MD-025-PB-CXXX

encoTRive PROFIBUS Handbuch / *Manual*

Dezentrale Stellantriebe / *Decentralized positioning drives*
MD-025-PB-CXXX Series with Profibus-DP interface

- Zusätzliche Sicherheitshinweise
- PROFIBUS-Kommunikation
- Konfiguration / Parametrierung
- Diagnose

- *Additional safety instructions*
- *PROFIBUS communication*
- *Configuration / Parameterization*
- *Diagnosis*

TR - EMO - BA - DGB - 0016 - 01 / 02/28/2008

User Manual

Decentralized positioning drives MD-025-PB-CXXX

TR-Electronic GmbH
D-78647 Trossingen
Eglishalde 6
Tel.: (0049) 07425/228-0
Fax: (0049) 07425/228-33
E-mail: info@tr-electronic.de
http://www.tr-electronic.de

Copyright protection

Subject to amendments

Any technical changes that serve the purpose of technical progress, reserved.

Document information

Release date/Rev. date:	02/28/2008
Document rev. no.:	TR - EMO - BA - DGB - 0016 - 01
File name:	TR-EMO-BA-DGB-0016-01.DOC
Author:	MÜJ

Font styles

Italic or **bold** font styles are used for the title of a document or are used for highlighting.

`Courier` font displays text, which is visible on the display or screen and software menu selections.

″ < > ″ indicates keys on your computer keyboard (such as <RETURN>).

Trademarks

PROFIBUS-DP and the PROFIBUS logo are registered trademarks of PROFIBUS Nutzerorganisation e.V. (PNO) [PROFIBUS User Organization]

CoDeSys is a registered trademark of 3S – Smart Software Solutions GmbH

encoTRive is a registered trademark of TR-Electronic GmbH

Contents

List of tables

List of figures

Revision index

Revision	Date	Index
First release	01/08/08	00
Modification parameter “PNU 804”	02/28/08	01

1 General information

This encoTRive PROFIBUS manual includes the following topics:

- Safety instructions in additional to the basic safety instructions defined in the project engineering Instructions
- PROFIdrive drive profile
- PROFIBUS communication
- Configuration / Parameterization
- Troubleshooting and diagnosis options

As the documentation is made up in a modular manner, this encoTRive PROFIBUS manual constitutes an addition to other documentation such as customer-specific user manuals, assembly/installation instructions, dimension drawings, brochures etc.

The encoTRive PROFIBUS Manual may be included in the customer's specific delivery package or it may be requested separately.

1.1 Target group

This documentation is directed towards

- commissioning, operating and maintenance personnel, who are tasked with carrying out such activities on the MD-025-PB positioning drive.

The respective qualifications of the personnel are defined in the assembly/installation manual in the chapter entitled "Choice and qualifications of personnel; basic obligations".

1.2 Applicability

The encoTRive PROFIBUS manual applies exclusively to the following types of decentralized positioning drive with ***PROFIBUS-DP*** interface:

- MD-025-PB-CXXX

The products are labeled with affixed nameplates and are components of a system.

The following documentation therefore also applies:

- operator's operating instructions specific to the system,
- this encoTRive PROFIBUS manual,
- the project engineering manual **TR-EMO-BA-DGB-0015**,
- the customer-specific user manual (optional),
- commissioning instructions for CoDeSys/PLCopen/Function modules/Hand-held unit (optional)

1.3 Abbreviations used / Terminology

A	Ampere
ASCII	American Standard Code for Information Interchange
CCD	Command Code
CPU	Central Processing Unit
DIP switch	Dual in-line package switch
DPM1	DP master Class 1 (central automation device)
DPM2	DP master Class 2 (programming, configuring device)
DS	Draft Standard
DSP	Draft Standard Proposal
encoTRive	TR-specific term for the drive
FMS	Fieldbus Message Specification
GSD	Device Data File (device description, input for a bus configuring tool)
HW	Hardware
inc	Increments
mA	Milliampere
mm	Millimeter
mNm	Millinewton meter
mV	Millivolt
Nm	Newton meter
OD	object directory
PC	Personal computer
PI	Proportional-Integral
PID	Proportional-Integral-Derivative
PKW	Parameter ID/Parameter value
PNU	Parameter number
Pxyz	Parameter xyz, e.g. P913 : Parameter 913
PZD	Process data; is transmitted cyclically
ro	read only
rph	Revolutions per hour
rpm	Revolutions per minute
rps	Revolutions per second
RR	Register control
RTR	Remote Transmission Request
rw	read/write
sec	Second
STW	Control word
STW.x	Bit x of the control word
PLC	Programmable Logic Controller
SW	Software
V	Volt
ZSW	Status word
ZSW.x	Bit x of the status word

2 Additional safety instructions

2.1 Definition of symbols and instructions

 ***WARNING !***	means that death, serious injury or major damage to property could occur if the required precautions are not met.
 ***CAUTION !***	means that minor injuries or damage to property can occur if the stated precautions are not met.
	indicates important information or features and application tips for the product used.

2.2 Organizational measures

- This encoTRive PROFIBUS manual must always be kept accessible at the place of operation of the encoTRive.
- Prior to commencing work, personnel working with the encoTRive must
  - have read and understood the assembly/commissioning manual, in particular the chapter entitled ***"Basic safety instructions"***,
  - and this encoTRive PROFIBUS manual, in particular the chapter entitled "Additional safety instructions"

  This particularly applies for personnel who are only deployed occasionally, e.g. in the parameterization of the encoTRive.

3 PROFIdrive drive profile

The linguistic devices for controlling the drive are extensively independent of the manufacturer. For this reason, communication between the drive and the superimposed control system has been standardized in so-called ***drive profiles***.

A ***drive profile*** specifies how an electrical drive is controlled via a field bus. It defines the behavior of the device and the method of accessing the drive data. The following sub areas in particular are controlled:

- Control and status monitoring
- Standardized parameterization
- Changing operating modes

The profile for electrical drives on PROFIBUS is called ***PROFIDrive*** (PNO [2002b]).

As a PROFIBUS node, encoTRive supports the PROFIDrive 3.0 profile (PNO [2000]).

The profile divides drives into different application classes.
The encoTRive is assigned to application class 3 (positioning drive).

The following information is typically exchanged between a master (e.g. control system) and a drive, which assumes a “slave” function:

The drive provides information on its current status (e.g. “*Drive running”*) and possibly additional information such as the current position, current speed etc. In the other direction, the control system assigns positioning orders, for example, (“*Move at speed x to position y”*). Without profiles such as PROFIDrive, every manufacturer would have to specify his own protocol for transmitting commands and status messages, and there would be a corresponding number of applications, which always perform the same task in their own different ways.

3.1 The object directory

A basic feature of drive profiles is the ***object directory*** (***OV***). All the information (parameters) relevant to a device is brought together in the object directory. A parameter is identified by its **parameter number** (16 Bit). Certain ranges of parameter numbers are occupied or reserved; others are available for so-called manufacturer-specific parameters.
Included in the pre-defined parameters are optional parameters and those, which must be supported by every slave that conforms to the profile (“mandatory parameters”).

3.2 PROFIDRIVE object directory

PROFIDrive uses decimal notation for the parameter numbers. Parameter numbers 900 to 999 and 60000 to 65535 are defined and reserved as profile-specific ranges. Parameter numbers outside these two ranges are manufacturer-specific.

3.3 State machine, status and control word

The state machine is a central element in the drive profile. This is where the operating states and the state transitions are defined. The states that the device goes through after switch-on and how it is transferred into the “ready” state are defined so that a positioning movement, for example, can be carried out.
Most state transitions are initiated sequentially by the master transmitting certain commands in the control word in the form of bit patterns.

4 PROFIBUS communication

All signals and information that are required for controlling the electrical drive are transmitted via the field bus.

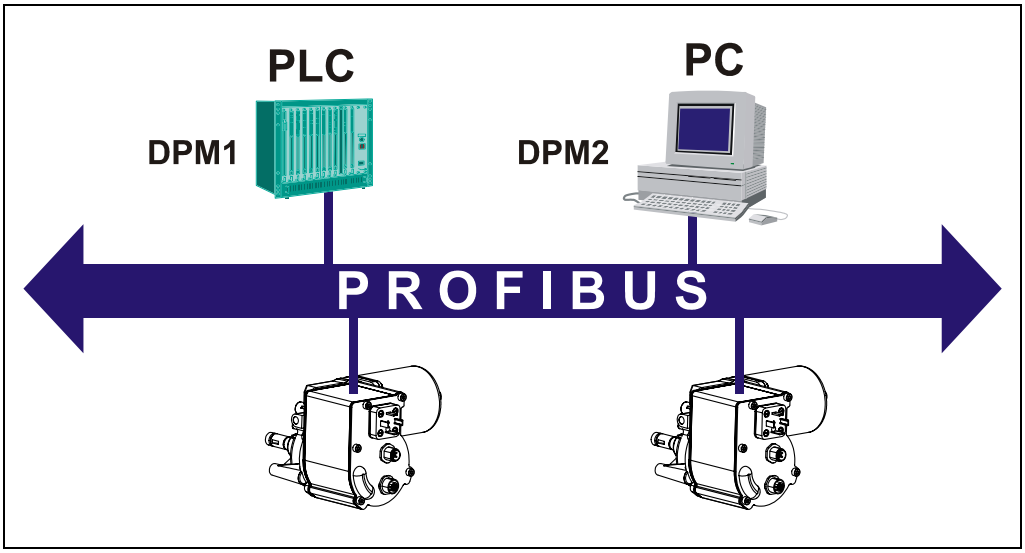


Figure 1: Drives on the field bus

4.1 Cyclical data traffic, data required

The object directory contains all parameters, which are relevant to a drive. These include parameters, which do not change during the whole running period (e.g. serial number of the device, software version).
Other parameters (e.g. speed, acceleration, deceleration) are changed rather infrequently.
Finally, some parameters are always required to be as up-to-date as possible, the so-called ***process data*** (PZD). As a general rule, these always include the ***control word*** (***STW***)***, the status word*** (***ZSW***), and often the current position value and the target position.

4.2 PROFIBUS-DP

encoTRive is incorporated into a PROFIBUS-DP network as a ***slave***. A slave may only receive and acknowledge messages, and respond to inquiries from a master. It communicates with a ***master***, which is also referred to as an ***active bus node***. There are two types of master:

- **DP master Class 1 (DPM1):** This exchanges information with the decentralized stations (slaves) in fixed message cycles. As a rule, a DPM1 is a programmable logic controller (PLC) or a PC. The DPM1 reads the inputs of the field devices and writes the outputs (setpoints) of the actuators at fixed intervals.

- **DP master Class 2 (DPM2):** These are engineering, development and control units. A DPM2 does not have to be continuously connected to the bus. Like the DPM1, it actively accesses the bus.

Communication between a DPM1 and PROFIBUS DP slave runs **cyclically**: The master transmits output data for the slave at regular intervals, and the slave transmits its input data to the master in a reply telegram.
The telegrams used have the same structure throughout the whole of the run time.
This type of communication is suitable for information, which has to be continuously updated, the so-called process data (PZD).

To reserve a fixed space in the telegram for parameters, which are only changed infrequently, would be inefficient. This lengthens the telegram unnecessarily and thus increases the transmission time. For this reason, the DP-V1 power stage of PROFIBUS-DP provides ***acyclic services*** for reading and writing. With these services, parameters can be interrogated or written as required. In doing so, parameters are accessed using special linguistic devices (***DPV1***). With this approach, only that information, which must be continuously up-to-date, is transmitted cyclically, and the on-demand data are transmitted acyclically in the form of a DPV1 request and a DPV1 response.

A DPM1 can use cyclic and acyclic services. Acyclic data transmission takes place using a dedicated connection, which is set up by the DPM1. This can only be used by the master, which has also parameterized and configured the slave.

A DPM2 uses exclusively acyclic services. To do so, it sets up a connection to the appropriate slave. A slave can support several active connections of this kind at the same time.

Unfortunately, the DPV1 services are not yet in very wide use – although they have been specified for some years. For this reason, the current version of PROFIDrive (PNO [2002b]) also still allows access to on-demand data as part of the normal cyclic data exchange. For this purpose, 8 transmission bytes are reserved in each case for a ***parameter channel*** in both directions of transmission. The master transmits information on this ***PKW channel*** (***Parameter Identification Value***) for selecting a parameter (parameter number, subindex), on the type of access (read/write) and, if necessary, the parameter value. After processing the order, the slave formulates its response. If processing in the slave takes a long time, then "*no response"* is signaled in the PKW part of the slave reply in the meantime.

By this means, all parameters can be accessed as part of the cyclic data traffic.

encoTRive supports parameter access by means of the PKW channel and by means of the acyclic DPV1 services.

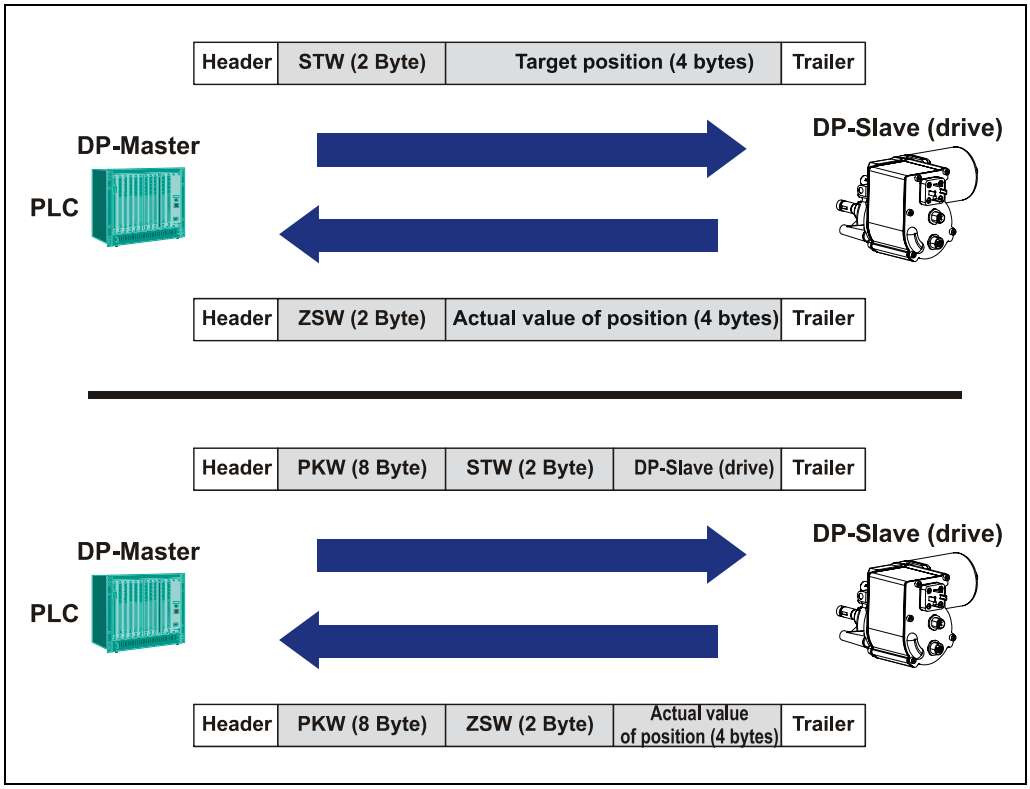


Figure 2: Cyclic communication with PKW channel (bottom) and without (top)

Figure 2 shows the telegrams, which are exchanged between DPM1 and slave as part of the cyclic data traffic. At the same time, the control word and target position are transmitted from the DPM1 to the slave as process data, and, in the opposite direction, the status word and the position value.

