the hardware limit-switch or the mechanical stop. There is a danger of damage being caused.**

The control word (STW) Bit 12 = 1 defines the present position as being the reference point. The positioning functions are enabled. **The shifting of the zero point (NI-offset) is ineffective.** The replay "Reference point set" is made through Bit 17 in the manufacturer-specific status register (PNU 1002) or Bit 1 (manufacturer status of the process data).

**Conditions:**

PNU930 ≠ -16

No motion function active    manufacturer specific status, process data 5 bit 0

### 6.1.6 Start homing run

**⚠ CAUTION**

After switching on the 24V auxiliary voltage the system must first of all carry out a homing run.

Take care that the position of the machine zero point (reference point) permits the following positioning operations. The parameterized software limit-switches in the servo amplifier may not be effective. The axis could then drive up to the hardware limit-switch or the mechanical stop. There is a danger of damage being caused.

If the reference point (machine zero point) is approached too fast, with high moments of inertia in the system, then it might be overrun, and the axis could then drive up to the hardware limit-switch or the mechanical stop. There is a danger of damage being caused.

The homing run is started by the control word (STW) Bit 11 = 1. The start of the homing run is detected by a positive transition edge for Bit 11.

If Bit 11 is set to 0 again, before the reference point has been reached, then the homing run is canceled. Status word (ZSW) Bit 17 remains at 0 (reference point not set).

A set reference point is a precondition for all the positioning functions of the linear axis.

The reference point switch is wired up to a digital input on the servo amplifier.

Depending on the type of homing run, you can freely shift the zero crossing point of the motor shaft within one turn, by using the parameter "Zero-point offset" (NI-offset). Furthermore, you can fix the position value to be the reference point by using the reference offset.

After the homing run, the amplifier signals "InPosition", thereby enabling the position controller.

The velocity for the homing run is transmitted with the setpoint HSW (PZD 2), as a 16-bit value.

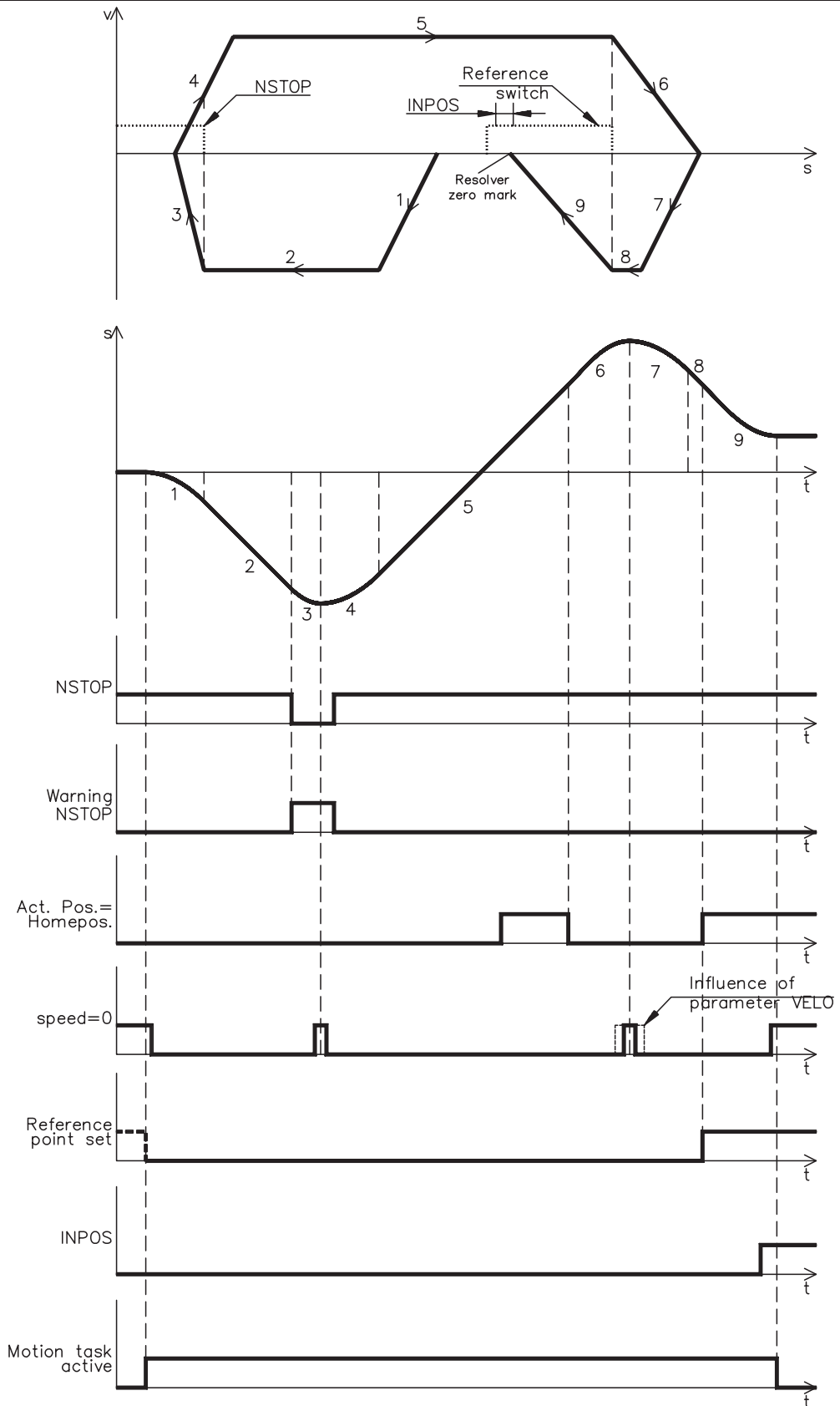
Multiplying this by the value of PNU 1894 determines the 32-bit speed. The sign is not evaluated.

