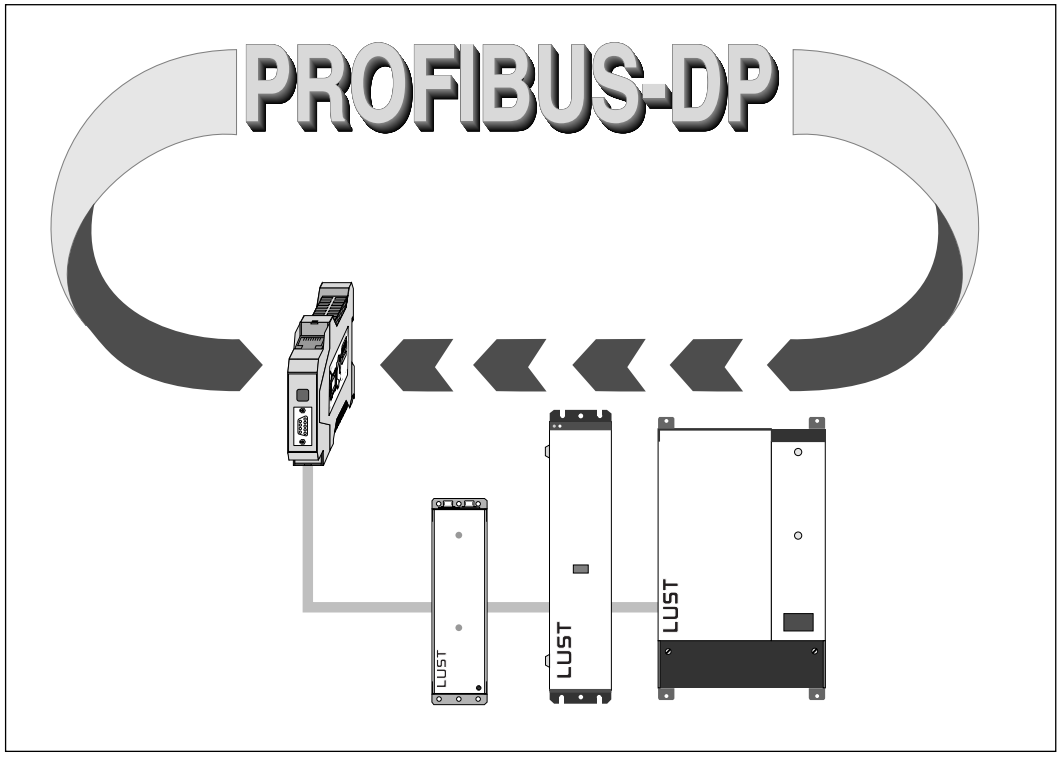
LUST
ANTRIEBSTECHNIK

Networking of inverters

EN

on the PROFIBUS-DP



Data transmission protocol

PROFIBUS-DP Data Transmission Protocol

for SMARTDRIVE VF1000S,G19,FA,CP
SMARTDRIVE VF1000M,CP
SMARTDRIVE VF1000L,CP

MASTERCONTROL MC6000,CP*
MASTERCONTROL MC7000,BASICxx,CP*

*** Note**: This PROFIBUS Data transmission protocol is valid for SMARTDRIVE VF1000S/M/L inverters, design version CP.
The MASTERCONTROL servocontrollers MC6000 / MC7000,BASIC design version CP are in preparation.

These two equipment types have a very similar transmission and for this reason have been included together in one document.

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1 General information

1.1 Foreword

This PROFIBUS documentation applies for all LUST SMARTDRIVE and MASTERCONTROL drive units. The drive units are connected to the LUST system bus via the PROFIBUS CP-DPx gateway.

1.2 Additional documentation

- Parameter description VF1000S/M/L, Summary, ID no.: 0786.04B.0
- Operation Manual PROFIBUS-DP Gateway, Type CP-DP1
- Additional information on the PROFIBUS is available from:

  PROFIBUS User Organisation e.V.

  Haid- und Neustraße 7

  D-76131 Karlsruhe

  Tel.: ++721/9658590

  Fax.: ++721/9658589

1.3 General comments

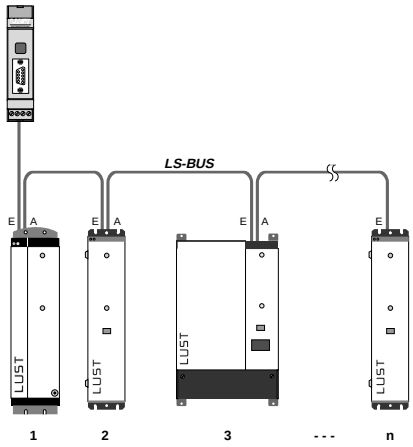
This PROFIBUS documentation is valid for SMARTDRIVE inverters and all MASTERCONTROL servo-controllers. These two equipment types have a very similar transmission and for this reason have been included together in one document. The two equipment types can be used in a single network.

In the following the term **"unit"** refers to both SMARTDRIVE type converters and MASTERCONTROL type servocontrollers.

The term **"master"** refers to a higher-level control system that takes over the organisation of the bus system.

The LUST drive units are networked via the **"LUST system bus (LS-BUS)"**. This bus is based on the firm's own CAN-BUS protocol.

The PROFIBUS User Organisation (Nutzer-organisation) e.V. will be refered to as **"PNO"**.



1.4 Instructions for use via PROFIBUS

The PROFIBUS interface operates via the LUST system bus on each unit at a relatively high user level. This means it is possible to obtain parameters which are not accessible via the KEYPAD.

Caution: Some parameters in these user levels are so-called service parameters and as such are not included in the standard operation manuals for each individual unit. Unintentional write access to such parameters can severely impair unit function!

2 General information on PROFIBUS

PROFIBUS is an independent open-type field bus standard for multiple applications in production, process and building automation. It is specified by international norm EN50170.

2.1 Masters

Master units control data traffic on the bus. A master can transmit messages on the bus without an external prompt if it has a bus access authorisation (**token**).

2.2 Slaves

Periphery units. Drives are an example of typical slave units.

Slaves have no bus access authorization, i.e. they can only acknowledge messages received or transfer messages to a master on request. Slaves are also refered to as passive stations.