4.2.1 encoTRive as PROFIBUS-DP slave

4.2.1.1 Transmission speed / Baud rate

encoTRive automatically detects the Baud rate set on PROFIBUS-DP when it is switched on. This is defined by the master to be the same for all devices when PROFIBUS-DP is commissioned. All common Baud rates are supported.

4.2.1.2 Slave address / PROFIBUS node address

The PROFIBUS node address uniquely identifies each device on the PROFIBUS.

In the case of the encoTRive, the PROFIBUS node address is permanently set in the device by hardware means. This can be read via the software from Parameter 918. The set-up options can be seen from the device-specific plug assignment.

4.2.1.3 Start-up: Parameterization, Configuration

A DP slave must be parameterized and configured before cyclic data exchange begins between a DPM1 and the slaves assigned to it. After switching on, the slave goes into the **`WAIT_PRM`** state (*Wait for parameterization*). The master sends a parameterizing telegram to the slave. After the slave has confirmed receipt of the parameterizing telegram, the slave goes into the **`WAIT_CFG`** state (*Wait for configuration*). The master now sends the configuration telegram to the slave, which defines the length and structure of the telegrams to be transmitted cyclically.

4.2.1.3.1 Parameterizing telegram (`Chk_Prm`)

Amongst other things, the parameterizing telegram contains the following information about the slave:

- Ident number of the slave
- Activation monitor (watchdog)
- Group association
- Minimum response time of the slave
- Protocols supported (FMS and/or DP)
- Baud rates supported

This information is contained in the first 7 bytes of the parameterizing telegram.

The user-specific data in the parameterizing telegram must be 3 bytes long. Its content (bytes 8,9,10) must be 0x80,0x00,0x00.

A configuration tool generally takes the above information from the GSD (Device Data File).

4.2.1.3.2 Configuration telegram (`Chk_Cfg`)

The configuration telegram defines the structure of the cyclic telegrams. Input and output ranges are combined in groups and each described by an ***Identifier Byte***. This can be used in ***simple format*** or in ***special format***. These formats differ with regard to bits 4 and 5. If both bits are 0, then the format is the special format.

encoTRive uses only the simple format.

Table 1: Identifier Byte

Bit	Description	Values
Bit7	Consistency over	0 – Byte or word 1 – Total length
Bit6	Data Unit Size	0 – Byte 1 – Word
Bit5	Input/Output	**0** Special Format **0** Input **1** Output **1** Input/Output
Bit4		**0** Special Format **1** Input **0** Output **1** Input/Output
Bit3	Length of the data	0000: 1 Byte or word (depending on Bit6), 0001: 2 bytes or 2 words … 1111: 16 bytes or 16 words
Bit2		
Bit1		
Bit0		

In the configuration data, the outputs come first, then the inputs.

The content of the configuration telegram is determined by the following data:

- Is a PKW channel being used?
- Configuration of process data

The PKW channel is always placed before the process data.

Examples:

1. **No PKW channel,**
   PZD: DPM1 → encoTRive: Control word (16 bit)
   encoTRive → DPM1: Status word (16 bit), Actual value of position (32 bit)
   (cf. Figure 2, Page 83)

   Hence: 2 bytes (1 word) output data, 6 bytes (3 words) input data

   Identifier byte output data: `0xE0 (1110 0000 bin)`
   Bit 7 = 1, i.e. consistency over the whole length)
   Bit 6 = 1, i.e. counting in words
   Bit 5 = 1, Bit 4 = 0, i.e. output
   Bit 3 = Bit 2 = Bit 1 = Bit 0 = 0, i.e. 1 word.

   Identifier byte input data: `0xD2 (1101 0010 bin)`
   Bit 7 = 1, i.e. consistency over the whole length)
   Bit 6 = 1, i.e. counting in words
   Bit 5 = 0, Bit 4 = 1, i.e. input
   Bit 3 = 0, Bit 2 = 0, Bit 1 = 1, Bit 0 = 0, i.e. 3 words.

   Configuration data overall: `0xE0, 0xD2`

2. **PKW channel, PZD: as in 1.** (cf. Figure 2, Page 83)

   The PKW channel can be construed to be a module with 4 words each of input and output data.
   Identifier byte for PKW channel: `0xF3 (1111 0011 bin)`
   Bit 7 = 1, i.e. consistency over the whole length)
   Bit 6 = 1, i.e. counting in words
   Bit 5 = 1, Bit 4 = 1, i.e. output/input
   Bit 3 = 0, Bit 2 = 0, Bit 1 = 1, Bit 0 = 1, i.e. 4 words.

   Configuration data overall: `0xF3, 0xE0, 0xD2`

3. **PKW channel.**
   PZD: Output data: Control word (16 bit) and target position (32 bit)
   Input data: Status word (16 bit) and actual position (32 bit).

   In this case, there are 3 words in the PZD in both directions of transmission, and the PZD – like the PKW channel – can be described by an identifier byte:

   Identifier byte PZD: 0xF2 `(1111 0010 bin)`
   Bit 7 = 1, i.e. consistency over the whole length)
   Bit 6 = 1, i.e. counting in words
   Bit 5 = 1, Bit 4 = 1, i.e. output/input
   Bit 3 = 0, Bit 2 = 0, Bit 1 = 1, Bit 0 = 0, i.e. 3 words.

   Configuration data overall: `0xF3, 0xF2`

4.2.2 Configuration of process data

PROFIDrive allows the process data (PZD) to be defined in different ways:

- **Parameter 922**: This parameter ("Telegram selection") enables a choice to be made from a series of pre-defined telegrams. If Parameter 922 has the value 0, then the telegrams can be freely configured in both directions of transmission. In this case, Parameters **915** and **916** define the structure of the PZD.

- **Parameter 915, 916**: These parameters constitute arrays, in which parameter numbers are stored. Parameter 915 is responsible for the transmission direction DPM1 → slave, and Parameter 916 for the opposite direction. The entries are interpreted as far as the first index, which contains the value 0. In doing so, the first entry of Parameter 915 must be the parameter number of the control word (***STW***) and the first entry of Parameter 916 the parameter number of the status word (***ZSW***).

As PROFIDrive does not specify specific parameter numbers for the actual value of position or for the actual value of speed, for example, the association between so-called ***standard signals*** and manufacturer-specific parameters, which can be seen in Table 2, is defined in a special parameter (**923**).
With the encoTRive, this is as follows:

Table 2: Standard signals for encoTRive

Standard signal No.	Significance	encoTRive parameter No.
1	Control word 1	967
2	Status word 1	968
3	Control word 2	400
4	Status word 2	401
5	Speed setpoint	201
6	Actual value of speed	103
21	Input (digital)	803
22	Output (digital)	804
27	Target position	200
28	Actual value of position	100
100	Actual value of current	101
101	Actual value of temperature	102

With Parameter 922, encoTRive supports the following parameter values:

Table 3: Standard telegrams supported (P922)

Value	Telegram configuration	
0	**PZD freely configurable by means of P915 and P916**	**PROFIdrive version 3.0**

Preadjust telegram, when the drive is delivered

Value	Telegram configuration					
0	**Manufacturer specific telegram "TR-Telegram 1: 8/8 PZD"**			**When the command "Load factory settings" is executed, this telegram is active**		
	PZD structure	**Position**	**Parameter-No.**	**Significance**	**Length**	
	DPM1 -> encoTRive	1	P967	Control word	WORD	8 WORDS
		2	P200	Target position	DWORD	
		3	P201	Speed	WORD	
		4	P202	Acceleration	WORD	
		5	P302	Max. continuous current	DWORD	
		6	P804	Digital outputs	WORD	
	encoTRive -> DPM1	1	P968	Status word	WORD	8 WORDS
		2	P100	Actual value of position	DWORD	
		3	P103	Actual speed	WORD	
		4	P101	Actual value of current	DWORD	
		5	P947	Error number	WORD	
		6	P803	Digital inputs	WORD	

Continuation Table 3

Value	Telegram configuration					
7	**Standard telegram 7**			**PROFIdrive version 3.0**		
	PZD structure	**Position**	**Parameter-No.**	**Significance**		**Length**
	DPM1 -> encoTRive	1 2	P967 P400	Control word No. of traveling record	WORD WORD	2 WORDS
	encoTRive -> DPM1	1 2	P968 P401	Status word Current command set	WORD WORD	2 WORDS

Value	Telegram configuration					
8	**Standard telegram 8**			**PROFIdrive version 3.0**		
	PZD structure	**Position**	**Parameter-No.**	**Significance**		**Length**
	DPM1 -> encoTRive	1 2 3 4	P967 P200 P400 P201	Control word Target position No. of traveling record Speed	WORD DWORD WORD WORD	5 WORDS
	encoTRive -> DPM1	1 2 3 4	P968 P100 P401 P103	Status word Actual position Current command set Actual speed	WORD DWORD WORD WORD	5 WORDS

Continuation Table 3

Value	Telegram configuration					
100	**Manufacturer specific telegram 100**			**e.g. necessary for using the S7 function block „control_pzd“**		
	PZD structure	**Position**	**Parameter-No.**	**Significance**	**Length**	
	DPM1 -> encoTRive	1	P967	Control word	WORD	13 WORDS
		2	P200	Target position	DWORD	
		3	P201	Speed	WORD	
		4	P202	Acceleration	WORD	
		5	P203	Deceleration	WORD	
		6	P302	Max. continuous current	DWORD	
		7	P400	No. of traveling record	WORD	
		8	P804	Digital outputs	WORD	
		9	P930	Operation mode	WORD	
		10	PXXX	not used	DWORD	
	encoTRive -> DPM1	1	P968	Status word	WORD	13 WORDS
		2	P100	Actual value of position	DWORD	
		3	P102	Electronic temperature	DWORD	
		4	P103	Actual speed	WORD	
		5	P101	Actual value of current	DWORD	
		6	P401	Current command set	WORD	
		7	P803	Digital inputs	WORD	
		8	P947	Error number	WORD	
		9	P953	Warning number	WORD	
		10	PXXX	not used	WORD	

Example:
Configuration of the process data shown in Figure 2 page 83.
The control word and target position are to be transmitted as process data in the direction DPM1 → encoTRive, and the status word and the actual value of position in the opposite direction.

Content of parameter 922: 0
Content of parameter 915 [15]: 967, 200, 0,…
Content of parameter 916 [15]: 968, 100, 0,…

The remaining elements of the two parameters can be set with capable of PZD parameter numbers, see chapter Manufacturer-specific parameters, page 114.

The length of the telegram which is given by the PZD configuration or the PKW channel must not exceed the lengths specified in the configuration telegram (cf. 4.2.1.3.2).

Sequence of the activation for the new configured telegram:
1. **Save all parameter values remanent: Parameter 971 "Save in flash"**
2. **Execute system cold start (disconnect Power supply from the drive).**

4.2.3 Drive-specific functions

4.2.3.1 General state machine

The state machine defines the internal states, which a PROFIDrive drive can assume, and the events, which lead to the transition between these states. In Figure 3, the states are designated by ***Sax***, and the transitions by ***Tax***. Most states are identified by particular status bits in the status word (***ZSW***). In the Figure, these are described by `ZSW.x = y`. Here, `ZSW.3=1` means: *"Bit 3 of the ZSW is set (value 1)"*. Most status transitions are initiated by bit patterns, which are set in the control word (STW). This is identified in the Figure by `STW.1=0` (*"Set Bit 1 of the STW to 0"*), for example.

`STW.7: 0->1` means that an edge from 0 to 1 must be generated on Bit 7 of the STW.

Other conditions, which give rise to changes of state, are noted after the respective change of state. With certain changes of state, a range of initial states is permissible. So, for example, in practice, it is possible to change from any state into a "fault" state. Such transitions are characterized by the initial states being bounded by a rectangle with a solid circle positioned on its edge. This indicates that the initial state can be any state within the rectangle on the edge of which the solid circle is located.

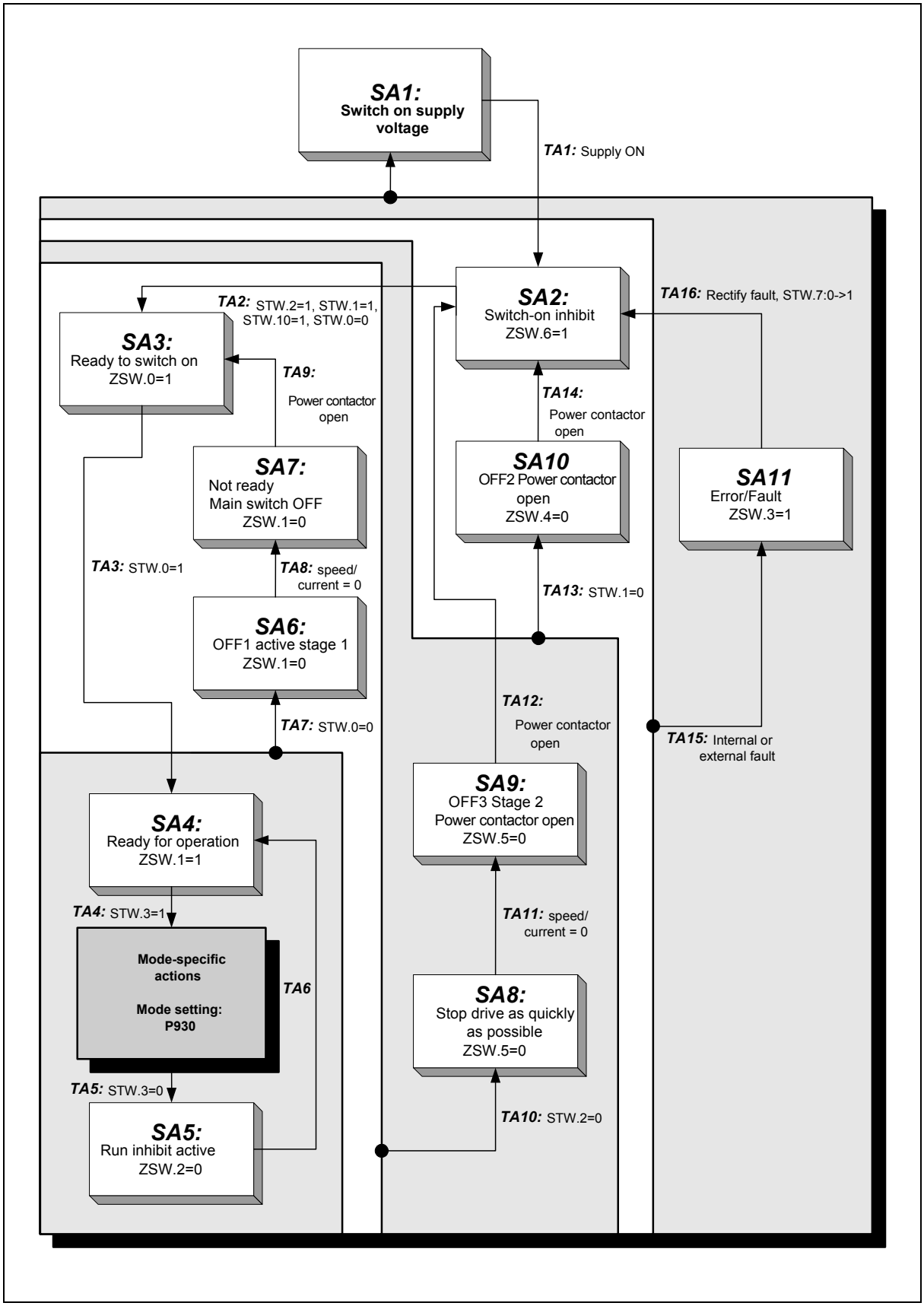


Figure 3: PROFIDrive state machine, general part

Actions, which are dependent on the selected operating mode, can be carried out after state transition **TA4**. The operating mode is set in **Parameter 930**. encoTRive supports the following operating modes:

Table 4: encoTRive operating modes (values for Parameter 930)

Coding	Description
0x0001	Speed control
0x0002	Positioning

4.2.3.2 Control word and status word

The master transmits commands to the drive in the control word. The drive passes back information on its status in the status word.