**Conditions :**

State of the state machine = "Operation enabled"

No warning message (ZSW Bit 7 = 0)

The following diagram uses the homing run Type 1 (negative direction of motion, positive rotation, starting point in negative direction relative to the reference switch) as an example to illustrate the signal sequence of the relevant bits in the manufacturer-specific state.



After the homing run has been completed, Bit 11 STW must be set to 0 again.

Alternatively, the reference point can also be set at the actual position.

This can be achieved by setting Bit 12 STW, or by setting the homing run type 0 with PNU 1773 and subsequent start of the homing run by Bit 11 STW .

### 6.1.7 Start a motion task

Motion tasks are started by a transition edge (positive or negative) at Bit 6 STW. Bit 14 STW is used to decide whether a stored motion task or a direct motion task should be carried out.

Conditions:

- Hardware enable is present.
- Amplifier is in the "Operation enabled" state.
- For linear axis: reference point is set.

Example: start the EEPROM motion task number 10:

| Byte 9    | 10         | 11        | 12        |
|-----------|------------|-----------|-----------|
| 0000 0100 | 0F*11 1111 | 0000 0000 | 0000 1010 |
| STW       |            | HSW       |           |

\* F stands for a transition edge, the state of Bit 6 STW also depends on the previous state.

By setting bit 5 in the manufacturer-specific status, the amplifier indicates that it has accepted the motion task and is carrying it out.

### 6.1.8 Start a direct motion task

If the motion task data is to be directly sent from the controller, then a direct motion task must be used. In this case, the target position, velocity and type of motion task are transferred using the process data channel (PZD), together with the call of the motion task. If required, further parameters for this motion task (e.g. ramps) can be transferred previously by parameter tasks.

|                  |  |
|------------------|--|
| Target position  | 135000 $\mu\text{m}$   |
| Velocity         | 20000 $\frac{\text{mm}}{\text{s}}$   |
| Motion task type | <ul style="list-style-type: none"> <li>- relative to actual position</li> <li>- with following motion task</li> <li>- without pause</li> <li>- target velocity for the following task should already be reached at the target position (only makes sense if there is no change of direction)</li> <li>- use SI (user) units</li> </ul> |

| Byte 1    | 2          | 3                 | 4         | 5         | 6         |
|-----------|------------|-------------------|-----------|-----------|-----------|
| 0100 0100 | 0F*11 1111 | 0000 0000         | 0000 0000 | 0100 1110 | 0010 0000 |
| PZD1      |            | PZD2              |           | PZD3      |           |
| STW       |            | velocity setpoint |           |           |           |

| Byte 7            | 8         | 9         | 10        | 11               | 12        |
|-------------------|-----------|-----------|-----------|------------------|-----------|
| 0000 0000         | 0000 0010 | 0000 1111 | 0101 1000 | 0010 0001        | 0001 1101 |
| PZD4              |           | PZD5      |           | PZD6             |           |
| position setpoint |           |           |           | motion task type |           |

\* F stands for a transition edge, the state of Bit 6 STW also depends on the previous state.

### 6.1.9 Polling a warning or error message

If a warning or error message is present, then parameter 1001 or 1002 can be interrogated to find out the number of the warning or error.

### 6.1.10 Writing a parameter (via parameter channel PKW)

Parameter v\_max is used as an example to show how control parameters are transmitted from the master to the servo amplifier.