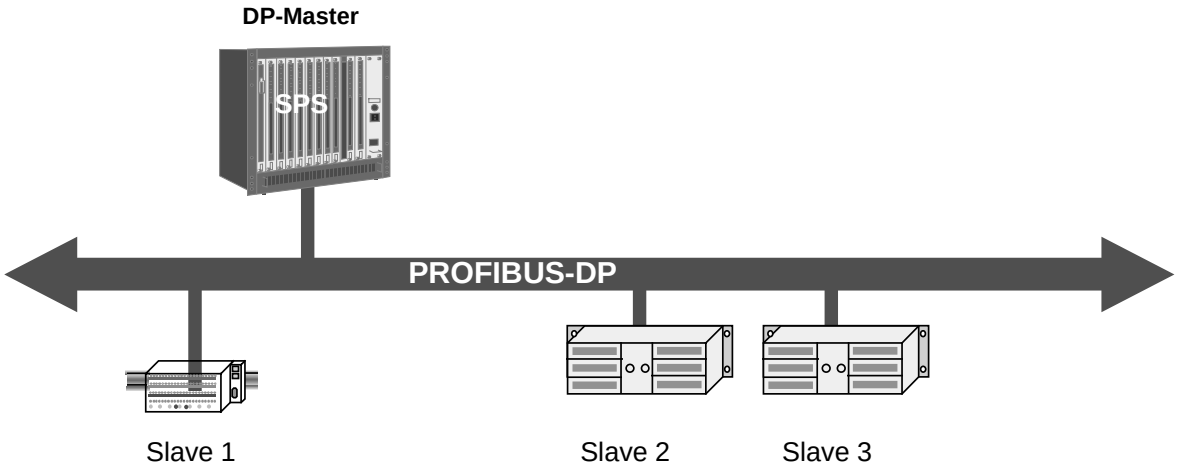


Diagram: bus structure master/slave

3 LUST PROFIBUS Gateway

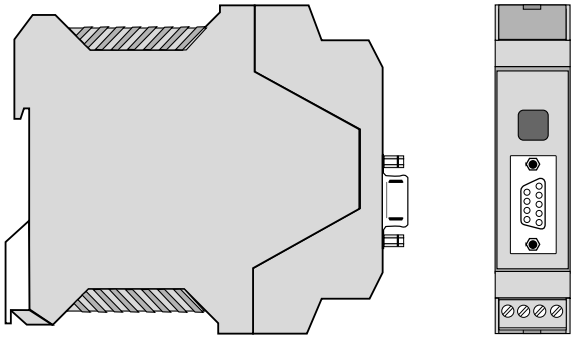


Diagram: PROFIBUS gateway type DP-CPx

PROFIBUS-DP Gateway CP-DP1	
ambient temperature	0 ... 50 °C
voltage gain	+24 V DC ± 20 %
power consumption	max. 1.4 A
protection	IP20

3.1 Normal mode of operation

Up to 10 drives can be connected to the PROFIBUS and controlled via the PROFIBUS gateway.

Drive addresses must lie within the range 0 - 9.

3.2 Rates of transmission

Supported rates of transmission range between 9.6 kbaud and 12 Mbaud.

Please take special note of the PNO application instructions, particularly for high rates of transmission.

3.3 Transmission technique

The gateway is connected to the PROFIBUS via an RS485.

4 Gateway operating features

4.1 Start performance

At start-up the gateway automatically detects the stations connected to the LUST system bus. Via the gateway it is possible to communicate with each individual drive immediately at the start.

The valid PROFIBUS configurations are determined from the types identified.

The configuration is checked during PROFIBUS communication start-up and if start-up is successful, the drive(s) can be controlled via the PROFIBUS, by PROFIDRIVE profile simulation or in transparent mode.

The following applies to servocontrollers:

Following PROFIBUS initialisation, the 492 - CACNF (see Section 6.3) parameter obtained from PPO type and parameter 1002 (see Section 6.4.1.3) is sent to all servos first.

Activation of the status machine for speed or position control follows.

Caution: The local CFCON parameter (subject area _CAN) for the servos determines whether position control or speed control is used. For this reason this parameter should not be changed locally later.

4.2 Operating modes

During PROFIBUS initialisation it is possible to select one of two operating modes available on the PROFIBUS gateway via the master:

- PROFIDRIVE emulation
- transparent mode

In PROFIDRIVE emulation mode the drives are operated using the PROFIDRIVE status machine.

In transparent mode it is possible to access LUST system bus data and process drive control words and status reports directly.

4.3 Automatic adjustments to inverter or server settings

- **Inverters:**

40 - TCAN watchdog to standard value

- **Servos:**

409 - BUTWD watchdog to standard value

The gateway adjusts the servo’s 492-CACNF parameter depending on PPO type (parameter process data object) and gateway parameter 1002 (see Section 6.6.1.3).

4.4 Malfunction performance

4.4.1 Gateway malfunction

Should a gateway error occur all drive units are set to emergency stop, a “5” appears in the display of the CP-DPx gateway and a diagnostic message is transmitted via the PROFIBUS.

4.4.2 Drive malfunction

Drive malfunctions are reported via the fault bit of the status word. The gateway will not react. A diagnosis is transmitted via the PROFIBUS to the effected PZD (see Secion 6.5).

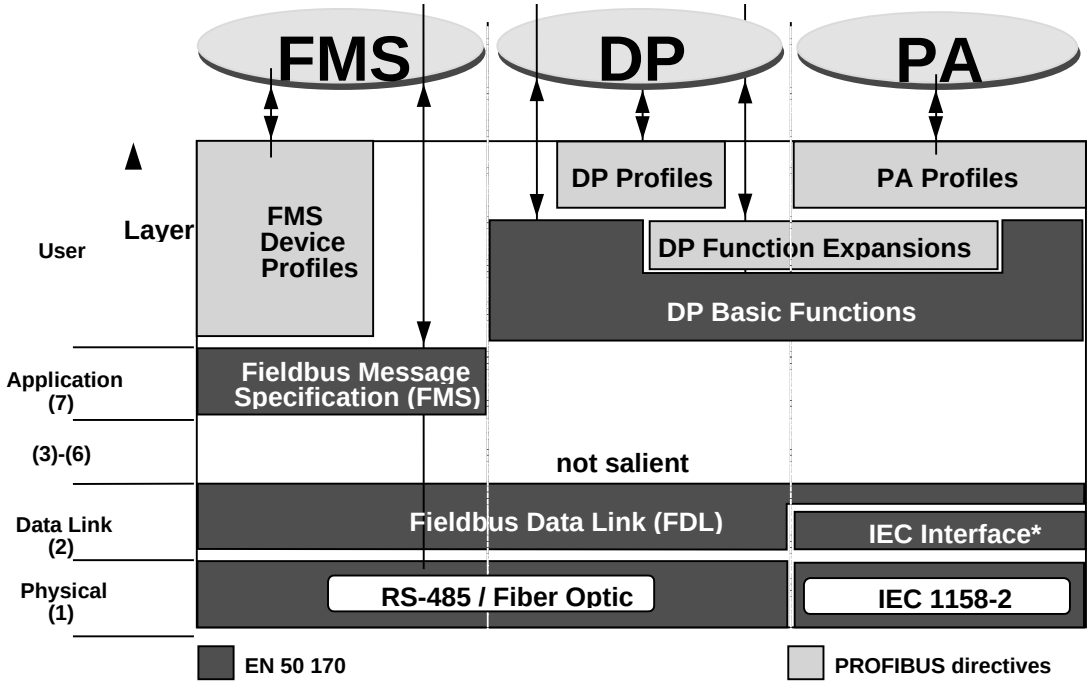
4.4.3 Bus malfunction

If there are faults in communication with the PROFIBUS master, the emergency stop is activated for all connected servocontrollers.

If there are faults in communication with one or more drive units, the emergency stop is activated for all malfunctioning servocontrollers (even if you probably will not recognise this).

5 PROFIBUS-DP

PROFIBUS-DP uses layers 1 (physical layer), 2 (data link layer) and 7 (application layer).



* Integration to EN 50170 Volume 2 as Appendix 2 applied for.

Diagram: Protocol architecture

5.1 Network structure

Individual LUST drive units are connected to the PROFIBUS via a gateway. The gateway is connected to each drive via the LUST system bus.

It is possible to connect up to 10 units to the PROFIBUS via a gateway.