Table 5: Control word (STW)

Bit	Value	Significance	Description
0	1	ON	Ready for operation. Voltage on converter.
	0	OFF 1	Stop (return to “Ready to switch on” state); decelerate on acceleration ramp
1	1	Operating condition	All “OFF 2” commands are canceled.
	0	OFF 2	Disconnection of voltage
2	1	Operating condition	All “OFF 3” commands are canceled.
	0	OFF 3	Fast stop; if necessary: remove operating inhibit; stop as fast as possible
3	1	Run enable	Enable electronics and pulses
	0	Run inhibit	Drive coasts to a stop and goes to “Ready” state.
4	Specific to operating mode		
5	Specific to operating mode		
6	Specific to operating mode		
7	1	Acknowledge	Fault acknowledged with positive edge (0->1). This is followed by a state transition to “Switch on inhibit” when the fault has been successfully removed.
	0	without significance	
8	1	Jog 1 on	Prerequisite: Run enabled, no positioning operation active.
	0	Jog 1 off	
9	1	Jog 2 on	Prerequisite: Run enabled, no positioning operation active.
	0	Jog 2 off	
10	1	Command by control system	Command undertaken by control system; Process data valid
	0	No command	Process data invalid
11	Specific to operating mode		
12-15		not used	

Table 6: Status word (ZSW)

Bit	Value	Significance	Description
0	1	Ready to switch on	Power supply switched on, electronics initialized. Main contactor de-energized, if applicable, pulses inhibited.
	0	Not ready to switch on	
1	1	Ready for operation	Ready for operation. Voltage on converter.
	0	Not ready	
2	1	Run enabled	Enable electronics and pulses
	0	Run inhibited	
3	1	fault	Fault present. Drive in “Fault” state.
	0	Fault free	
4	1	No OFF 2	
	0	OFF 2	OFF 2 command present.
5	1	No OFF 3	
	0	OFF 3	OFF 3 command present.
6	1	Switch-on inhibit	
	0	No switch-on inhibit	
7	1	Warning	Drive continues to run; Warning present and can be seen from P953. no acknowledgement
	0	no Warning	
8	Specific to operating mode		
9	1	Command required	The control system is requested to take over command
	0	Local operation	Only local control possible
10	Specific to operating mode		
11	Specific to operating mode		
12	Specific to operating mode		
13	Specific to operating mode		
14-15		not used	

4.2.3.3 “Positioning” mode

Positioning operations can be carried out in this mode. Various internal states are assumed (***SC***x). These states and the transitions (***TC***x) between these states are defined in the PROFIDrive profile. The same conventions apply in the following Figure 4 as in the general state machine Figure 3. In positioning mode, state SC1 is assumed after state transition TA4 (cf. Figure 3). State transition TA5 leads to state SA5 from any of the states in Figure 4.

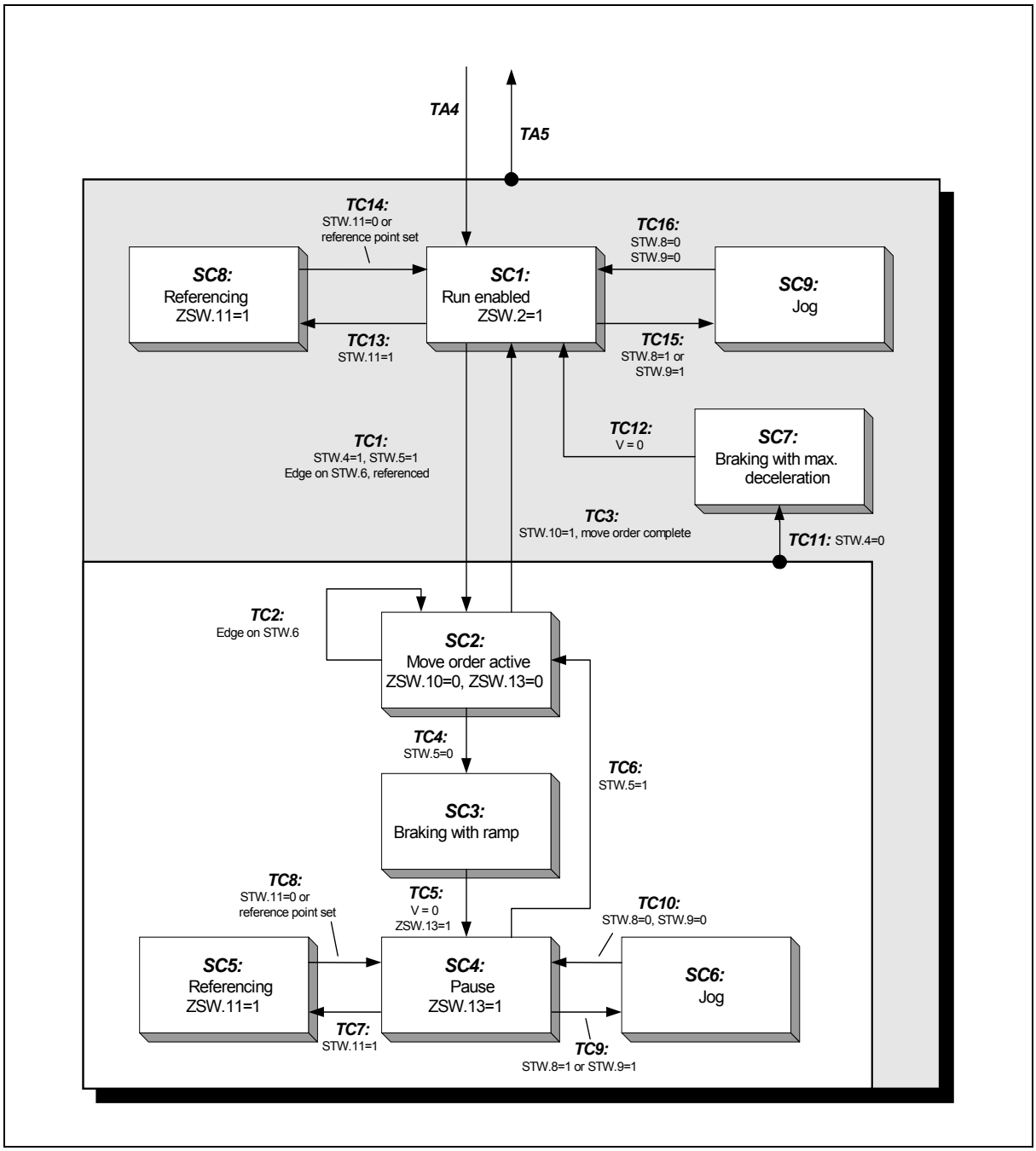


Figure 4: PROFIDrive state machine, positioning mode

Table 7: Control word, positioning

Bit	Value	Significance	Description
4	1	Operating condition	
	0	Reject move order	Drive brakes to rest from an active move order with maximum acceleration. The current move order is rejected.
5	1	Operating condition for positioning	
	0	Pause	Drive brakes to zero speed from an active move order on the ramp, and remains stopped with holding torque. The move order is not rejected. The move order is resumed when Bit 5 changes to 1.
6		Activate move order	Each **edge** enables a move order or a setpoint. A toggle without changed the movement parameter is not allowed.
11	1	Start referencing	Referencing operation started. ZSW.11 is set to 0. Prerequisite: Run enabled.
	0	Stop referencing	A current referencing operation is interrupted. Drive stops on ramp.

Table 8: Status word, positioning

Bit	Value	Significance	Description
8	1	No tracking error	The dynamic comparison of setpoint and actual value lies within the tracking window (P305)
	0	Tracking error	The dynamic comparison of setpoint and actual value lies outside the tracking window (P305)
10	1	Target position reached	The position value is within the positioning window at the end of a move order (P304)
	0	Not in target position	The position value lies outside the positioning window (P304)
11	1	Reference point set	Referencing has been carried out and is valid. ZSW.11 = 1: Response of the referencing procedure and is only active until the system is rebooted (cold starting). The parameter 805 represents the permanently adjusted reference point, see chapter 4.2.6.5.1 Manufacturer-specific parameters.
	0	No reference point set	
12		Acknowledge setpoint	The acceptance of a new move order is acknowledged by an edge (same level as STW.6)
13	1	Drive stopped	Signalizes the completion of a move order, or standstill in the case of pause and stop.
	0	Drive running	Move order is being executed, drive in motion

Referencing

The measuring system must be referenced to the machine datum once during assembly / initial commissioning. As the encoTRive is fitted with an absolute multi-turn encoder, re-referencing is not required following a supply failure or emergency stop.

In states SC1 (Run enabled) and SC4 (Pause), referencing is initiated by setting Bit 11 of the STW. When referencing is complete, the system reverts automatically to the initial state (SC1 or SC4). The value stored in Parameter 3 (Reference point coordinate “P003”) is transferred to the actual value of position.

Positioning

A positioning movement can be carried out in state SC1. A prerequisite for this is that the drive has been referenced. This is signaled by ZSW.11=1.

Positioning is started by an edge on STW.6 (“*Activate move order*”). The positioning movement is carried out on a ***ramp***, which is derived from the current settings for the speed “P201”, acceleration “P202” and deceleration “P203”:

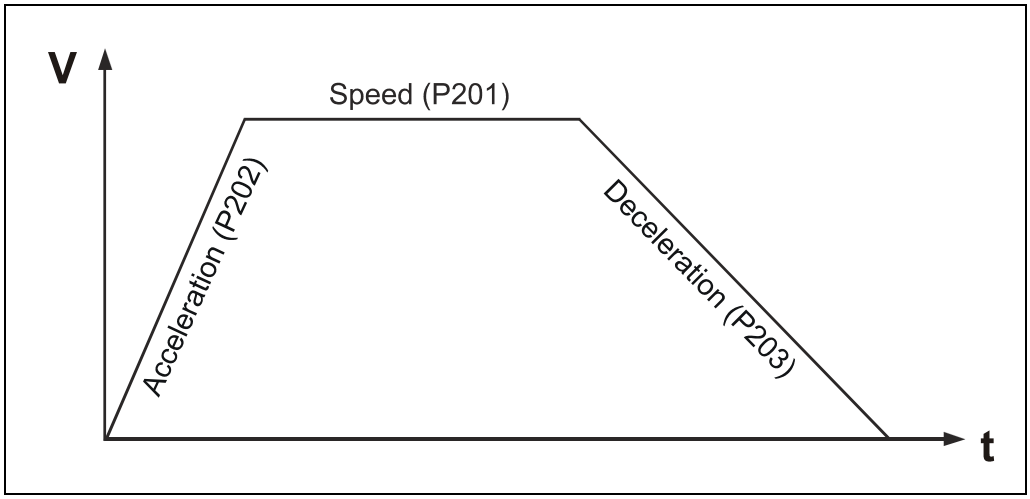


Figure 5: Ramp settings

The acceleration is initially constant according to P202 until the required speed (P201) is reached. This is then followed by a phase at constant speed. Finally, the drive brakes to rest in accordance with P203. The distance to be covered is given by the actual position (P100) at the start of positioning and the target position (P200). If these values lie close together, it may be that the constant speed phase is omitted, i.e. the speed demanded by P201 is not reached.

The end of the positioning movement is signaled by the drive in ZSW.10 ("*Set position reached*"). This bit is set internally when the actual value is within the defined target range (P304).

The maximum tracking distance (P305) defines the maximum permissible difference between the internal setpoint and the current actual value. If this value is exceeded, then Error 700 "Tracking error" is generated (see Error list, Page 108), and the drive switches to the fault state (SA11). In addition, Bit 8 in the status word is reset to "0".

Travel command table

For positionings max. 32 parameter sets can be stored in the drive. This is managed about the indices of parameter 200 to 203.
Each index number from 1 to 31 corresponds one travel command number, which can be called about parameter 400 (STW2) or 402 (command set selection).
Parameters P401 (ZSW2) and P403 (current command set) indicate the current set of travel commands. If no set of travel commands has been selected, Set 0 is processed automatically.

The following parameters affect a positioning order:

Table 9: Parameters affecting a positioning movement

Parameter	Significance
200	Target position
201	Speed
202	Acceleration
203	Deceleration
304	Target range
305	Tracking distance
400	Control word 2
401	Status word 2
402	Command set selection
403	Current command set

Conversion into physical units

Position information is generally given in **(mm) linear and (degree) rotative**. Here data type C4 is used (cf. Table 16). A C4 value of 12345678 therefore corresponds to the value 1234.5678.

Position information can be defined application-specific as demonstrated in examples:

Example 1 spindle:
Position information = [mm]

PNO 1 (Gearbox factor)	20000 (C4 data type) complies **i = 2**
PNO 2 (Pitch)	40000 (C4 data type) complies

Example 2 belt:
Position information = [mm]

PNO 1 (Gearbox factor)	10000 (C4 data type) complies **no gearbox**
PNO 2 (Pitch)	2199114 (C4 data type) complies Volume of driving panel V = Pi * d **219,9114 mm = 3,14 * 70 mm**

Example 3:
Position information = [degree]

PNO 1 (Gearbox factor)	20000 (C4 data type) complies **i = 2**
PNO 2 (Pitch)	3600000 (data type) complies **360 degree per gearbox revolution**

Speed values (PNO 201) and **acceleration values (PNO 202)** are specified **in percent**. Here data type N2 is used (cf. Table 16).