Parameter number:       **1816**                               111 0001 1000  
 Parameter value:       **350000** µm/s               0000 0000 0000 0101 0101 0111 0011 0000

| Byte 1    | 2         | 3         | 4         | 5         | 6         | 7         | 8         |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 0011 0111 | 0001 1000 | 0000 0100 | 0000 0000 | 0000 0000 | 0000 0101 | 0101 0111 | 0011 0000 |
| PKE       |           | IND       |           | PWE       |           |           |           |

Note: after an error has occurred in parameter transmission (AK = 7), a "Zero telegram" should be transmitted, i.e. the first 8 bytes of the transmit telegram from the PLC should be kept at 0, until the servo amplifier has responded with a zero telegram.

### 6.1.11 Reading actual values

#### Cyclical actual value request

This PKW task switches on the reading of an actual value. The actual value will now be transmitted with each cyclical telegram – until a new PKW task is presented.

**Telegram layout:**

|                | Request                               | Response       |
|----------------|---------------------------------------|----------------|
| <b>PKE/AK</b>  | 1                                     | 2              |
| <b>PKE/PNU</b> | Parameter number of the actual values | as transmitted |
| <b>IND</b>     | 0 = read                              | 0              |
| <b>PWE</b>     | no significance                       | actual value   |

### 6.1.12 Write a parameter via the ASCII channel

The KP value for the current controller is to be set through the ASCII channel. The command is then `MLGQ_1.985`. Here the understroke stands for a space. Since every telegram only has 10 positions available for the transmission of ASCII characters, the termination of the line ("CR LF") must be transmitted in a second telegram.

Conditions:

ASCII mode is switched on (PNU 930 = -16)

Bit 13 STW = 0 (if necessary, toggle Bit 14 STW until Bit 13 ZSW = 0)

Procedure:

1. Write data to PZD 2..6 and invert Bit 12 STW

| Byte 1    | 2         | 3         | 4         | 5         | 6         |
|-----------|-----------|-----------|-----------|-----------|-----------|
| 0001 0000 | 0000 0000 | 0100 1101 | 0100 1100 | 0100 0111 | 0101 0001 |
| PZD1      |           | PZD2      |           | PZD3      |           |
| STW       |           | "M"       | "L"       | "G"       | "Q"       |

| Byte 7    | 8         | 9         | 10        | 11        | 12        |
|-----------|-----------|-----------|-----------|-----------|-----------|
| 0010 0000 | 0011 0001 | 0010 1110 | 0011 1001 | 0011 1000 | 0011 0101 |
| PZD4      |           | PZD5      |           | PZD6      |           |
| "_"       | "1"       | "."       | "9"       | "8"       | "5"       |

2. Wait for the transition edge on Bit 12 ZSW
3. Continue writing data to PZD 2..6 and invert Bit 12 STW

| Byte 1    | 2         | 3         | 4         | 5..12     |
|-----------|-----------|-----------|-----------|-----------|
| 0000 0000 | 0000 0000 | 0000 1101 | 0000 1010 | 0000 0000 |
| PZD1      |           | PZD2      |           | PZD3..6   |
| STW       |           | "CR"      | "LF"      |           |

4. Wait for the transition edge on Bit 12 ZSW
5. Wait until Bit 13 ZSW = 1
6. Invert Bit 14 STW
7. Wait until Bit 14 ZSW = 1
8. The servo amplifier sends a response telegram

| Byte 1    | 2         | 3         | 4         | 5         | 6         |
|-----------|-----------|-----------|-----------|-----------|-----------|
| 0110 0010 | 0000 0000 | 0100 1101 | 0100 1100 | 0100 0111 | 0101 0001 |
| PZD1      |           | PZD2      |           | PZD3      |           |
| ZSW       |           | "M"       | "L"       | "G"       | "Q"       |

| Byte 7    | 8         | 9         | 10        | 11        | 12        |
|-----------|-----------|-----------|-----------|-----------|-----------|
| 0010 0000 | 0011 0001 | 0010 1110 | 0011 1001 | 0011 1000 | 0011 0101 |
| PZD4      |           | PZD5      |           | PZD6      |           |
| "_"       | "1"       | "."       | "9"       | "8"       | "5"       |

9. Repeat steps 5 to 8 until a response telegram indicates "EOT".

| Byte 1    | 2         | 3         | 4         | 5         | 6         | 7..12     |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 0000 0010 | 0000 0000 | 0000 1101 | 0000 1010 | 0000 0100 | 0000 0000 | 0000 0000 |
| PZD1      |           | PZD2      |           | PZD3      |           | PZD4..6   |
| ZSW       |           | "CR"      | "LF"      | "EOT"     |           |           |

Note: The sequence of response telegrams shown above is only one of many possibilities (for the same response from the servo amplifier). Because of the transmission rate and the internal synchronization mechanism, it can happen that process data sections remain empty and so the response is broken into segments. This could possibly alter the number of response telegrams.

## 6.2 Index

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