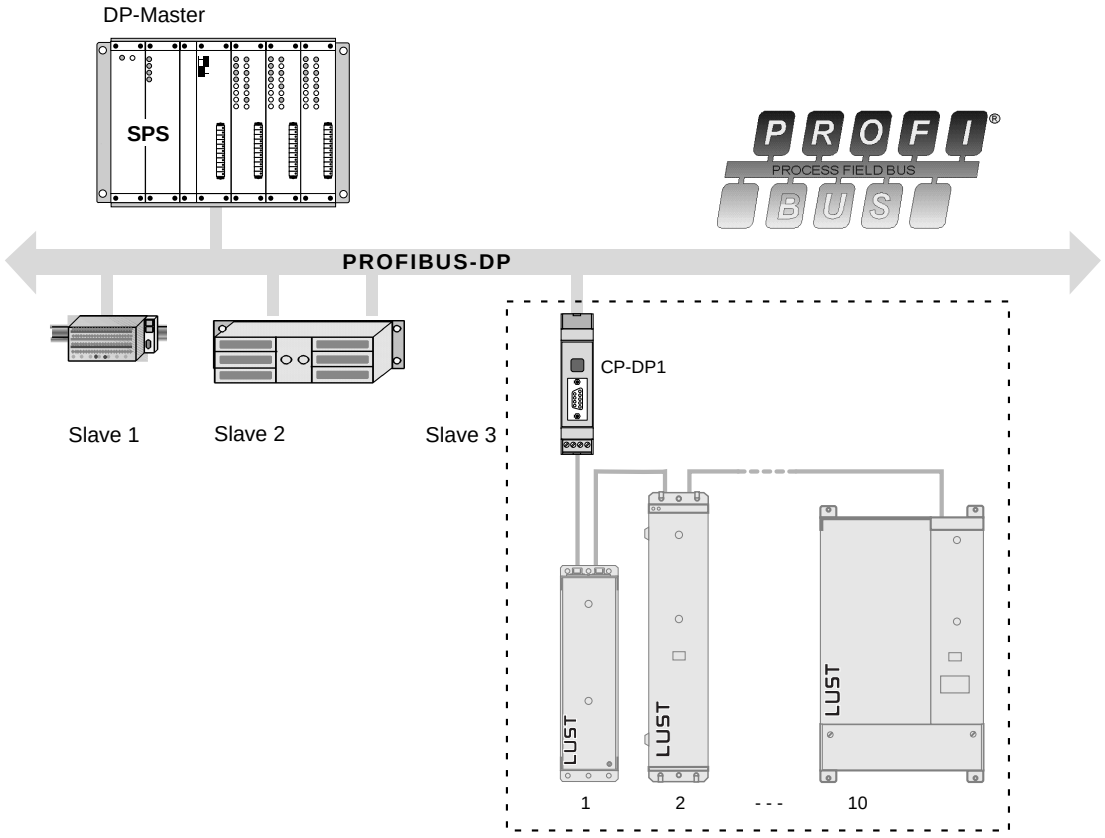


Diagram: Bus structure: PROFIBUS / LUST system bus

5.2 PROFIBUS Basic Functions

The master retrieves the input data from the drives cylically. The bus cycle time must be shorter than the program cycle time for the master.

- Transmission technique:
  - RS485 twisted two-wire line
- Bus access:
  - token passing
  - monomaster or multimaster systems possible
- Communication:
  - cyclical master / slave user data exchange
- Protective functions:
  - all messages transmitted with Hamming distance HD = 4
  - response monitoring for DP slaves
  - monitoring of user data exchange using adjustable monitoring timer for the master

6 Protocol description

6.1 Structure of user data in PROFIBUS-DP

The PROFIBUS-DP divides its telegram logically into identifiers. An identifier represents a virtual E/A module. It contains information on data length (1..16 bytes or words) and consistency. Identifiers are created offline using the PROFIBUS master's configuration tool.

The identifier "4 word EA with consistency" (0xF3) stands for a parameter range (PKW), while 2 or 6 word EA with consistency (0xF1, 0xF5) stand for process data range (PZD).

The following is valid for parameter process data objects (PPO):

PPO type	identifier bytes	identifier Siemens Step7, COM PROFIBUS
PPO 1	0xF3, 0xF1	4AX,2AX
PPO 2	0xF3, 0xF5	4AX,6AX
PPO 3	0xF1	2AX
PPO 4	0xF5	6AX

The sequence is important.

If more than one drive unit is to be used, the desired PPOs are stringed to each other consecutively (2 x PPO1: 0xF3, 0xF1, 0xF3, 0xF1). The first PPO effects the drive unit that has the lowest CAN address.

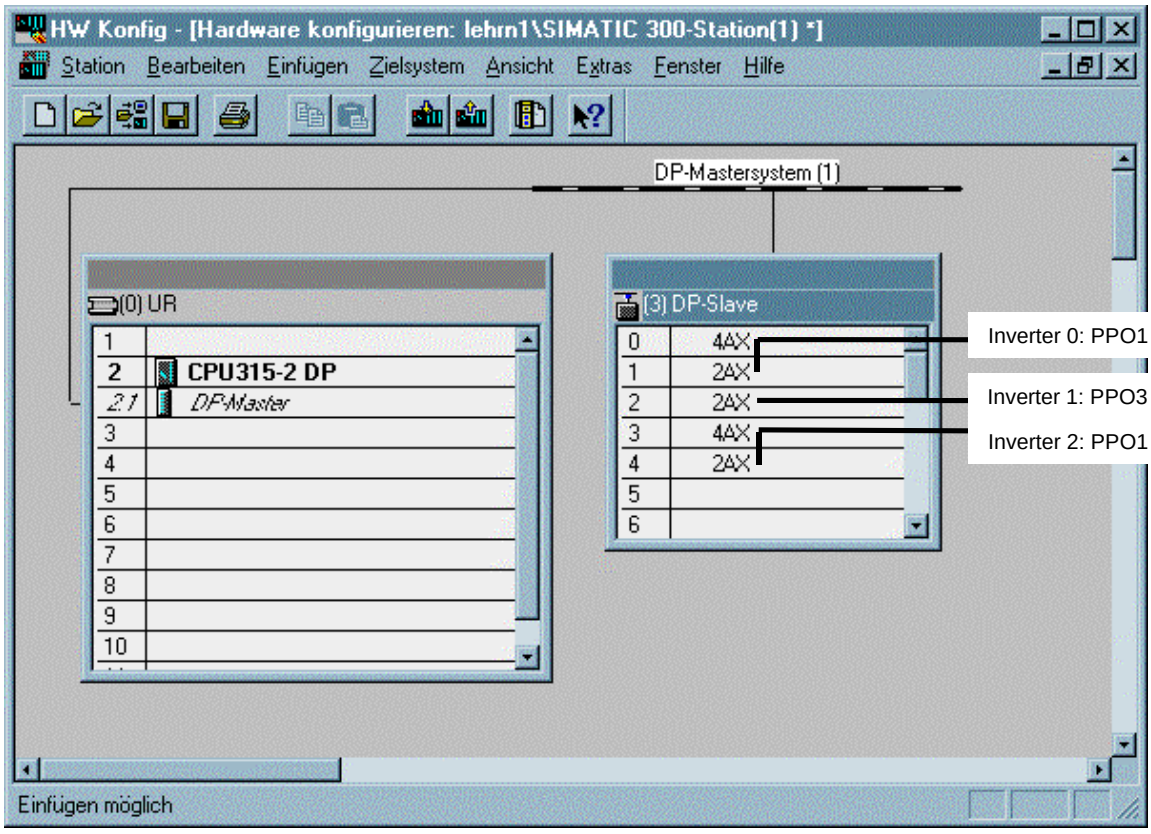
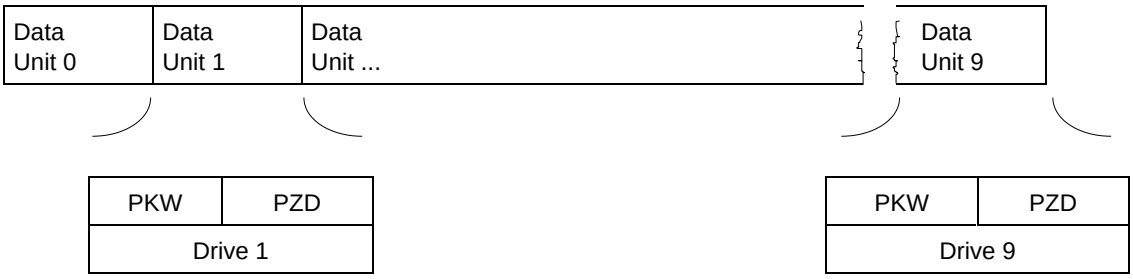