A N2 value of x corresponds to 100*x/16384 %. Here the reference value (100 %) is given by the maximum speed (Parameter 514) or the maximum acceleration (Parameter 515). These are specified in **rev/min** (Parameter 514) and **inc/sec²** (Parameter 515). System-dependently the parameters are protected over a password.

Interpretation of N2-value in physical units, see following example:

Table 10: Parameters for converting units

(PNO) Parameter number	Significance
1	Gearbox factor
2	Pitch
201	Speed
202	Acceleration
514	Maximum speed
515	Maximum acceleration

Fixed values by 5Nm type of drive:
Encoder resolution = **4096 Inc**
Maximum speed = **54 rev/min = 3686 Inc/sec**
Maximum acceleration = **10000 (rev/min) / sec = 682667 Inc/sec²**

Example:

Given:
PNO 1 (Gearbox factor) = **10000** C4 data type
PNO 2 (Pitch) = **40000** C4 data type

Conversion to **mm/sec and mm/sec²** respectively is carried out using the position factor:

$$\text{Position factor} = \frac{\text{Encoder resolution [inc/revolution]} \bullet \text{Gearbox factor}}{\text{Pitch [position information/revolution]}}$$

Position factor account:

$$\text{Position factor} = \frac{4096 \bullet 1.0}{4.0}\text{[Inc/mm]} = 1024\ \text{[Inc/mm]}$$

Maximum speed account:

$$\text{Maximum speed} = \frac{3686\ \text{[Inc/sec]}}{1024\ \text{[Inc/mm]}} = 3{,}6\ \text{[mm/sec]}$$

3,6 mm/sec = 100 % = 16384 = 54 U/min

Maximum acceleration account :

$$\text{Maximum acceleration} = \frac{682667\text{[Inc/sec}^2\text{]}}{1024\ \text{[Inc/mm]}} = 666{,}66\ \text{[mm/sec}^2\text{]}$$

666 mm/sec² = 100% =16384 = 10000 (U/min)/sec

4.2.3.4 “Speed control” mode

The drive can be run under speed control in this mode. Various internal states are assumed (***SB***x). These states and the transitions (***TB***x) between these states are defined in the PROFIDrive profile. The same conventions apply in the following Figure 6 as in the general state machine Figure 3. In “speed control” mode, state SB1 is assumed after state transition TA4 (cf. Figure 3). State transition TA5 leads to state SA5 from any of the states in Figure 4.

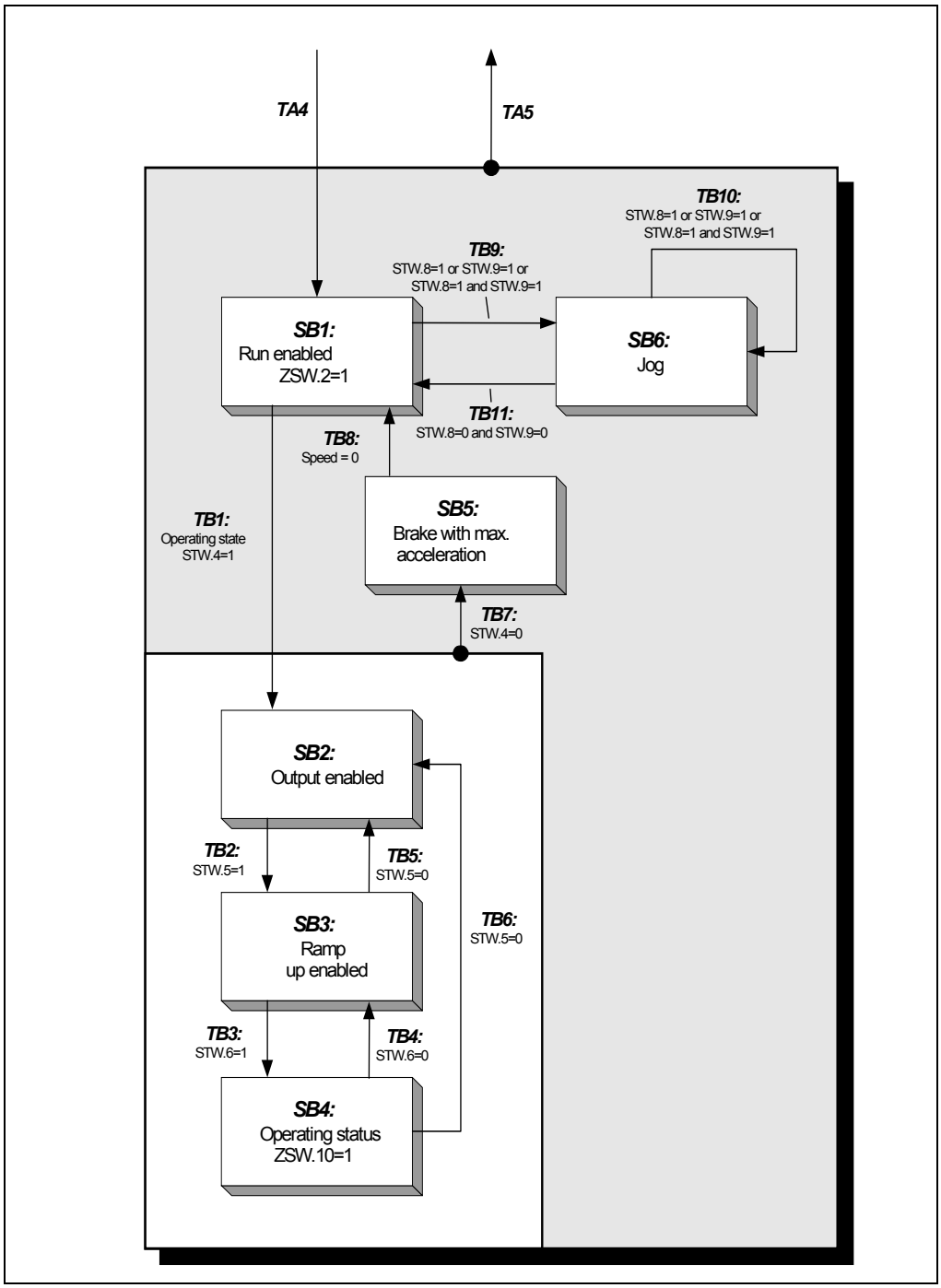


Figure 6: PROFIDrive state machine, speed control mode

WARNING!

There is a risk of bodily injury and material damage if the parameterized software limit switches P300 and P301 are exceeded!

- The parameterized software limit switches P300 and P301, which relate to the actual value of position, are inoperative in “speed control” mode.

  Range overruns can occur in rotary applications, for example, due to the integral position measuring system. Depending on the direction of rotation, this is manifested by a step change in the actual value of position (P100): Max → Min / Min → Max.

  The application must therefore not be dependent on the actual value of position.

Table 11: Control word, speed control

Bit	Value	Significance	Description
4	1	Operating condition	
	0	Inhibit ramp function generator	Drive decelerates at current limit, converter remains energized.
5	1	Enable ramp function generator	
	0	Stop ramp function generator	Drive decelerates on the configured deceleration ramp (P203).
6	1	Enable setpoint	Drive runs up on the configured acceleration ramp (P202) until the speed setpoint (P201) is reached.
	0	Inhibit setpoint	Drive decelerates on the configured deceleration ramp (P203) until it stops.
11	No meaning in this mode		

Table 12: Status word, speed control

Bit	Value	Significance	Description
8	Not supported by the EncoTRive. Tracking error monitoring is active instead.		
10	1	Set speed reached	The preselected speed (P201) has been reached.
	0	Actual speed less than set speed	The preselected speed (P201) has not yet been reached.
11	No meaning		
12	No meaning		
13	No meaning		

The positioning parameters related to this mode of operation P201-P203 refer to the index 0.

Run under speed control

For speed ramp settings, see “Positioning” mode Figure 5 Page 97.

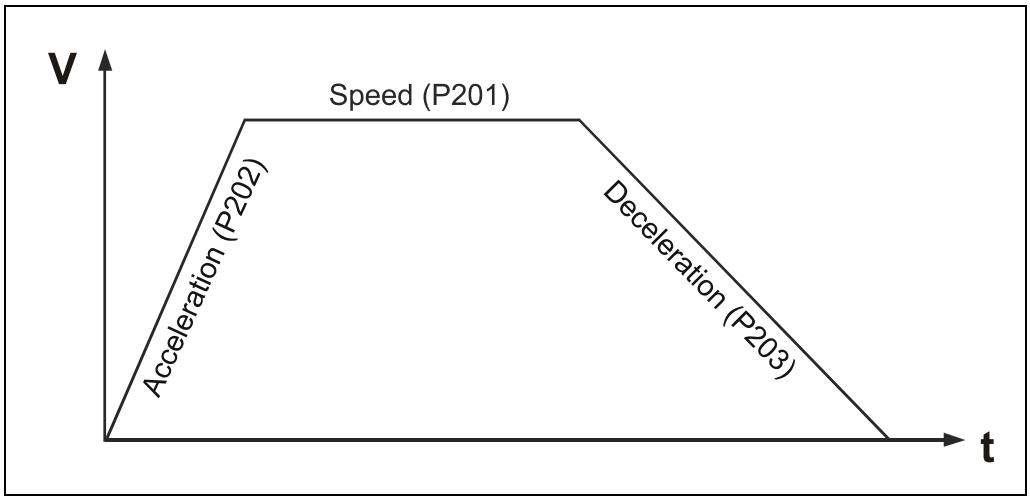


Figure 7: Ramp settings

In order to be able to run under speed control, it is necessary to go through state transitions TB1 to TB3. After TB3, the drive begins to move according to the set ramp. When the preset speed has been reached, this is indicated in the status word, Bit10. The speed is maintained until either the fastest possible stopping is initiated by resetting Bit 4 in the control word, or the drive is ramped down at the set deceleration by resetting Bit 5 or 6.
In state SB4, i.e. the drive has reached the preset speed, the drive accepts a changed speed setpoint without delay (P201).

The following parameters affect a positioning order:

Table 13: Parameters affecting a positioning movement

Parameter	Significance
201	Speed
202	Acceleration
203	Deceleration
305	Tracking distance, (see Positioning mode, page 95)

4.2.4 Travel range and reference point coordinate

Internal in the drive the reference point is always assumed as center point of the max. travel range.

4.2.4.1 Reference point coordinate

If the Max. Software Limit Switch Positions shall be kept, a displacement of the Reference Point Coordinate is not possible.

The adjusted Reference Point must be considered as difference to both Software Limit Switch Positions in order to avoid an exceeding of the Travel Range.

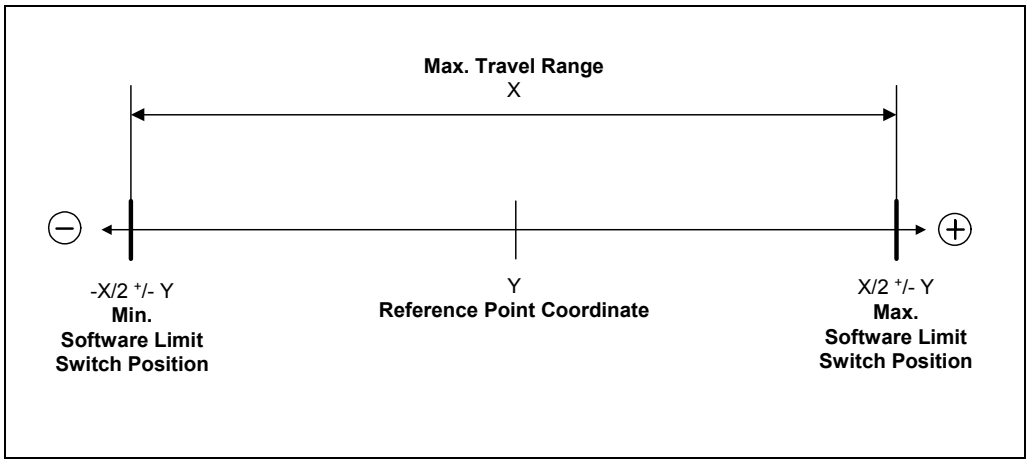


Figure 8: Software limit switch positions / Reference point coordinate

4.2.4.2 Calculation of the max. software limit switch position values

	Ascertainable revolutions (mechanically)	[2] Ascertainable revolutions (Software limit switch calculation)
	256	255

$$Travel\ Range_{Max}\,[C4] = \frac{Revolution_{Ascertainable} * Pitch_{Feed}}{Gear\ speed\ reduction} * 10000\,[C4]$$

Formula 1: Calculation of the max. travel range

	Example 1 C4 Data type	**Example 2** C4 Data type	**Example 3** C4 Data type
PNO 1 (Gear factor)	10 000	10 000	20 000
PNO 2 (Pitch)	10 000	30 000	40 000
Max. Software Limit Switch	+/- 2 550 000	+/- 7 650 000	+/- 5 100 000
Max. Travel Range	2 550 000	7 650 000	5 100 000
Default value PNO 300	-1 275 000	- 3 825 000	- 2 550 000
Default value PNO 301	1 275 000	3 825 000	2 550 000

Table 14: Examples from the calculation of the maximum travel range

[2] Numerical value for calculation of the maximum travel range

4.2.4.3 Definition of the travel range

Is the Real Travel Range, which is defined about the Software Limit Switch Positions, larger than 1/2 * Max. Travel Range a maximum Reference Point Coordinate can be defined from the difference between the Max. Travel Range and the Real Travel Range.

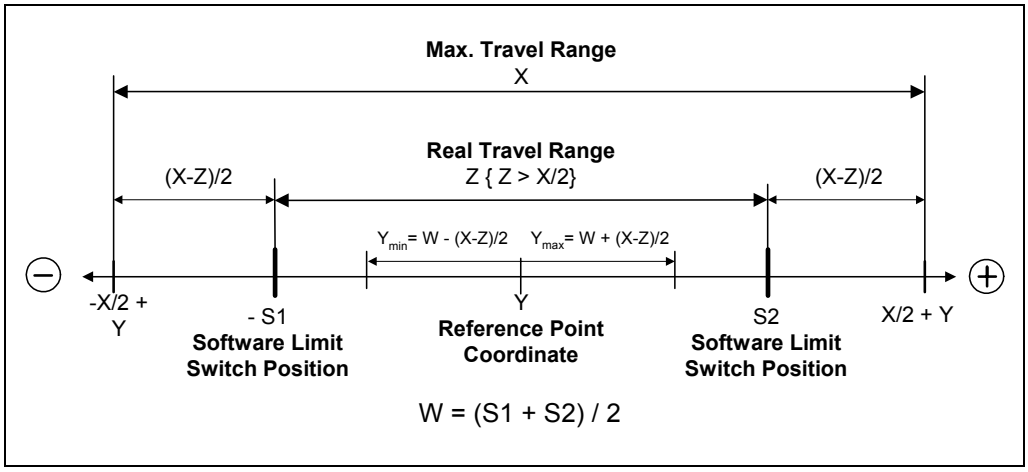


Figure 9: Max. Reference point coordinate, Z > X/2

Is the defined Travel Range smaller than 1/2 * Max. Travel Range a freely definable Reference Point Coordinate can be transferred.

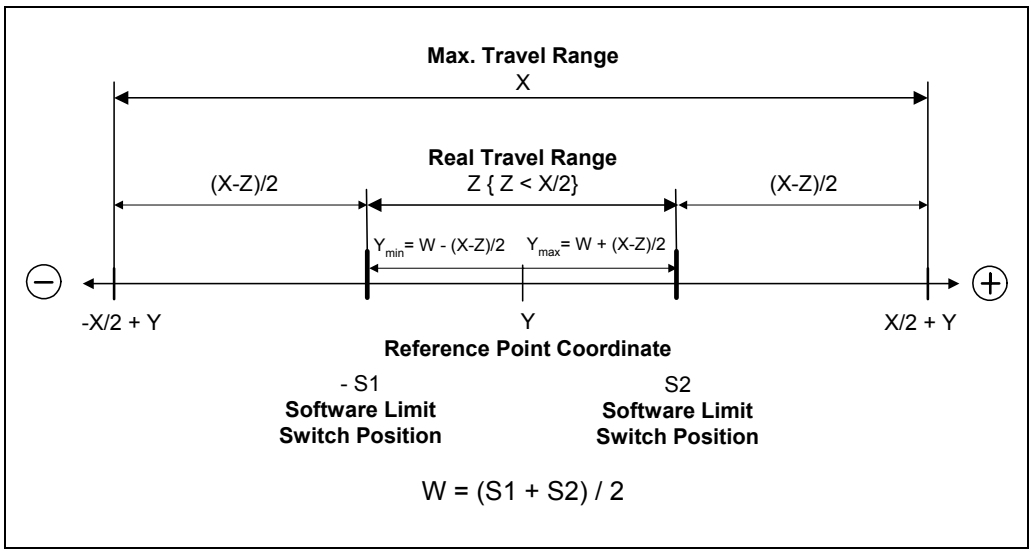


Figure 10: Max. Reference point coordinate, Z < X/2

4.2.5 Diagnosis and maintenance

4.2.5.1 Faults and warnings

Faults

are internal fault situations, which cause the drive to respond: the drive switches to the “Fault” state (SA11). Faults must be acknowledged in the STW after removing the cause of the fault.

Warnings

are temporary fault situations. These do not have to be acknowledged. If the reason for the warning is no longer present, the warning disappears.

A fault is indicated in the “Fault” bit. A fault is present if ZSW.3=1. If a warning is present, then this is indicated by the “Warning” bit (ZSW.7=1).

In the event of a warning, Parameter 953 (Warning) contains the reason for the warning as a bit code. The following situations are reported as warnings:

Table 15: encoTRive warnings (Parameter 953)

Coding	Significance
1 (bit 0)	Temperature too high
2 (bit 1)	Target position outside the range defined by the software limit switches (Parameter 300, 301).

If a **fault** is present, then the cause of the fault can be seen from **Parameter 947**.
Parameter 947 is an array of 64 UNSIGNED16 values, which describe the cause of the fault.
The information relating to a fault can consist of two consecutive array elements. The first value gives the error identification, and the second contains a more detailed description of the error. A fault situation can contain up to 8 faults. In turn, the fault buffer stores a total of 8 fault situations.

The first array element contains the oldest fault, which has led to the fault situation. More recent fault information is obtained with each increasing index. If an array index contains the value 0, then no further fault information follows.

A fault is **acknowledged** by means of the “*Acknowledge*” bit in the control word. A fault situation is acknowledged by STW.7=1. This automatically switches the fault memory (Parameter 947) to the next fault situation, i.e. by 8 entries. A prerequisite for this is that the cause of the fault has been removed.

If, following this, the ZSW still shows that there is a fault present, then the acknowledge process must be repeated by first setting STW.7 to 0 and then to 1.

The following faults are defined:

100	**General system fault in the application module** All application module faults, which are not explicitly listed, are implemented here.
101	**Internal communications fault, CANopen**
102	**FEPROM fault** Checksum error in Flash
104	**Communications fault, DPV1**
110	**Positioning by means of digital inputs** Positioning has been carried out by means of digital inputs.
500	**General system fault in the basic module**
510	**Overvoltage fault** Power voltage > 55.0 V
520	**Undervoltage fault** Power voltage < 21.0 V
530	**Temperature exceeded** The internal temperature is greater than the set maximum permissible limit.
531	**Temperature sensor defective** The internal temperature sensor is defective
550	**Encoder fault** Signals from the internal encoder are unreliable. Position and speed signals cannot be generated.
560	**Positioning time too long** The run parameters have been chosen so that positioning would take too long.
580	**Positive hardware limit switch reached** Drive was stopped as fast as possible and put into the SA2 status. Check Target position, Reference point coordinate and Software limit switch positions.
581	**Negative hardware limit switch reached** Drive was stopped as fast as possible and put into the SA2 status. Check Target position, Reference point coordinate and Software limit switch positions.
700	**Tracking error** The maximum tracking distance has been exceeded.
800	**Profibus communication** Profibus communication has failed

Continuation of the fault messages:

801	**PZD configuration:** Telegram from slave => master too short
802	**PZD configuration:** Telegram from master => slave too short
803	**PZD configuration:** Consistency problem
804	**PZD configuration:** PKW identifier (0xF3) in the wrong place in the configuration telegram
805	**PZD configuration:** No PZD configured in the direction master => slave
806	**PZD configuration:** No PZD configured in the direction slave => master
807	**PZD configuration:** Format error, length calculation not possible
810	**PZD configuration:** Telegram in the direction Slave => Master too large
811	**PZD configuration:** Telegram in the direction Master => Slave too large

4.2.6 The object directory

4.2.6.1 Saving the object directory in flash / Factory settings

When the encoTRive is switched on, the object directory is initially preloaded with the factory settings. If the flash memory contains a valid image of the object directory, then the object directory is overwritten with this image. Otherwise, the works settings will be retained.
Changes to the object directory can be made during operation by changing the value of Parameter 971 from 0 to 1. The values stored in this way are used in the next run-up. The object directory can be reloaded with the factory settings by changing the value of Parameter 970 from 1 to 0. These can be stored in flash by means of Parameter 971.

4.2.6.2 Types of parameter

PROFIDrive differentiates between simple parameter values (***simple variables***) and those, which are made up of several similar types of information (***array variables***). An array consists of a number n of elements of the same data type. In the case of arrays, the individual elements can be accessed by means of the subindex.

When accessing parameters via the PKW, the indexing of an array starts with subindex 1, and when accessing via the DPV1 with subindex 0!

Subindex 0 is always used with simple variables.

4.2.6.3 Data types

Amongst other things, PROFIDrive defines integer data types of different length, which can be used with and without sign. In the case of integer data types with sign, the most significant bit indicates whether the number is positive or negative. If this bit is set (1), then the number is negative. In this case, the value of the number is displayed internally by means of the ***two's complement***. The ***one's complement*** of x is obtained by inverting all the bits of x. If 1 is added to the one's complement, then the two's complement Z(x) is obtained. Z(x) is the internal representation of –x.

Examples:

1. In the case of an 8-bit number with sign, **`1100 0001 bin`** (0xC1) represents a negative number. The one's complement of the number is **`0011 1110 bin`**, and the two's complement **`0011 1111 bin`**. The number is therefore -63.
2. Let a 16-bit value with sign contain 0xFF73. As the most significant bit is set, then the number is negative. The two's complement has the form 0x008D. The value is therefore the value 141.

encoTRive uses the following subset of the PROFIDrive data types:

Table 16: PROFIDrive data types used by encoTRive

Coding	Data type	Length	Description
1	BOOLEAN	8 bit	Two possible values: 0 (false) or 1 (true)
2	INTEGER8	8 bit	Integer 8-bit value with sign. Range of values: -128 … 127
3	INTEGER16	16 bit	Integer 16-bit value with sign. Range of values: -32768 … 32767
4	INTEGER32	32 bit	Integer 32-bit value with sign. Range of values: -2^{31}… $+2^{31}-1$
5	UNSIGNED8	8 bit	Integer 8-bit value without sign. Range of values: 0…255
6	UNSIGNED16	16 bit	Integer 16-bit value without sign. Range of values: 0…65535
7	UNSIGNED32	32 bit	0… $2^{32}-1$
9	Visible String	Variable	Character string of ASCII characters
33 (0x21)	N2	16 bit	Linear normalized value. 0 % corresponds to value 0, 100 % corresponds to value 16384 (0x4000), Resolution: 100% / 2^{14} = 0.0061 % N2 value x corresponds to 100*x/16384 %.
34 (0x22)	N4	32 bit	Linear normalized value. 0 % corresponds to 0, 100 % corresponds to 2^{30}. Resolution: 100% / 2^{30} = 0.000000093 %
39 (0x27)	T4	32 bit	The value is specified in multiples of the constant scan rate of 1ms.
42 (0x2A)	C4	32 bit	Linear fixed-point value with four places after the decimal point. Value 0 in C4 representation: 0 Value 0.0001 in C4 representation: 1 Value 1 in C4 representation: 10000 … Range of values: as INTEGER32. The C4 value represents the value divided by 10000 (4 places after the decimal point): C4 value 1234567 is interpreted as 123.4567.

4.2.6.4 Description of parameters

Each parameter in the encoTRive object directory has a ***parameter description***, which contains information relating to the parameter. The parameter description is stored in the encoTRive memory and can be read out by means of the PKW or DPV1.

The parameter description for a parameter has a fixed length of 46 bytes.
The individual elements of the parameter description can be accessed by means of the subindex. If subindex 0 is used, then this means the whole of the parameter description.

Table 17: Description of parameters

<table>
<tr><th>Subindex</th><th>Significance</th><th>Meaning</th></tr>
<tr><td>1</td><td>Identifier (2 bytes)<table><tr><th>bit</th><th>significance</th></tr><tr><td>15</td><td>reserved</td></tr><tr><td>14</td><td>1-Array 0-Simple parameter</td></tr><tr><td>13</td><td>1-Parameter can only be reset (e.g. time difference)</td></tr><tr><td>12</td><td>1-Parameter has been changed from the factory setting</td></tr><tr><td>11</td><td>reserved</td></tr><tr><td>10</td><td>1-Additional text array available</td></tr><tr><td>9</td><td>1-Parameter cannot be written</td></tr><tr><td>8</td><td>1-Normalization and size attribute not relevant</td></tr><tr><td>0-7</td><td>Data type (cf. Table 16)</td></tr></table></td><td>encoTRive uses only bits 0-7, 9, 14.
The following values are fixed for the remaining bits:

bit 13: 0
bit 12: 0
bit 10: 0
bit 8: 0</td></tr>
<tr><td>2</td><td>Number of array elements or string length (2 bytes)
If the parameter is an array parameter, then the number of array elements is specified here.
In the case of a character string, this element contains the length of the string.</td><td></td></tr>
<tr><td>3</td><td>Normalization factor (4 bytes)
Floating-point number with which an internal value can be converted to a physical representation.</td><td>Not used for encoTRive.</td></tr>
<tr><td>4</td><td>Attribute (2 bytes)
Physical unit / quantity</td><td>Not used for encoTRive.</td></tr>
<tr><td>5</td><td>Reserved (4 Byte)</td><td></td></tr>
<tr><td>6</td><td>Name (16 Byte)
Parameter name. Character string</td><td></td></tr>
<tr><td>7</td><td>Lower limit value (4 Byte)</td><td></td></tr>
<tr><td>8</td><td>Upper limit value (4 Byte)</td><td></td></tr>
<tr><td>9</td><td>Reserved (2 Byte)</td><td></td></tr>
<tr><td>10</td><td>ID extension. Reserved (2 Byte)</td><td>Not used for encoTRive.</td></tr>
<tr><td>11</td><td>PZD reference parameter (2 bytes)</td><td>Not used for encoTRive.</td></tr>
<tr><td>12</td><td>PZD normalization (2 bytes)</td><td>Not used for encoTRive.</td></tr>
<tr><td>0</td><td>Full description (46 bytes)</td><td>Content of subindices 1-12</td></tr>
</table>

4.2.6.5 List of encoTRive parameters

The following is a list of all the encoTRive parameters arranged in parameter number order. Each parameter is specified in the form

PNU	name	Attribute	data type	Default	Min	Max

where

PNU — Parameter number (900-999, 60000-65535: PROFIDrive profile parameter, other PNUs: manufacturer-specific parameters)

Name — Parameter designation

Attribute — Information in the form
Access/Flash memory/Factory setting

Access: rw – read/write: Parameter can be read and written,
ro – read only: Parameter is write-protected

Flash memory:	f	Parameter is stored in Flash on a 0/1 transition of the value of Parameter 971.
	-	Parameter is not stored in Flash
Factory setting: w		Parameter is preset to the default value when the factory settings are loaded (Parameter 970: 1/0 transition)
	-	Value is not preset to the default value
Password-protected: s		Parameter can only be written after the password has been enabled.
PZD configuration: p		Parameter can be mapped in the PZD telegram

Data type — Data type according to Table 16 Page 111 for simple parameters.
For arrays: `Array[NumberElements] Data type of the array elements`

Default — Factory setting.

Min — Minimum value

Max — Maximum value

4.2.6.5.1 Manufacturer-specific parameters

PNU	Name	Attribute	Data type	Default	Min	Max
1	Gearbox factor	rw/f/w	C4	[1] 10000	1	2000000000
The gearbox factor is the ratio of motor revolutions to the revolutions of the gearbox output shaft: $Gearbox\ factor = \frac{Motor\ revolutions}{Drive\ shaft\ revolutions}$ [1] Default value change by external gearbox only. Example: i=2 Default value = 20000 = 2 motor revolutions for each revolution of the drive shaft.						

PNU	Name	Attribute	Data type	Default	Min	Max
2	Pitch	rw/f/w	C4	10000	1	2000000000
This parameter defines the spindle pitch: $Spindle\ pitch = \frac{Displacement\ [\mathrm{mm}]}{Drive\ shaft\ revolutions}$ The default value 10000 corresponds to 1 mm per revolution.						

PNU	Name	Attribute	Data type	Default	Min	Max
3	Reference point coordinate	rw/f/w	C4	0	-2000000000	2000000000
The parameter specifies the position (in mm) at the reference point.						