Diagram: Hardware configuration using STEP7

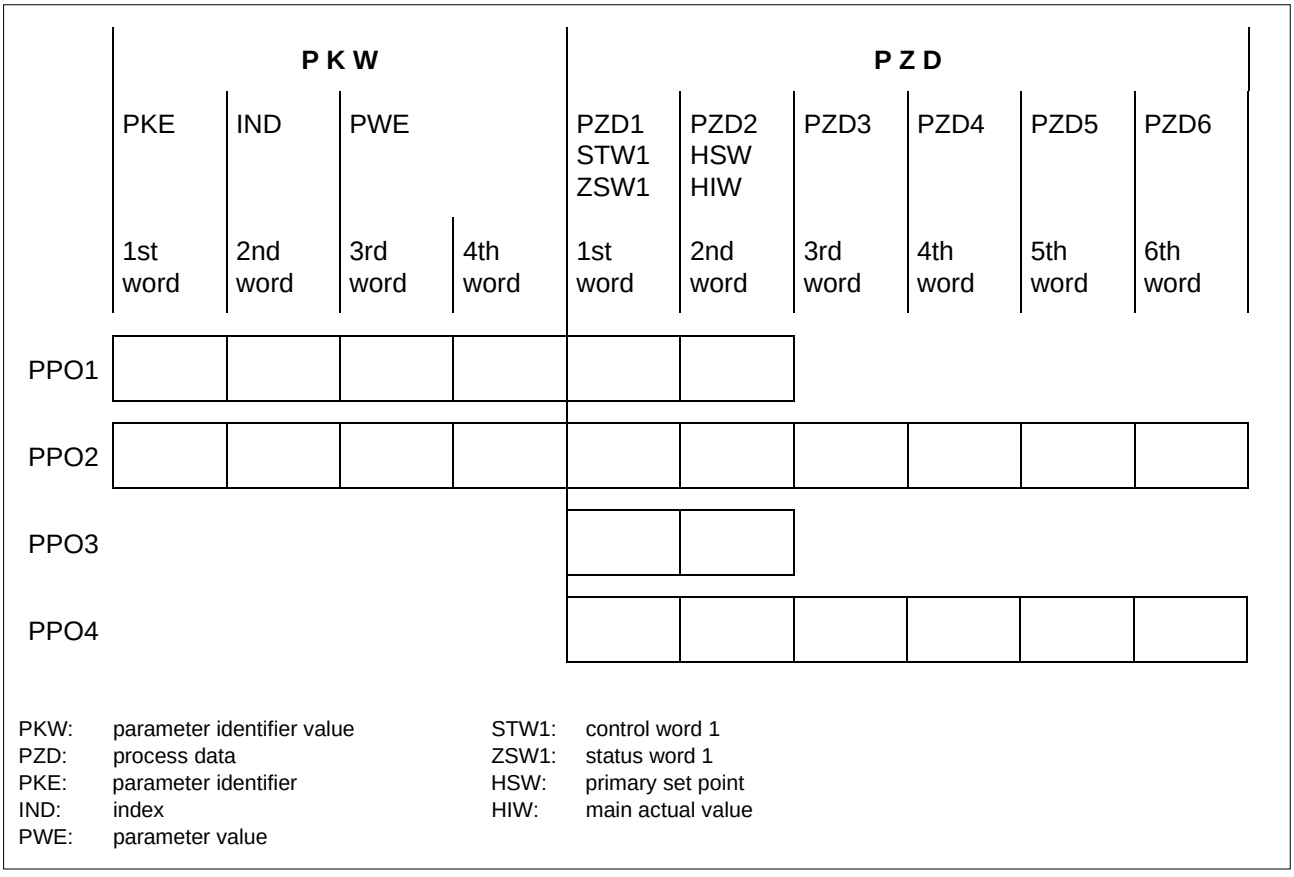
PROFIBUS communication will begin only if:

- the identifiers form permitted PPOs only.
- the number of PPOs corresponds to the number of drive units on CAN.
- inverters are actuated with PPO1 or PPO3 only.

If multiple units (max. 10 stations) are attached to the LUST system bus the network data for the different units is arranged in ascending order in the transmission protocol.



6.2 Structure of PPO types



6.3 PPO Types Used

The gateway supports

- PPOs 1 and 3 for inverters
- PPOs 1 to 4 for servos

In PROFIDRIVE mode for **servos** the gateway adjusts the servo's 492-CACNF parameter (in subject area _CAN) dependent on PPO type and gateway parameter 1002 (see Section 6.6.1.3). This parameter configures databyte analysis in the servocontroller.

	CACNF	PPO1	PPO2	PPO3	PPO4	gateway parameter 1002
Servo	1	✔		✔		0 or 1
	2		✔		✔	0
	3		✔		✔	1
	4					
Inverter		✔		✔		-

Caution: The network must be reset if the CACCNF has been changed. Subsequent readjustment of the CACNF parameter via the bus can cause malfunctions!

6.4 Parameter data

When a PROFIBUS-DP slave is commissioned the PROFIBUS master transmits a parameter telegram to the slave.

For the PROFIBUS gateway the user parameters must be transmitted in addition to the standard parameters between 4 and 24 bytes (between 2 and 12 words).

Byte	
0	**station status (standard)**
1	**WD_fact_1 (standard)**
2	**WD_fact_2 (standard)**
3	**min Tsdr (standard)**
4	**ID number (high byte) (standard)**
5	**ID number (low byte) (standard)**
6	**Group_ID (standard)**
7,8	**bit field for transparent mode (user)**
9,10	bit field for 32 bit set points (user)
11	100% for current adjuster 0 (high byte) (user)
12	100% for current adjuster 0 (low byte) (user)
13,14	100% for current adjuster 1 (user)
.....	....
29,30	100% for current adjuster 9 (user)

The 100% values are used to set the scaling of 16 bit set points in speed control. The value transmitted via CAN to the current adjuster is calculated from

$$\text{CAN - set point} = \frac{\text{PROFIBUS - set point}}{4000_{hex}} * 100\%\text{-value}$$

Setting these values is optional; if no such values are transmitted then 4000_{hex} will be assumed, which corresponds to “not scaled”.

Transparent Mode		
Byte	Bit	Connotation
7	2.....7	reserved
	1	current adjuster 9
	0	current adjuster 8
8	7	current adjuster 7
	6	current adjuster 6
	.....	
	1	current adjuster 1

32 bit set point		
Byte	Bit	Connotation
9	2...7	reserved
	1	current adjuster 9
	0	current adjuster 8
10	7	current adjuster 7
	6	current adjuster 6
	.....	
	1	current adjuster 1
	0	current adjuster 0

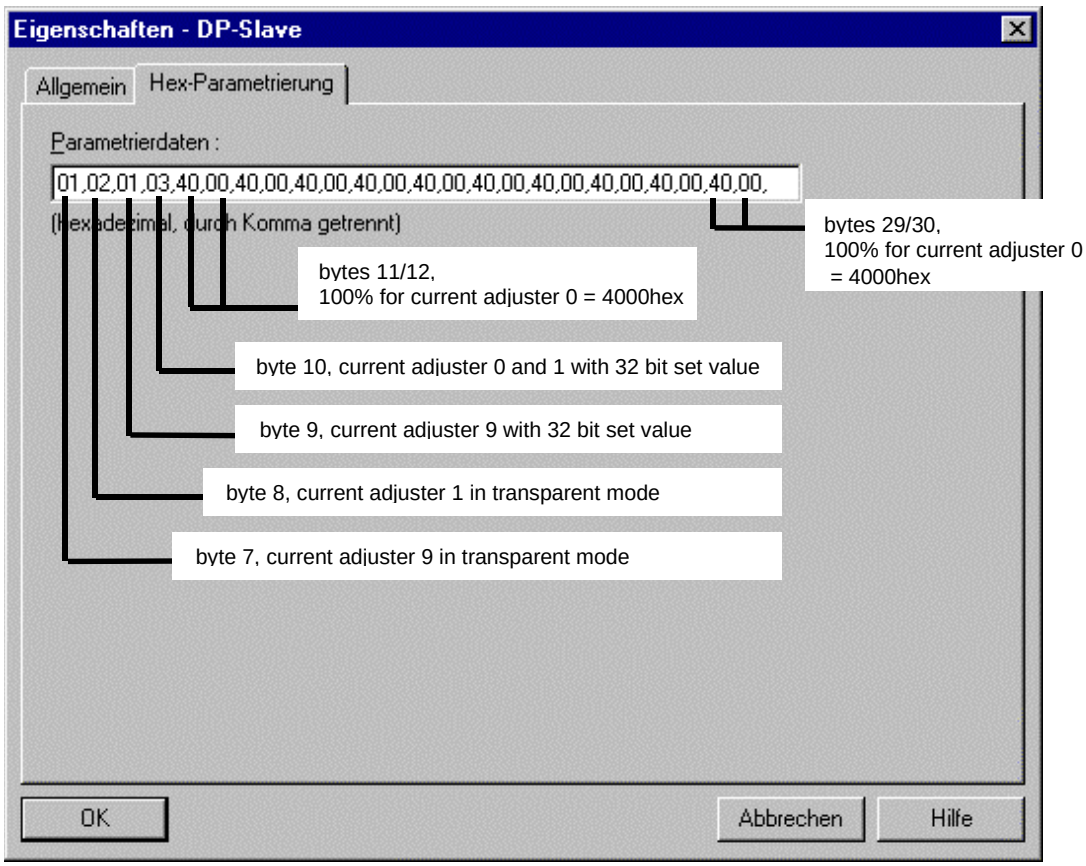


Diagram: Hardware configuration with STEP 7 DP slave object characteristics

6.5 Diagnosis

Byte	Connotation
0	station status 1 (standard)
1	station status 2 (standard)
2	station status 3 (standard)
3	DP master station address (standard)
4	ID number (high byte) (standard)
5	ID number (low byte) (standard)
6	user diagnosis header (standard)
7	CAN block status (user)
8...9	list of recognised current adjusters on CAN (user)
10	(CAN-) error message from current adjuster 0 (user)
....	... ...
19	(CAN-) error message from current adjuster 9 (user)

Diagnostic byte 7 is the content of the on-chip CAN interface status register in the C167 micro-controller:

Byte	Bit
7	7 bus off status
	6 error warning status
	3..5 reserved
	0..2 **"last error code"**

"last error code"	
0	no error
1	stuff error
2	form error
3	ack error
4	bit1 error
5	bit0 error
6	CRC error

One bit is reserved for each current adjuster in bytes 8 and 9. If this bit is set then a current adjuster was found at the corresponding CAN address.

Byte	Bit	
9	2...7	reserved
	1	current adjuster 9
	0	current adjuster 8
10	7	current adjuster 7
	... ...	
	0	current adjuster 0

If the gateway receives an error message from a drive unit, the error number (see 6.6.1.1) is entered into the corresponding PROFIBUS-DP diagnosis byte. This means the current error messages are transferred to bytes 11 to 20.

6.6 Parameterrange in PROFIDRIVE mode (PKW)

In the PROFIBUS PKW section the task (set or request parameters) is set along with AK (in accordance with PROFIDRIVE). PNU determines the parameter numbers. The gateway interprets parameters inside the range 1..999 as normal drive parameter numbers. Refer to the corresponding drive operation manuals for the connotation of the parameters.

6.6.1 Definition: Parameter Identifier (PKE)

BIT															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AK				SPM	PNU										

AK: Task Identifier
SPM: Spontaneous Message Processing (not supported)
PNU: Parameter Number

6.6.1.1 Definition: Task Identifier (AK)

Master to gateway:

0 no task

1 request parameter value

2 write parameter value (word)

3 write parameter value (double word)

Gateway to master:

0 no answer

1 transmit parameter value (word)

2 transmit parmeter value (double word)

7 cannot execute task and error number

Mapping of system bus error numbers to PWE error numbers (parameter value)

	CAN error no. included with AK7	Definition
SIO Status 0000 0000	no error	read not permitted
SIO Status xxxx 1xxx	error number 19	unknown parameter
SIO Status xx1x xxxx	error number 0	change not permitted
SIO Status x1xx xxxx	error number 1	illegal value
SIO Status 1xxx xxxx	error number 2	SIO watchdog
SIO Status 0000 001x	error number 100	unknown transmission mode
SIO Status 0000 010x	error number 101	read not permitted
SIO Status 0000 011x	error number 102	(not assigned)
SIO Status 0001 000x	error number 103	(not assigned)
SIO Status 0001 001x	error number 104	(not assigned)
SIO Status 0001 010x	error number 105	(not assigned)
SIO Status 0001 011x	error number 106	(not assigned)

6.6.1.2 Definition: Spontaneous Messages (SPM)

Spontaneous messages are not supported because the gateway cannot recognise changes to parameters made via other interfaces (e.g. KEYPAD).

6.6.1.3 Definition: Parameter No. and Gateway Parameter (PNU)

Allocation of parameter numbers:

1..999 LUST parameters are relayed to the drive units

(documentation for each drive unit)

1000..1049 Gateway parameters

1000 Unsigned16 CAN baud rate corresponds to inverter parameter 37 - BCAN and servo parameter 489 - CABDR, effects gateway only; read-only parameter

1001 Unsigned16 nominal value (100%) for speed control; this parameter exists for the configured part of each drive unit

1002 Unsigned16 For servos with speed control which are operated using PPO2 or PPO4 this signifies:

0: PZD1 + PZD2 = 32 bit rotational speed (CACNF = 2)

1: PZD1 = 16 bit rotational speed, PZD2 = 16 bit torque (CACNF = 3); this parameter exists for the configured part of each drive unit

1003 Unsigned16 PROFIBUS address; read-only

1004 Unsigned16 During change to 1, non-volatile storage of gateway parameters in the gateway.

6.7 Parameterrange in transparent mode

6.7.1 Inverter parameter channel

Parameter enquiry/transfer

Data are normalized for this transfer according to the definitions in the inverter parameter list.

For detailed information on adjustment and availability of these functions refer to the parameter description available separately for each unit.

Data direction: Master -> FU

Data byte 0	Data byte 1	Data byte 2	Data byte 3	Data byte 4
PARA_LO	PARA_HI	transmission mode: "ENQ" = 02 "SEL" = 05	DATA_LO	DATA_HI

Data direction: FU -> Master

Data byte 0	Data byte 1	Data byte 2	Data byte 3	Data byte 4
PARA_LO	PARA_HI	SIO STATUS 0 = transmission OK BIT 0 = power on 1 = SIO watchdog 2 = unknown transmission mode 3 = read not permitted 4 = (not assigned) 5 = unknown parameter 6 = change not permitted 7 = illegal value	DATA_LO	DATA_HI

PARA_LO: low byte parameter number

PARA_HI: high byte parameter number

Transmission mode:

ENQ	data enquiry
SEL	data transfer

DATA_LO: low byte data

DATA_HI: high byte data

6.7.2 Servo parameter channel

Parameter enquiry/transfer

Data are normalised for this transfer according to the definitions in the servo parameter list (detailed information on adjustment and availability of these functions is available on request).