PNU	Name	Attribute	Data type	Default	Min	Max
4	Inversion	rw/f/w	UNSIGNED16	0	0	1
Direction of rotation of the motor shaft with view onto the motor output shaft.						
Parameter value		0		1		
Positive drive direction		clockwise		counter clockwise		
Negative drive direction		counter clockwise		clockwise		

PNU	Name	Attribute	Data type	Default	Min	Max
100	Actual value of position	ro/-/-/p	C4	-	-2000000000	2000000000
Current position in mm.						

PNU	Name	Attribute	Data type	Default	Min	Max
101	Actual value of current	ro/-/-/p	C4	-	1	10000000
Motor current in A						

PNU	Name	Attribute	Data type	Default	Min	Max
102	Temperature	ro/-/-/p	C4	-	- 1000000	2000000
Electronics temperature in °C						

PNU	Name	Attribute	Data type	Default	Min	Max
103	NIST_A	ro/-/-/p	UNSIGNED 16	-	0	65535
Actual speed in %.						

PNU	Name	Attribute	Data type	Default	Min	Max
104	Power voltage	ro/-/-/p	C4	-	0	10000000
Supply voltage to the power section in V.						

PNU	Name	Attribute	Data type	Default	Min	Max
200	Target position	rw/f/w/p	Array[32] C4	0	-2000000000	2000000000
Target position in mm.						

PNU	Name	Attribute	Data type	Default	Min	Max
201	Speed	rw/f/w/p	Array[32] N2	16384	0	16384
Speed in %. The reference value (100 %) is determined by the maximum speed (Parameter 514).						

PNU	Name	Attribute	Data type	Default	Min	Max
202	Acceleration	rw/f/w/p	Array[32] N2	16384	0	16384
Acceleration in %. The reference value (100 %) is determined by the maximum acceleration (Parameter 515).						

PNU	Name	Attribute	Data type	Default	Min	Max
203	Deceleration	rw/f/w/p	Array[32] N2	16384	0	16384
Deceleration in %. The reference value (100 %) is determined by the maximum acceleration (Parameter 515).						

PNU	Name	Attribute	Data type	Default	Min	Max
204	JOG speed	rw/f/w	N2	16384	0	16384
Speed when jogging (in %). The reference value (100 %) is determined by the maximum speed (Parameter 514).						

PNU	Name	Attribute	Data type	Default	Min	Max
205	JOG acceleration	rw/f/w	N2	4096	0	16384
Acceleration when jogging (in %). The reference value (100 %) is determined by the maximum acceleration (Parameter 515).						

PNU	Name	Attribute	Data type	Default	Min	Max
206	JOG deceleration	rw/f/w	N2	16384	0	16384
Deceleration when jogging (in %). The reference value (100 %) is determined by the maximum acceleration (Parameter 515).						

PNU	Name	Attribute	Data type	Default	Min	Max
300	Software limit switch min.	rw/f/w	Array [4] C4	-	-2000000000	2000000000
The parameter specifies the left-hand software limit switch. The default value depends from the gear used.						

PNU	Name	Attribute	Data type	Default	Min	Max
301	Software limit switch max.	rw/f/w	Array [4] C4	-	-2000000000	2000000000
The parameter specifies the right-hand software limit switch. The default value depends from the gear used.						

PNU	Name	Attribute	Data type	Default	Min	Max
302	Max. current	rw/f/w/p	C4	50000	1	150000
This parameter defines the maximum continuous current in A.						

PNU	Name	Attribute	Data type	Default	Min	Max
304	Target range	rw/f/w	C4	100	1	100000
The parameter specifies the accuracy window (in mm). If the actual value of position is within the range defined by this parameter, then a positioning movement is looked upon as being complete. If the target range is chosen to be too small, then it is possible that a positioning order may not be completed. The target range depends on Parameters 505 (encoder resolution), 1 (gearbox factor) and 2 (pitch). The default value is 0.01 mm.						

PNU	Name	Attribute	Data type	Default	Min	Max
305	Tracking distance	rw/f/w	C4	160	0	2000000000
The maximum tracking distance defines the maximum permissible difference between the internal setpoint and the current actual value of position. A value “0” means that the tracking error monitoring is deactivated. Interpretation of the default value: 1024 encoder increments x 10 motor revolutions						

PNU	Name	Attribute	Data type	Default	Min	Max
306	Max. temperature	rw/f/w	C4	1000000	0	2000000000
Maximum permissible temperature of the electronics in °C.						

PNU	Name	Attribute	Data type	Default	Min	Max
307	Overcurrent	rw/f/w	C4	200000	1	200000
This parameter defines the maximum overcurrent in A. This current is allowed for a short time when accelerating for 500 ms in order to overcome the break-free torque.						

PNU	Name	Attribute	Data type	Default	Min	Max
308	Temperature warning	rw/f/w	C4	1000000	200000	1500000
An appropriate warning is output if the temperature of the electronics exceeds this defined parameter value.						

PNU	Name	Attribute	Data type	Default	Min	Max
400	STW2	rw/-/w/p	UNSIGNED16	0	0	65535
The command set selection parameter (P402) can also be written by means of control word 2. According to ProfiDrive profile 3.0, this must be carried out within the standard telegram 7.						

PNU	Name	Attribute	Data type	Default	Min	Max
401	ZSW2	rw/-/-/p	UNSIGNED16	0	0	65535
The current command set parameter (P403) can also be read by means of control word 2. According to ProfiDrive profile 3.0, this must be carried out within the standard telegram 7.						

PNU	Name	Attribute	Data type	Default	Min	Max
402	SATZANW	rw/-/w/p	UNSIGNED16	0	0	65535
This parameter can be used to preselect a command set from the command set table. This will occur the next time a positioning movement is started.						

PNU	Name	Attribute	Data type	Default	Min	Max
403	AKTSATZ	rw/-/w/p	UNSIGNED16	0	0	65535
This parameter indicates the current set of travel commands.						

PNU	Name	Attribute	Data type	Default	Min	Max
500	Password	wo/-/w	Visible String	“ ”	-	-
Password for write access to Parameters 501 – 520.						

PNU	Name	Attribute	Data type	Default	Min	Max
501	KV_Proportional	rw/f/w/s	UNSIGNED16	65	0	20000
Closed-loop gain factor of the P-fraction						

PNU	Name	Attribute	Data type	Default	Min	Max
502	KV_Differential	rw/f/w/s	UNSIGNED16	4194	0	20000
Closed-loop gain factor of the D-fraction						

PNU	Name	Attribute	Data type	Default	Min	Max
503	KV_Integral	rw/f/w/s	UNSIGNED16	262	0	20000
Closed-loop gain factor of the I-fraction						

PNU	Name	Attribute	Data type	Default	Min	Max
505	Encoder resolution	rw/f/w/s	C4	4096	0	2000000000
Encoder resolution. The parameter specifies the number of position increments per motor revolution. Is not interpreted as C4 data type.						

PNU	Name	Attribute	Data type	Default	Min	Max
508	Stop brake	rw/f/w/s	UNSIGNED16	1	0	1
Stop brake available						

PNU	Name	Attribute	Data type	Default	Min	Max
514	Max_speed	rw/f/w/s	C4	4350	0	2000000000
Internal maximum speed Is not interpreted as C4 data type.						

PNU	Name	Attribute	Data type	Default	Min	Max
515	Max_acceleration	rw/f/w/s	C4	10000	0	2000000000
Maximum acceleration and deceleration in rpm /sec Is not interpreted as C4 data type.						

PNU	Name	Attribute	Data type	Default	Min	Max
520	Operating hours	rw/-/-/s	UNSIGNED32	0	0	4294967295
Operating hours counter, incremented only when controller activated.						

PNU	Name	Attribute	Data type	Default	Min	Max
802	Parameter initialized	ro/f/w	UNSIGNED16	0	0	1
Indicates whether a valid image of the encoTRive object directory is stored in Flash. If the parameter contains the value 0xAB18, a valid encoTRive object directory is stored in Flash.						

PNU	Name	Attribute	Data type	Default	Min	Max
803	Digital_Input	ro/-/-/p	UNSIGNED16	-	0	16
Shows the status of the digital inputs						

PNU	Name	Attribute	Data type	Default	Min	Max
804	Digital_Output	rw/-/-/p	UNSIGNED16	0	0	16
The digital outputs bit 0-3 (Byte 0) can be controlled using bit coding by means of this parameter. Example: 0000 0000 0000 1111						

PNU	Name	Attribute	Data type	Default	Min	Max
805	Reference point set	rw/-/-	UNSIGNED16	0	0	1
Indicates whether the drive has been referenced. Value 1: Drive referenced, Value 0: Drive not referenced. After referencing the parameter value is set permanent to 1. Restore default value 0, permanently: Load factory default setting or overwrite manually with 0.						

PNU	Name	Attribute	Data type	Default	Min	Max
807	Digital IN Function	rw/-/w	UNSIGNED32	0	0	2000000000
By standard type, not available. About this 4-byte parameter to the 4 digital inputs different functions can be assigned. For each input one byte is reserved.						

PNU	Name	Attribute	Data type	Default	Min	Max
808	Dig Out Function	rw/-/w	UNSIGNED32	0	0	2000000000
By standard type, not available. About this 4-byte parameter to the 4 digital outputs different functions can be assigned. For each output one byte is reserved.						

PNU	Name	Attribute	Data type	Default	Min	Max
809	Debounce time E	rw/-/w	T4	10	0	1000
Takeover of the signal level when the defined debouncing time in ms is expired.						

PNU	Name	Attribute	Data type	Default	Min	Max
880	Firmware	rw/-/-	Array [32] UNSIGNED32	2^{32}	-	-
Enabling of the firmware update about the TR EncoTRiveTool.						

4.2.6.5.2 Profile-specific parameters

PNU	Name	Attribute	Data type	Default	Min	Max
915	PZD configuration, setpoints	rw/f/w	Array[15] UNSIGNED16	[967,0,…]	0	65535
Configuration of the PZD (output data). For the telegram DPM1 → drive. Cf. 4.2.2						

PNU	Name	Attribute	Data type	Default	Min	Max
916	PZD configuration, actual values	rw/f/w	Array[15] UNSIGNED16	[968,0…]	0	65535
Configuration of the PZD (output data). For the telegram drive → DPM1. Cf. 4.2.2						

PNU	Name	Attribute	Data type	Default	Min	Max
918	PROFIBUS-DP node address	ro/f/-	UNSIGNED16	-	0	65535
PROFIBUS-DP node address of the drive. With encoTRive, the DP address is fixed and can be read by means of this parameter.						

PNU	Name	Attribute	Data type	Default	Min	Max
922	Telegram selection	rw/f/w	UNSIGNED16	0	0	65535
The PZD can be configured by means of this parameter. If the parameter contains the value 0, then the two parameters 915 and 916 are definitive for configuring the PZD. Otherwise, a so-called standard telegram will be selected with Parameter 922. Cf. 4.2.2						

PNU	Name	Attribute	Data type	Default	Min	Max
923	Standard signals	ro/-/w	Array[100] UNSIGNED16	see Table 3	0	65535
Association between standard signals such as target position and actual value of position, and manufacturer-specific parameters.						

PNU	Name	Attribute	Data type	Default	Min	Max
927	Control priority	rw/-/w	UNSIGNED16	2	0	65535
This parameter defines who may have access to parameters. In addition to PROFIBUS-DP, encoTRive supports access to the parameters of the object directory via serial interface. **If access is made via the serial interface, then access to parameters via PROFIBUS-DP is blocked.** Value 1: Control priority local, i.e. via serial interface Value 2: Control priority PROFIBUS-DP						

PNU	Name	Attribute	Data type	Default	Min	Max
928	PZD control priority	rw/-/w	UNSIGNED16	2	0	65535

Defines who can have write access to the process data. It is possible that parameters of the object directory may be accessed simultaneously by a DPM1 and a DPM2. As the PZD is updated cyclically, it must be ensured that only one master influences the PZD.

Value 1: DPM1 has PZD control priority. DPM2 write access to PZD parameters is denied.

Value 2: DPM2 has PZD control priority PZD from DPM1 are ignored

When the link is established about DPM2 (EncoTRive Tool):

At the time of establishing the communication, the EncoTRive Tool has the highest priority.

With writing of the parameter value “1” the highest priority is handed back to the PLC (DPM1).

PNU	Name	Attribute	Data type	Default	Min	Max
930	Operating mode	rw/-/w/p	UNSIGNED16	2	0	65535

Selection of operating mode values: see Table 4 page 93

PNU	Name	Attribute	Data type	Default	Min	Max
947	Error/Faults	ro/-/w/p	Array[64] UNSIGNED16	0	0	65535

Fault memory. Fault messages are stored permanently in a ring buffer. If a new fault is present, then this is indicated by ZSW.3=1 (“Fault present”), see 4.2.5.1.

PNU	Name	Attribute	Data type	Default	Min	Max
953	Warning	ro/-/w/p	UNSIGNED16	0	0	65535

Indicates whether a fault is present.

PNU	Name	Attribute	Data type	Default	Min	Max
964	Device identification	ro/-/w	Array[9] UNSIGNED16	Current identification of hardware and software	0	65535
Device identification. The individual elements must be read in the following order: Manufacturer: (0xAAAE) Device type: 0x0001 (manufacturer-specific) Version: xxyy (200 means: 2.00) Firmware date: Year Firmware date: ddmm (day/month) Number of axes: 1 Hardware version: xxyy serial number: dddd						

PNU	Name	Attribute	Data type	Default	Min	Max
965	Profile number	ro/-/w	UNSIGNED16	0x0303	0	65535
Profile number. Profile number= 03 (PROFIDrive), Version = 3						

PNU	Name	Attribute	Data type	Default	Min	Max
967	STW	rw/-/w	UNSIGNED16	0	0	65535
Control word (STW). The state machine is controlled by means of the control word. Cf. Section 4.2.3.1						

PNU	Name	Attribute	Data type	Default	Min	Max
968	ZSW	ro/-/-	UNSIGNED16	64	0	65535
Status word (ZSW). The status word provides information related to current states Cf. Section 4.2.3.1						

PNU	Name	Attribute	Data type	Default	Min	Max
970	Load factory setting	rw/-/w	UNSIGNED16	1	0	65535
All parameters of the object directory are set to their default values by means of an edge 1 → 0 on this parameter.						

PNU	Name	Attribute	Data type	Default	Min	Max
971	Save in Flash	rw/-/w	UNSIGNED16	0	0	65535
The current content of all savable parameters is stored in Flash by means of an edge 0 → 1.						

PNU	Name	Attribute	Data type	Default	Min	Max
980	List of all parameters	ro/-/w	Array[79] UNSIGNED16	Numbers of all defined parameters	0	65535
This parameter contains a list of all defined parameters in ascending order. An entry with a value 0 signals the end of the list.						