Data direction: MASTER -> SERVO

Data byte 0	Data byte 1	Data byte 2	Data bytes 3+4+5+6	Data byte 7
PARA_LO	PARA_HI	Transmission mode: "SEL" = 02 "ENQ" = 05	DATA	COUNTER

PARA_LO: low byte parameter number

PARA_HI: high byte parameter number

Transmission mode:

ENQ data enquiry
SEL data transfer
DATA: 32 bit data at "List End": check sum)

COUNTER: block counter
(incremented for each transfer)

Data direction: SERVO -> MASTER

Data byte 0	Data byte 1	Data byte 2	Data bytes 3+4+5+6	Data byte 7
PARA_LO	PARA_HI	SIO STATUS 0 = transmission OK BIT 0 = power on 1 = SIO watchdog 2 = unknown transmission mode 3 = read not permitted 4 = repeat action 5 = unknown parameter 6 = change not permitted 7 = illegal value	DATA	COUNTER

PARA_LO: low byte parameter number

PARA_HI: high byte parameter number

DATA: 32 bit data (at "List End": check sum)

COUNTER: block counter (incremented for each transmission of a new block within an array)

6.8 Configuration of process data (PZD)

Two different control modes are available for unit control:

- direct transmission (transparent mode)
- PROFIDRIVE mode

Two different control modes are available for unit control via CAN:

- In **control mode 1** the control terminal function of the drives is simulated. The terminal simulation is available for all units.
- In **control mode 2** the unit is controlled via the DRIVECOM status machine. This control mode is supported by the servodrives only.

6.8.1 Direct transmission (transparent mode)

To retain the usual control of LUST units the gateway can transmit PROFIBUS data from the PZD range directly to the system bus. For inverters PPO 1 or 3 must be used (for servos PPO 2 or 4). The mode is activated by transmitting PROFIBUS user parameter 8 or 9 for the corresponding drive unit.

Words PZD1 through PZD4 are mapped to data bytes 1 - 8 of the control or status channel without modification and vice versa.

6.8.1.1 Terminal simulation

This function provides control bits via the CAN control word which simulate the unit input terminals (e.g. STL/STR - start enable or S1IND programmable input).

Terminal simulation for inverters

Control functions:

As the inverter's internal status machine has a cycle time of 8 ms, these values enter the inverter control cycle every 8 ms. Data byte 2 contains the inverter terminal simulation.

Cycle time: 8 ms

Data byte 0	Data byte 1	Data byte 2	
SET_LO	SET_HI	inbits	0 = STR
			1 = STL
			2 = S1IND
			3 = S2IND
			4 = S1OUT
			5 = S2OUT
			6 = S3OUT
			7 = ERROR_RESET

- For parameter adjustment: 04-FSSEL = 26
  set point normalisation: 1 bit = 0.009934 Hz

In this mode the maximum resolution of the inverter is obtained. No conversions or ramps enter into the exactness of the output frequency. The output frequency of the inverter is solely dependent on the quarz oscillator used.

Caution: The drive complies rigidly with the set point input **(no ramp functions!)** For this reason the set point ramp must be generated by a higher-order control system.

- For parameter adjustment: 04-FSSEL = 25
  set point normalisation: 1 bit = 0.05 Hz

All ramp and control functions can be used in this mode. For detailed information on adjustment and availability of these functions refer to the parameter description available separately for each unit.

04-FSSEL defines which set point source will be used to control the inverter. Values 25 and 26 refer to the LUST system bus as set point source. Please note that if these parameters are changed, set point sources other than the LUST system bus will be processed. For detailed information on adjustment and availability of these functions refer to the parameter description available separately for each unit.

Explanation of inbits:

STR /STL	=	Start commands: for 01-MODE = 4 CAN as control location (default setting for the unit in CAN mode)
S1IND/S2IND	=	Fully programmable inverter inputs: If these bits are set in the control word, they will be linked to the values for the inverter's hardware inputs by means of an OR operation inside the inverter (in default setting, fixed frequencies are selected via the inputs).
S1OUT/S2OUT/S3OUT	=	Fully programmable inverter outputs: If these bits are set in the control word, they will be linked to the values for the inverter's hardware outputs by means of an OR operation inside the inverter. If these outputs are to be controlled via the CAN bus only, all inverter functions which could be set to parameter values at this output must be deactivated. For detailed information on adjustment and availability of these functions refer to the parameter description available separately for each unit.
ERROR_RESET	=	This bit is used to reset errors; the inverter changes to status "System_Stop".

Inverter status messages:

The inverter transmits a status message every 80 ms.

Cycle: 80 ms

Data byte 0	Data byte 1	Data byte 2	
ACT_LO	ACT_HI	OUT_BIT	0 = STR
			1 = STL
			2 = S1IND
			3 = S2IND
			4 = S1OUT
			5 = S2OUT
			6 = S3OUT
			7 = ERROR

If 04-FSSEL = 26, actual value normalisation: 1 bit = 0.009934 Hz

If 04-FSSEL = 25, actual value normalisation: 1 bit = 0.05 Hz

Explanation of outbits:

STR /STL	=	Status of start commands
S1IND/S2IND	=	Fully programmable inverter inputs: If these bits are set in the control word, they will be linked to the values for the inverter inputs by means of an OR operation inside the inverter and listed here as status.
S1OUT/S2OUT/S3OUT	=	Fully programmable inverter outputs: If these bits are set in the control word, they will be linked to the values for the inverter outputs by means of an OR operation inside the inverter. If these outputs are to be used via the CAN bus only, all inverter functions which could be set to parameter values at this output must be deactivated. For detailed information on adjustment and availability of these functions refer to the parameter description available separately for each unit.
ERROR	=	error message

Terminal simulation for servos

The servo status machine has a cycle time of 1 ms. All control commands and set points are processed by the servocontroller in this cycle time.

Cycle time = 1 ms

Select status control and set point input via parameter 492-CACNF.

CACNF	1	2	3	4
set point 1	16 bit	32 bit	32 bit	32 bit
set point 2				
Actual value 1	16 bit	16 bit	16 bit	32 bit
Actual value 2		16 bit	16 bit	
DRIVECOM				
Terminal simulation				

The network must be reset if the CACNF has been changed.

If 492-CACNF = 4

Data byte 0	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Data byte 5
Bit:	Bit:	SET	SET	SET	SET
0 = START	0 = OS00	_LWLB	_LWHB	_HWLB	_HWHB
1 = INV	1 = OS01				
2 = /STOP	2 = empty				
3 = E_EXT	3 = empty				
4 = MP_UP*	4 = empty				
5 = MP_DOWN*	5 = empty				
6 = empty	6 = empty				
7 = ERROR_RESET	7 = empty				

*Note: active only if the MOP function is set via the reference selector (set point selector)

SET_LWLB: set point low word low byte

SET_LWHB: set point low word high byte

SET_HWLB: set point high word low byte

SET_HWHB: set point high word high byte

Servodrive status messages

If 492-CACNF = 4

Data byte 0	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Data byte 5
Bit:	Bit:	ACT	ACT	ACT	ACT
0 = ERROR	0 = ENPO	_LWLB	_LWHB	_HWLB	_HWHB
1 = WARN	1 = IS00				
2 = REF	2 = IS01				
3 = LIMIT	3 = OS00				
4 = ACTIV	4 = OS01				
5 = ROT_0	5 = A0				
6 = ROT_R	6 = A1				
7 = ROT_L	7 = EXT_SYN1				

ACT_LWLB: actual value low word low byte
ACT_LWHB: actual value low word high byte
ACT_HWLB: actual value high word low byte
ACT_HWHB: actual value high word high byte

6.8.1.2 DRIVECOM mode (servos only)

Control using the DRIVECOM status machine

If 492-CACNF = 1

Data bytes 0+1	Data bytes 2+3	Data byte 4
control word	set point	reserved

Control word: see description (control word).

Set point: set point (depending on control used).