4.2.6.6 Access to parameters via PROFIBUS-DP

There are two mechanisms for accessing the parameters of the object directory via PROFIBUS-DP:

- PKW channel as part of the cyclic data exchange between DPM1 and DP slave
- acyclic DPV1 services

If a PKW channel is used, then this occupies the first 8 bytes of the telegrams, which are cyclically exchanged between DPM1 and DP slave (see Figure 2, Page 83). The drive recognizes as part of the configuration (cf. 4.2.1.3.2), whether the system is working with or without PKW channel: If the first configuration byte is **`0xF3`**, then the cyclic data contain a PKW channel, otherwise not.

Parameters can be written and read by means of PKW and with DPV1. In this case, the following conventions apply:

- In the case of arrays, the PKW access is to the first element with subindex 1. In the case of DPV1, with subindex 0.
- In the case of simple parameters, 0 is always used as the subindex.
- Parameter numbers and parameter values are in ***Big Endian Format***: An integer 16-bit value 0x1234 is transmitted so that 0x12 is sent first and then 0x34. With a 32-bit value 0x12345678, the value 0x12 appears first in the telegram (at the lowest address), then 0x34, then 0x56, and then 0x78.

4.2.6.7 Access to parameters via PKW

The 8 bytes of the PKW channel are occupied as follows:

Table 18: PKW range

<table>
<tr><th>Byte 0</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6</th><th>Byte 7</th></tr>
<tr><td colspan="2" rowspan="2">PKE (Parameter identification)</td><td colspan="2">IND
(Subindex)</td><td colspan="4" rowspan="2">PWE
(Parameter value)</td></tr>
<tr><td>Subindex</td><td>0</td></tr>
</table>

The PKE range is used to identify parameters and the type of access:

Table 19: Parameter identification (PKE)

Bit	Significance	
15-12	**Order identification (direction DPM1→slave) / response identification (direction slave→DPM1)**	
	Direction DPM1 → slave: 0 : no order 1 : Request parameter value 2 : Change parameter value (word) 3 : Change parameter value (double word) 4 : Request parameter description 5 : - 6 : Request parameter value (array) 7 : Change parameter value (array word) 8 : Change parameter value (array double word) 9 : Request number of array elements	**Direction slave →DPM1:** 0 : no response 1 : Transmit parameter value (word) 2 : Transmit parameter value (double word) 3 : Transmit parameter description 4 : Transmit parameter value (array word) 5 : Transmit parameter value (array double word) 6 : Transmit number of array elements 7 : Order cannot be executed
11	reserved	
10-0	Parameter number (PNU)	

If the value 7 is given as the response identification (“Order cannot be executed”), then the PWE range is assigned an error number, which specifies the cause of the fault. These are shown in the following table:

Error number	Significance
0x0000	Invalid PNU
0x0001	Value cannot be changed
0x0002	Value range exceeded
0x0003	Invalid subindex
0x0004	Parameter is not an array
0x0005	Wrong data type
0x0006	Setting not allowed
0x0007	Description element cannot be changed
0x0009	Description data not available
0x000B	No control priority
0x000C	Wrong password
0x0011	Wrong operating state
0x0012	Other fault
0x0014	Invalid value
0x0015	Reply too long
0x0016	Address range inadmissible
0x0017	Invalid format
0x0018	Number of values inconsistent

Table 20: PKW/DPV1 error numbers

The PKW order is being processed as long as the slave gives the response identification 0 (“no response”.

Examples:

1. **The master wants to read the first element (subindex 1 in the case of PKW) of Parameter 947:**
   Order identification: 7 (“*Request parameter value array word*”). PNU = 947 (0x3B3),
   Subindex = 1, the slave responds positively and returns the value 1000 (0x3E8)

PKW order:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x73	0xB3	0x01	0x00	0x00	0x00	0x00	0x00

PKW response:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x43	0xB3	0x01	0x00	0x00	0x00	0x03	0xE8

2. **The master wants to write Parameter 100 with the value 1000 000. The slave responds with error identification “Parameter cannot be written”**
   (cf. Table 20: PKW/DPV1 error numbers).
   Order identification: 3 (Change parameter value double word). PNU = 100 (0x64),
   Subindex = 0, Parameter value = 1000 000 (0xF4240)

PKW order:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x30	0x64	0x00	0x00	0x00	0x0F	0x42	0x40

PKW response:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x70	0x64	0x00	0x00	0x00	0x00	0x00	0x01

4.2.6.8 Access to parameters via DPV1

Up to a maximum of 4 bytes of user data can be transported with a PKW order. With DPV1, on the other hand, considerably larger amounts of data can be transported. In particular, sub-areas of arrays can be transmitted in one order. PROFIDrive 3.0 even allows so-called ***multi-parameter orders***, where several parameters can be read or written in one DPV1 order.

encoTRive does not support multi-parameter orders. A write or read order always refers to only one parameter.

A DPV1 order is transmitted from the master to the slave as a data range of an acyclic write order. For this purpose, the master uses the service **MSAC1_WRITE** (for DPM1) or **MSAC2_WRITE** (for DPM2). Correct transmission of the order is acknowledged to the master.
The master tries to obtain the response to the DPV1 order (DPV1 response) from the slave with the service **MSAC1_READ** (or **MSAC2_READ**). As long as the order is being processed, this read order is acknowledged in the negative (error code “State Conflict”).
When the DPV1 response is available at the slave, the slave sends a positive acknowledgement as a reply to the **MSAC1_READ/MSAC2_READ**, which contains the DPV1 response in the data range.

The acyclic connection between the DPM1 and slave is set up automatically.

INITIATE Request
A DPM2 must explicitly set up the acyclic connection to the slave. For this purpose, PROFIBUS defines a special linguistic device, the so-called ***INITIATE request***. The structure of this message is described in the PROFIBUS standard. encoTRive evaluates only certain parts of this message. Below is an example of an INITIATE request, which is accepted by encoTRive.

Table 21: Example of an INITIATE request

Byte	Description	
0	Send Timeout (High Byte): 0x00	
1	Send Timeout (Low Byte): 0x64	
2	Features Supported 1: 0x01 (MSAC2_READ and MSAC2_WRITE supported)	
3	Features Supported 2: 0x00	
4	Profile Features Supported 1: 0x00	
5	Profile Features Supported 2: 0x00	
6	Profile Ident Number (High Byte): 0x00	
7	Profile Ident Number (Low Byte): 0x00	
8	Address Type (Source): 0x01	
9	Address Length (Source): 0x0A	
10	Address Type (Destination): 0x02	
11	Address Length (Destination): 0x05	
12	0x01	Source Address
13	0x02	
14	0x03	
…	…	
21	0x0A	
22	**0x00 (checked by encoTRive!)**	Destination Address
23	0x12	
24	0x13	
25	0x14	
26	0x15	

Structure of a DPV1 request / response
The total length of a DPV1 request / DPV1 response is a maximum of 124 bytes.

Table 22: DPV1 request

Byte	Description		
0	**Request reference**: Uniquely identifies request / response. The master changes the reference for each new request.		
	Name	**Significance**	
1	Request ID	0x01 Request parameter – read parameter	
		0x02 Change parameter – write parameter	
2	Axis	Axis addressing for multi-axis drives. Not currently evaluated	
3	Number of parameters	With multi-parameter accesses, this field contains the number of parameters. With encoTRive: value **0x01**	
4	Attribute	Specifies what is to be accessed: 0x10 Access to value 0x20 Access to description	
5	Number of elements	When accessing simple parameters: value 0x00 Otherwise: Number of array elements to be accessed.	
6	Parameter number	High Byte	
7	Parameter number	Low Byte	
8	Subindex	High Byte	
9	Subindex	Low Byte	
10	Format	Data type according to Table 16 Page 111; Also allowed are: 0x41 Byte 0x42 Word 0x43 Double Word	This part is only available when write-accessing parameters
11	Number of values	Number of following values	
12-…	Values		

Table 23: DPV1 response

Byte	Description		
0	**Request reference**(mirrored)		
	Name	**Significance**	
1	Response ID	0x01 Parameter read successfully 0x81 Parameter not read successfully 0x02 Parameter written successfully 0x82 Parameter not written successfully	
2	Axis (mirrored)	Axis addressing for multi-axis drives. Not currently evaluated	
3	Number of parameters	With encoTRive: value **0x01**	
4	Format	Data type according to Table 16 Page 111; Also allowed are: 0x41 Byte 0x42 Word 0x43 Double Word 0x44 **Error**	This part is not available when a write access is successful. In the event of a (partially) failed request
5	Number of values	Number of following values	format = 0x44 Number of values = 1 Value = Error number (see Table 20)
6-…	Values / Error information		or format = 0x44 Number of values = 2 Value1 = Error number (see Table 20) Value2 = Subindex of the first array element in which the error occurred.

Examples:

1. Parameter 930 (0x3A2) is to be set to the value 2:

DPV1 Request:

Byte	Content
0	Request reference
1	0x02 (Write parameters)
2	0x00 (Axis)
3	0x01
4	0x10 (value)
5	0x00 (simple parameter)
6	0x03 (PNU high byte)
7	0xA2 (PNU low byte)
8	0x00 (Subindex High Byte)
9	0x00 (Subindex Low Byte)
10	0x42 (Format: Word)
11	0x01 (Number of values: 1)
12	0x00
13	0x02 (Value: 2)

DPV1 Response:
a) If carried out successfully:

Byte	Content
0	Request reference
1	0x02 (Parameters written successfully)
2	0x00 (Axis)
3	0x01

b) In the event of failure:

The error number is assumed to be 0x1234

Byte	Content
0	Request reference
1	0x82 (write error with parameter)
2	0x00 (Axis)
3	0x01
4	0x44 (Format: Error)
5	0x01 (Number of values: 1)
6	0x12 (Error number high byte)
7	0x34 (Error number low byte)

2. Let Parameter 915 (0x393) contain the values { 967, 1, 200, 300, 0,0,..., 0}.

The values with the gray background are to be overwritten with the values 200, 201, 202, 203.

DPV1 Request:

Byte	Content	
0	Request reference	
1	0x02 (Write parameters)	
2	0x00 (Axis)	
3	0x01	
4	0x10 (value)	
5	0x04 (4 elements)	
6	0x03 (PNU high byte)	
7	0x93 (PNU low byte)	
8	0x00	first subindex 0x0001
9	0x01	
10	0x42 (Format: Word)	
11	0x04 (Number of values: 4)	
12	0x00	Value 200 (0x00C8)
13	0xC8	
14	0x00	Value 201 (0x00C9)
15	0xC9	
16	0x00	Value 202 (0x00CA)
17	0xCA	
18	0x00	Value 203 (0x00CB)
19	0xCB	

DPV1 Response:
a) If carried out successfully:

Byte	Content
0	Request reference
1	0x02 (Parameters written successfully)
2	0x00 (Axis)
3	0x01

b) In the event of failure:
The error number is assumed to be 0xABCD

Byte	Content
0	Request reference
1	0x82 (write error with parameter)
2	0x00 (Axis)
3	0x01
4	0x44 (Format: Error)
5	0x01 (Number of values: 1)
6	0xAB (Error number high byte)
7	0xCD (Error number low byte)

If the error does not occur until writing the third element (Value 202), the DPV1 response can have the following format:

Byte	Content	
0	Request reference	
1	0x82 (write error with parameter)	
2	0x00 (Axis)	
3	0x01	
4	0x44 (Format: Error)	
5	0x02 (Number of values: 2)	
6	0xAB (Error number high byte)	
7	0xCD (Error number low byte)	
8	0x00	Subindex of the first element in which the error occurred
9	0x03	

In this case, the first two array elements have been successfully overwritten. Therefore, after the partially failed write access, P915 has the content `{ 967, 200, 201, 300, 0,0,..., 0}`.

3. **Let Parameter 915 (0x393) contain the values** `{ 967, 1, 200, 300, 0,0,..., 0}`.

The values with a gray background are to be read.

DPV1 Request:

Byte	Content	
0	Request reference	
1	0x01 (Read parameters)	
2	0x00 (Axis)	
3	0x01	
4	0x10 (value)	
5	0x04 (4 elements)	
6	0x03 (PNU high byte)	
7	0x93 (PNU low byte)	
8	0x00	first subindex 0x0001
9	0x01	

DPV1 response if carried out successfully:

Byte	Content	
0	Request reference	
1	0x01 (Parameters read successfully)	
2	0x00 (Axis)	
3	0x01	
4	0x42 (Format: Word)	
5	0x04 (Number of values: 4)	
6	0x00	Value 1 (0x0001)
7	0x01	
8	0x00	Value 200 (0x00C8)
9	0xC8	
10	0x01	Value 300 (0x012C)
11	0x2C	
12	0x00	Value 0 (0x0000)
13	0x00	

4. Reading the whole parameter description from Parameter 915 (0x393):

DPV1 Request:

Byte	Content	
0	Request reference	
1	0x01 (Read parameters)	
2	0x00 (Axis)	
3	0x01	
4	0x20 (description)	
5	0x01 (1 element)	
6	0x03 (PNU high byte)	
7	0x93 (PNU low byte)	
8	0x00	Subindex: 0x0000 (full description)
9	0x00	

DPV1 response if carried out successfully:

Byte	Content		
0	Request reference		
1	0x01	(Parameter read successfully)	
2	0x00	(Axis)	
3	0x01	1 Parameter	
4	0x41	(format: byte)	
5	0x2E	(Number of values: 46)	
6	0x40	Identifier: 0x4006: Array from UNSIGNED16	
7	0x06		
8	0x00	Number of array elements: 6	
9	0x06		
10	0x3F	Normalization factor: Floating-point number 1.0	
11	0x80		
12	0x00		
13	0x00		
14	0x00	Attribute: 0x0000	
15	0x00		
16	0x00	reserved	
17	0x00		
18	0x00		
19	0x00		
20	0x50	'P'	Name: “PZD Setpt.conf.”
21	0x5A	'Z'	
22	0x44	'D'	
23	0x20	' '	
24	0x73	'S'	
25	0x65	'e'	
26	0x74	't'	
27	0x70	'p'	
28	0x74	't'	
29	0x2E	'.'	
30	0x63	'c'	
31	0x6F	'o'	
32	0x6E	'n'	
33	0x66	'f'	
34	0x2E	'.'	
35	0x00		
36	0x00	lower limit value: 0x00000000	
37	0x00		
38	0x00		
39	0x00		
40	0x00	upper limit value: 0x0000FFFF (65535)	
41	0x00		
42	0xFF		
43	0xFF		
44	0x00	Reserved / ID extension / PZD Ref. /PZD normalization	
45	0x00		
46	0x00		
47	0x00		
48	0x00		
49	0x00		
50	0x00		
51	0x00		

5 Configuration example, SIMATIC® Manager

5.1 GSD file installation

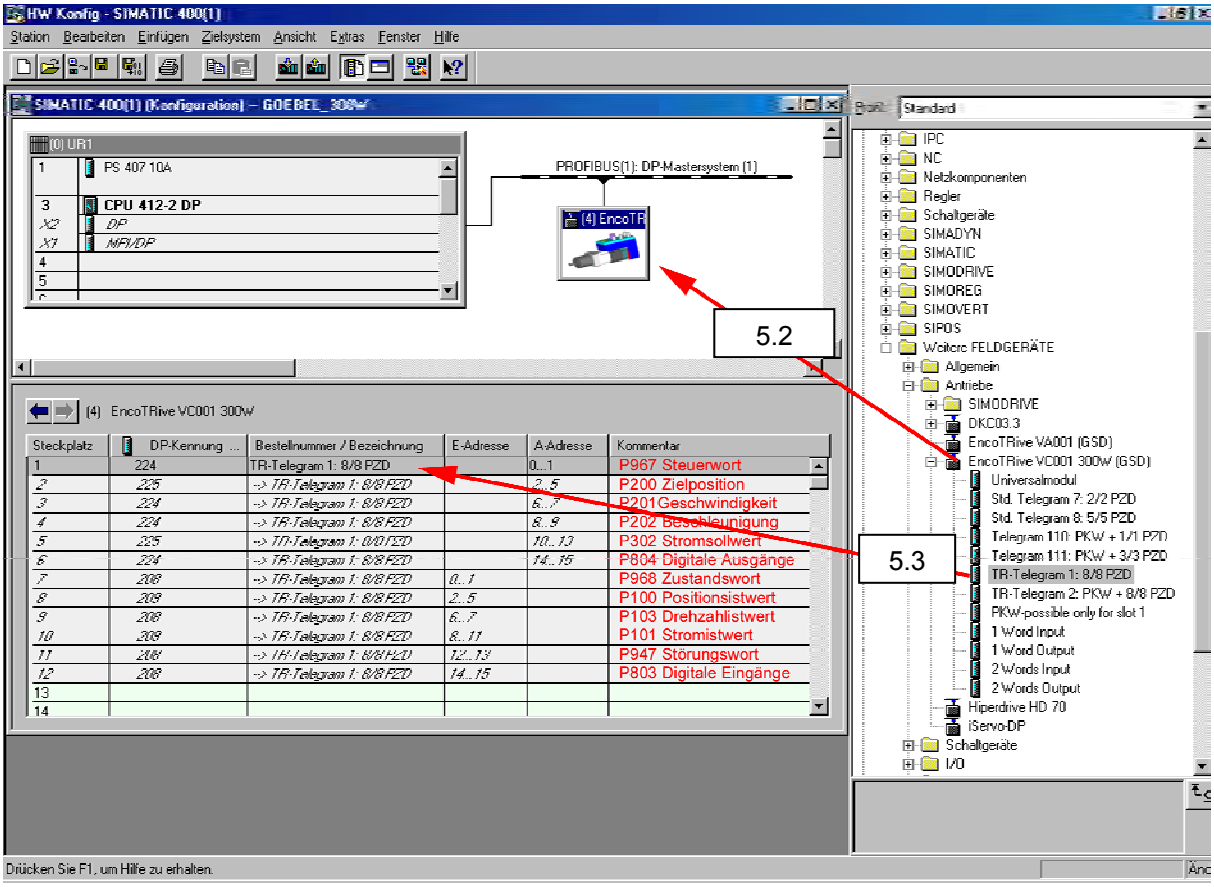
- Install the GSD file supplied on the CD-ROM using the hardware configurator.
- HW config => Extras => install new GSD

5.2 Adding a drive to the Profibus network

In accordance with the profile, the drive *EncoTRive VC001 300W* can now be taken from the hardware catalogue and attached to the Profibus network.

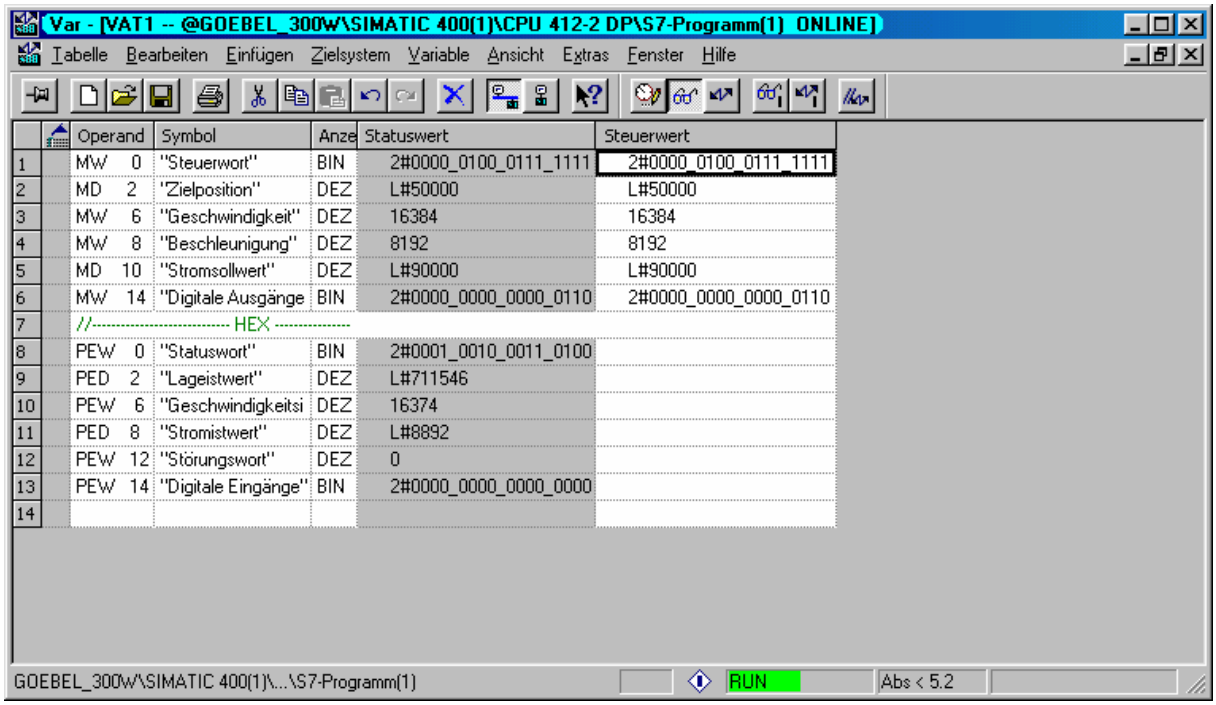
5.3 Telegram selection

As the PZD configuration has been pre-set in the drive, the TR telegrams can be used for simplification. This makes it possible to transmit the above-mentioned parameters cyclically. Further configuration is therefore unnecessary. Telegrams can be selected with and without PKW channel. Parameter access via DPV1 channel does not require any additional telegram.



5.4 Initial commissioning by manual control with the help of the variables table

It is recommended that the drive be controlled manually for initial commissioning. This can be achieved with the help of the variables table in the S7 Manager. This makes it possible to read the parameters directly from the drive, and to write them indirectly using marker words (MW) and marker double words (MD)



	Operand	Symbol	Anze	Statuswert	Steuerwert
1	MW 0	"Steuerwort"	BIN	2#0000_0100_0111_1111	2#0000_0100_0111_1111
2	MD 2	"Zielposition"	DEZ	L#50000	L#50000
3	MW 6	"Geschwindigkeit"	DEZ	16384	16384
4	MW 8	"Beschleunigung"	DEZ	8192	8192
5	MD 10	"Stromsollwert"	DEZ	L#90000	L#90000
6	MW 14	"Digitale Ausgänge	BIN	2#0000_0000_0000_0110	2#0000_0000_0000_0110
7	//---------- HEX ----------				
8	PEW 0	"Statuswort"	BIN	2#0001_0010_0011_0100	
9	PED 2	"Lageistwert"	DEZ	L#711546	
10	PEW 6	"Geschwindigkeitsi	DEZ	16374	
11	PED 8	"Stromistwert"	DEZ	L#8892	
12	PEW 12	"Störungswort"	DEZ	0	
13	PEW 14	"Digitale Eingänge"	BIN	2#0000_0000_0000_0000	
14					

6 Procedure for positioning, referencing and jogging

6.1 Set drive to “Positioning Mode”

To enable the drive to be positioned, referenced or jogged via Profibus, the drive must first be put into Positioning Mode according to PROFIDRIVE V3.0. This can be done by using the following procedure.

The order of the control commands (control word) and the interrogation of the current status by means of the status word must be maintained, as otherwise the command sent cannot be executed.

1. Status word (ZSW, P968) returned after switch-on:

ZSW = 0000_0010_0100_0000

- ⇨ Bit6 (ZSW) = 1 => Switch on inhibit
- ⇨ Bit9 (ZSW) = 1 => Command required; the control system is requested to take over command.

Status: SWITCH-ON INHIBIT
Action required: none

2. Change from SWITCH ON INHIBIT to READY TO SWITCH ON

STW = 0000_0100_0000_0110

- ⇨ Bit1,2 (STW) = 1 => All “OFF2” and “OFF3” commands are canceled
- ⇨ Bit10 (STW) = 1 => Command assumed by control system; process data valid. Must always be set for cyclical communication via Profibus.

Feedback:
ZSW = 0000_0010_0011_0001

- ⇨ Bit0 (ZSW) = 1 => Ready to switch on
- ⇨ Bit4, 5 (ZSW) = 1 => No “OFF2”, “OFF3”

3. Change from READY TO SWITCH ON to READY

STW = 0000_0100_0000_0111

- ⇨ Bit0 (STW) = 1 => Ready, voltage on converter

Feedback:
ZSW = 0000_0010_0011_0010

- ⇨ Bit1 (ZSW) = 1 => Ready

4. Change from READY to OPERATION ENABLE

STW = 0000_0100_0000_1111

- ⇨ Bit0 (STW) = 1 => Enable electronics and pulses

Feedback:
ZSW = 0010_0010_0011_0100

- ⇨ Bit2 (ZSW) = 1 => Ready
- ⇨ Bit13 (ZSW) = 1 => Drive

6.1.1 Referencing

To reference the drive, it is simply a matter of setting Bit11 of the control word. When this is done, the drive assumes the reference point coordinates defined in P003 as the new position setpoint.

STW = 0000_1100_0000_1111
⇨ Bit11 (STW) = 1 => Referencing started.

Feedback:

ZSW = 0000_1010_0011_0100
⇨ Bit11 (ZSW) = 1 => Reference point set

6.1.2 Jog mode

To jog in the positive and negative direction, it is simply a matter of setting Bit8 or Bit 9.

1. Jogging as standard in the positive direction:

STW = 0000_0110_0000_1111
⇨ Bit9 (STW) = 1 => Jog 1 On

2. Jogging as standard in the negative direction:

STW = 0000_0101_0000_1111
⇨ Bit8 (STW) = 1 => Jog 1 On

Feedback for both:

ZSW = 0000_0010_0011_0100
⇨ Bit13 (ZSW) = 0 => Drive running

6.1.3 Positioning

For positioning, the setpoint parameters mapped in the PZD telegram must be written according to the PZD configuration P915 and P916. In detail, these are:

P200[0] = Target position in mm C4 (=*10000)
P201[0] = Speed in % N2 (100% = Value 16384)
P202[0] = Acceleration in % N2
P302 = Current setpoint in Ampere C4 (=*10000)

The following bits must first be preset before starting the positioning process:

1. Presetting for positioning bits

STW = 0000_0100_0011_1111

⇨ Bit4 (STW) = 1 => Operating condition for positioning
⇨ Bit5 (STW) = 1 => Operating condition for positioning

2. Start positioning

STW = 0000_0100_01/011_1111

⇨ Bit6 (STW) = Edge => Start positioning

Feedback:

ZSW = 0001/0_0010_0011_0100

⇨ Bit12 (ZSW) = Edge => Setpoint acknowledged (level STW Bit6)
⇨ Bit13 (ZSW) = 0 => Drive running

Positioning complete, i.e. target position reached:

ZSW = 0010_0110_0011_0100

⇨ Bit10 (ZSW) = 1 => Target position reached
⇨ Bit13 (ZSW) = 1 => Drive stopped

To restart a positioning movement, it is only necessary to specify a new target position and then toggle Bit 6 in the control word. The drive will then move to the specified target position.

It is even possible to change a drive command on the fly:

1. Write new target position, speed or acceleration PZD telegram
2. Bit6 (STW) = Edge => Enable new setpoints
3. Drive runs according to new movement parameters.

A positioning movement can be interrupted by setting Bit5=0 in the control word. The movement can be resumed by resetting the same bit.

7 FAQ´s

This section answers the most frequent questions during start-up or serves for general understanding.

1. **General software questions**
2. **General hardware questions**
3. **Positioning mode**
4. **Speed control mode**
5. **PLC / Function blocks / Communication**

1. General software questions

Q 1:
How are the different data types to be interpreted (section 4.2.6.3) and how are their real physically dimensions?

The used data types were defined by the PROFIBUS-User organization (PNO) and can be referred in the "PROFIdrive" drive profile.
Example C4 data type:
Corresponds to a linear fixed point value with four decimal places. 0 corresponds to 0 (0x0), 0.0001 corresponds to 2^0 (0x0000 0001). To realize this data type you need floating point numbers: E.g. REAL, FLOAT, DOUBLE or LONG DOUBLE.

Definition of the data types see section 4.2.6.3 .
Physical units see section 4.2.3.3 .

Q 2:
What means tracking distance?

The tracking distance (Parameter 305) defines the maximum difference between the calculated setpoint of position controller and the current actual value of position, that be reported from encoder system.
If tracking distance monitoring is activated (Fault report 700 / tracking error), the following cause of faults are possible.

- heavy movement rate of axis
- to high acceleration, velocity

The adjustment of tracking distance is left to the user. The higher offset is defined the longer needs the drive to reacts to a cause of fault.
The tracking distance monitoring should be not deactivated.

2. General questions to hardware

Q 1:
Status LED's of the drive don't flash?

Check the power supply of the drive and cabling of power supply connector.

3. Positioning mode

Q 1:
It is possible to start a new positioning order during already activated positioning?

Yes. If the new movement parameter are available, an edge change in control word bit 6 is required. It takes place an overhung start. Each edge on control word bit 6 starts a new move order. See section 4.2.3.3 Table 7.

4. Speed control mode

Q 1:
How shall I do, when I wont to give a new velocity during already activated speed control?

Here an additional edge change in control word bit 6 is not required. If a new velocity value is transferred to the drive (Parameter 201, velocity), the velocity is active immediately.

5. PLC / Function blocks / Communication

Q 1:
Is it possible to use synchronous interface access with PLC (PROFIBUS) and encoTRive-Tool (RS-232)?

In parallel operation with encoTRive-Tool should be consider, that before the encoTRive-Tool is closed, the highest priority must be handed to the PLC (DPM1) about the parameter 928 "PZD control priority", see parameter 928.