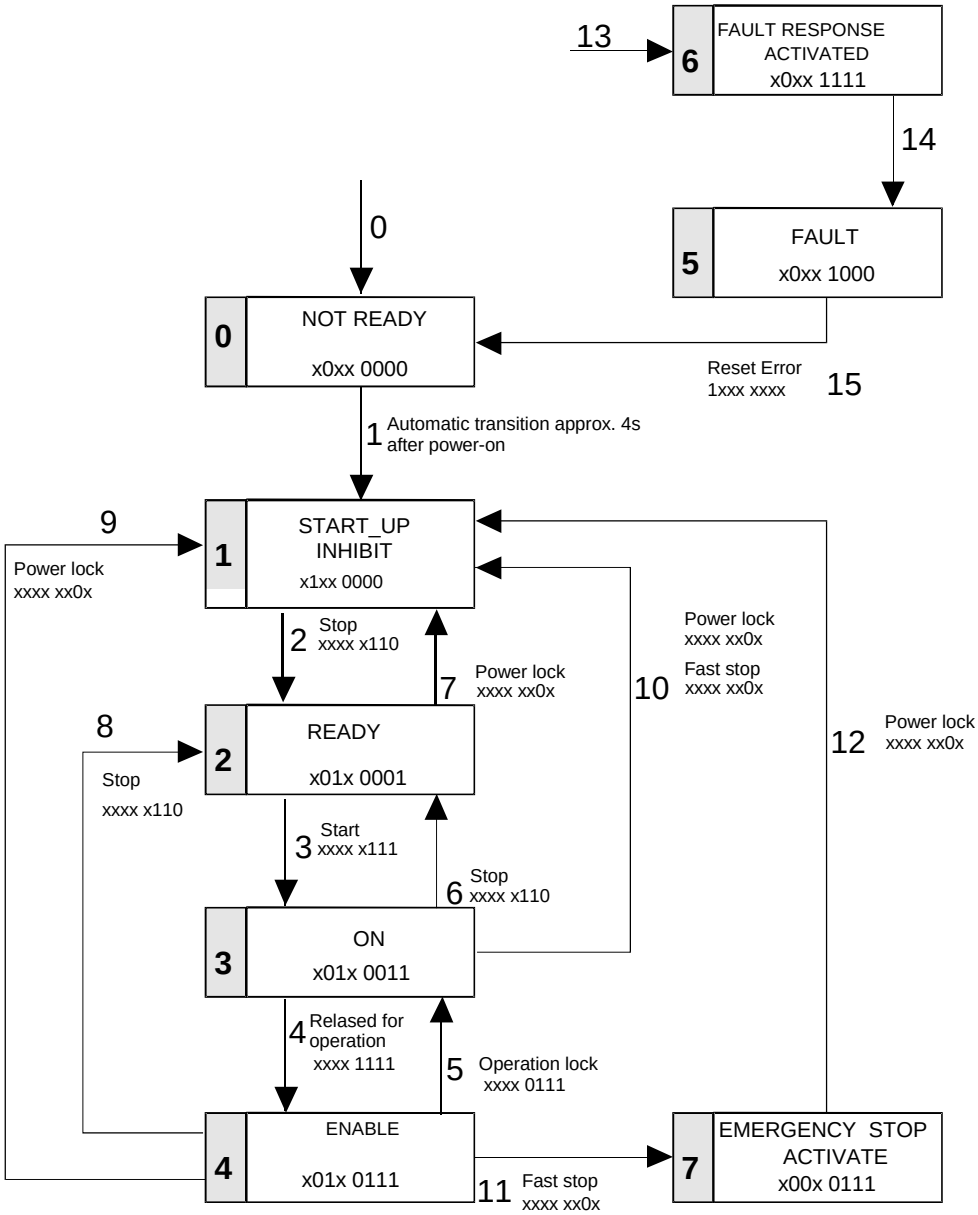
If 492-CACNF = 2.3

Data bytes 0+1	Data bytes 2+3+4+5	Data byte 6
control word	set point	reserved

Control word: see description (control word).

Set point: set point (depending on control used).

Status machine



Control word

By logical operation the 16 bits in the control word produce control commands which effect the status machine. The following bits of the DRIVECOM control word are supported:

Bit	Description
0	start up
1	block voltage
2	emergency stop
3	operation enabled
4	mode dependent
5	detailed definition:
6	DRIVECOM Profile no. 22 January 1994
7	reset malfunction
8	reserve
9	reserve
10	reserve
11	empty
12	empty
13	empty
14	set condition output OS00
15	set condition output OS01

Unit control commands

The following bit combinations form the unit control commands:

	Control bit					
Command:	**7**	**3**	**2**	**1**	**0**	**Junctions:**
SHUTDOWN	X	X	1	1	0	2, 6, 8
TURN-ON	X	X	1	1	1	3
BLOCK VOLTAGE	X	X	X	0	X	7, 9, 10, 12
EMERGENCY STOP	X	X	0	1	X	7, 10, 11
SUSPEND OPERATION	X	0	1	1	1	5
ENABLE OPERATION	X	1	1	1	1	4
RESET MALFUNCTION	0⇨1	X	X	X	X	15

Junctions 4 and 5 are also effected by 'System Start Stop'!

Servo status messages

Depending on the control mode in which the unit is operated, the corresponding mode for status messages will be selected automatically.

If 492-CACNF = 1

Data bytes 0 and 1	**Data bytes 2 and 3**	**Data byte 4**
status word	actual value	reserved

If 492-CACNF = 2.3

Data bytes 0 and 1	**Data bytes 2 and 3**	**Data bytes 4 and 5**	**Data byte 6**
status word	actual value 1	actual value 2	reserved

Status word: see description (status word)

Cycle: number of internal cycle in which the status word was determined; evaluated in synchronised operation only (no function at present).

Actual value 1: see definition (492-CACNF)

Actual value 2: see definition (492-CACNF)

DRIVECOM status word

The current status of the unit and additional messages are displayed in the status word. The following bits of the DRIVECOM status word are supported:

Bit	Description
0	ready
1	on
2	operation enabled
3	malfunction
4	voltage blocked
5	emergency stop
6	turn-on lockout
7	warning
8	no function
9	remote
10	set point attained
11	limit
12	mode dependent
13	detailed definition: DRIVECOM Profile no. 22 January 1994
14	actual status output IS00
15	actual status output IS01

Unit status

The following bit combinations form the unit control commands:

	Status bit					
Status:	**6**	**5**	**3**	**2**	**1**	**0**
NOT READY	0	X	0	0	0	0
TURN-ON LOCKOUT	1	X	0	0	0	0
READY	0	1	0	0	0	1
ON	0	1	0	0	1	1
OPERATION ENABLED	0	1	0	1	1	1
MALFUNCTION	0	X	1	0	0	0
MALFUNCTION RESPONSE ACTIVE	0	X	1	1	1	1
EMERGENCY STOP ACTIVE	0	0	0	1	1	1

6.8.2 Structure of user data in PROFIDRIVE mode

Structure of process data (PZD)

PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
STW ZSW	HSW HIW	SW IW			

- In the PZD section of the data telegram (PZD: process data) a control word and a set point (output data) or a status word and one or two actual values (input data) are transmitted.
- The control word and the status word correspond to those in the PROFIDRIVE current adjusters.
- If the set and actual value are transmitted as 16 bit numbers in speed control mode (PPO1/3 or actual values for PPO2/4 and CACNF - 1), they will be transmitted in normalised form. 100% are transmitted as 4000hex; the value range extends from - 200% (8000hex) to +199.99% (7FFFhex).
- The 100% value can be set separately for each current adjuster by means of gateway parameter 1001.
- In position control mode or if the set point or actual value is transmitted as a 32 bit number, the gateway will not conduct normalisation.

For PPO2 and 4 the last 6 bytes remain unused. In the input data telegram these bytes are set to zero.

- **PZD1**

The control or status word is transmitted in PZD 1. The individual bits are described in the section on the PROFIDRIVE status machine.

- **PZD2**

The primary set point or actual value is transmitted in PZD 2. Two options are available for reference input (set point input):

- input in unit normalisation: Refer to the description of the corresponding unit for further information on this type of normalisation.
- percentage input: The set point relayed is normalised to 100%. Parameter 1001 defines the reference value.

- **PZD3**

The lesser part of the set point or actual value (depending on the operation mode) is located here.

- **PZD4**

no data

- **PZD5**

no data

- **PZD6**

no data

6.8.2.1 PROFIDRIVE status machine

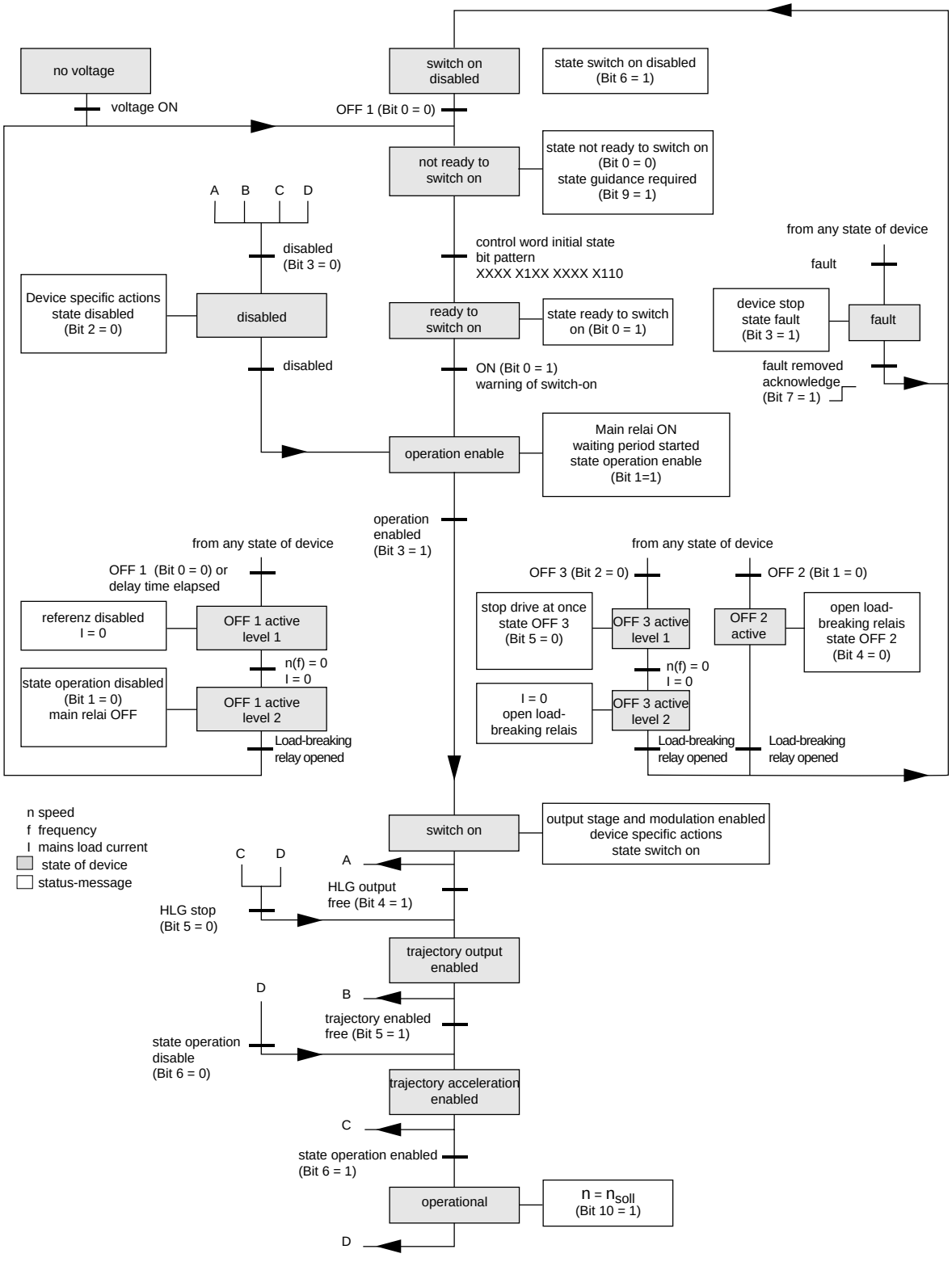


Diagram: PROFIDRIVE status machine

6.8.2.2 Control Word Speed Control Mode/Positioning

Bit	Connotation
0	ON / OFF 1
1	operating condition / OUT 2
2	operating condition / OUT 3
3	enable operation / operation blocked
4	operating condition / block speed ramp
5	enable speed ramp / block speed ramp
6	enable set point / inhibit set point
7	acknowledge / (no meaning)
8	jog 1 ON / jog 1 OFF
9	jog 2 ON / jog 1 OFF
10	set point tracking by programmable controller / no set point tracking
11-15	unit-specific

Table: Control word (speed control mode)
Explanation: the connotation for bit value = 1 is listed to the left of the slash mark, bit value = 0 at the right

6.8.2.3 Status Word Speed Control Mode/Positioning

Bit	Connotation
0	ready for turn-on / not ready for turn-on
1	ready for operation / not ready for operation
2	enable operation / operation blocked
3	malfunction / error free
4	no OUT 2 / OUT 2
5	no OUT 3 / OUT 3
6	turn-on lockout / no turn-on lockout
7	warning / no warning
8	set/actual in tolerance range **/** set/actual outside tolerance range
9	tracking required / no turn-on lockout
10	f or n attained / below f or n
11-15	unit-specific

Table: Status word (speed control mode)
Explanation: the connotation for bit value = 1 is listed to the left of the slash mark, bit value = 0 at the right

6.8.2.4 Reference list for state machines

The PROFIDRIVE state machine is executed in the gateway. This mode is the gateway default setting. The assignments of the PROFIDRIVE state machine to the state machines or states of individual units is defined in the following reference lists.

Reference list: status handling MC6000 / MC7000

PROFIDRIVE status	**unit status**
voltage off	
turn-on lockout	not ready for turn-on
not ready for turn-on	not ready for turn-on
ready for turn-on	ready for turn-on
ready for operation	on
operation enabled	operation enabled
operating block active	ready for operation
out 1 active level 1	not ready for turn-on
out 1 active level 2	not ready for turn-on
out 3 active level 1	emergency stop active
out 3 active level 2	emergency stop active
out 2 active	not ready for turn-on
release HLG output	operation enabled
release HLG run-up	operation enabled
operating condition	operation enabled
malfunction	malfunction

It is possible to define the form (16/32 bit) in which the set point or actual value is to be transmitted via the gateway parameter. The gateway then adjusts the CACNF parameter as required.

Reference list: status handling VF1000L/M/S:

It is not possible to transmit signed set points via the CAN bus in frequency inverter control. For this reason the direction of gateway rotation must be determined from the set point's sign and entered in the inverter's control word as "start right" or "start left".

PROFIDRIVE status	**unit control (control word)**
voltage off	control byte inverter = 0
turn-on lockout	control byte inverter = 0
not ready for turn-on	control byte inverter = 0
ready for turn-on	control byte inverter = 0
ready for operation	control byte inverter = 0
operation enabled	start right or start left (depending on transmitted set point)
operating block active	control byte inverter = 0
out 1 active level 1	control byte inverter = 0
out 1 active level 2	control byte inverter = 0
out 3 active level 1	control byte inverter = 0
out 3 active level 2	control byte inverter = 0
out 2 active	control byte inverter = 0
release HLG output	start right or start left (depending on transmitted set point)
release HLG run-up	start right or start left (depending on transmitted set point)
operating condition	start right or start left (depending on transmitted set point)
malfunction	change in condition if the inverter reports a malfunction using the ERROR bit in the status message

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