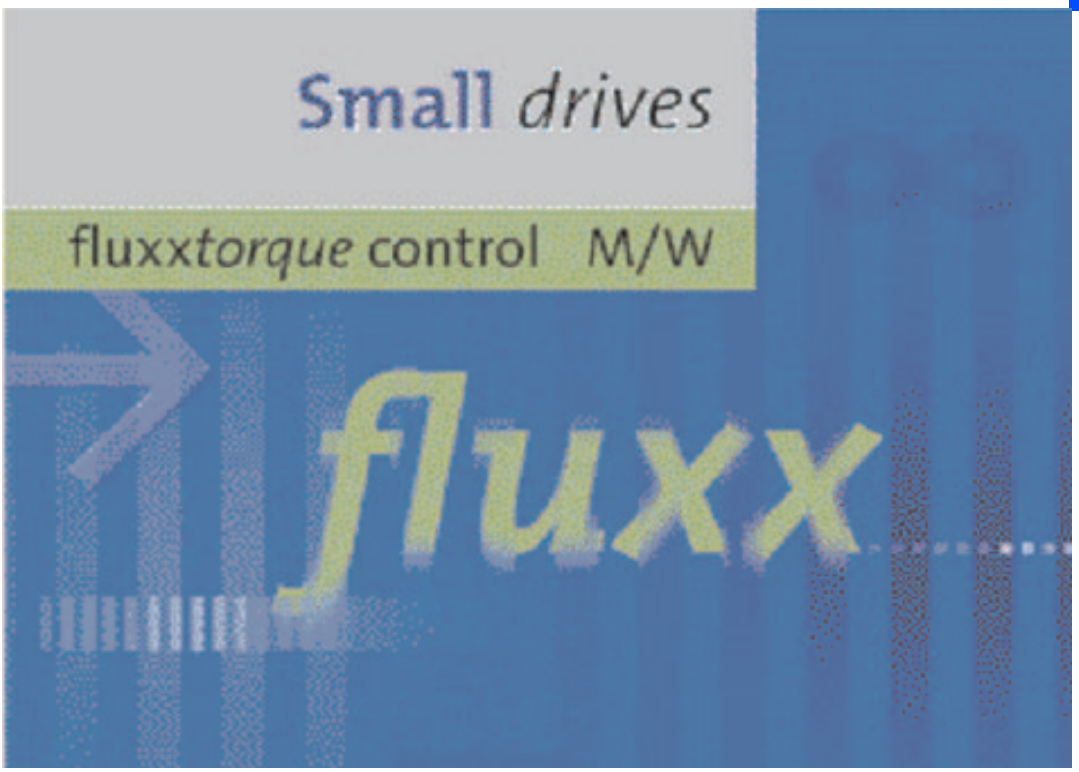
K-HB 13.0001-EN
13167473

L-force Drives

Communication Manual

Servo Drives 930 *fluxxtorque*



931M/W

PROFIBUS-DP

Lenze

This documentation is valid for 931M/W servo inverters.

Document history

Material No.	Version			Description
13167473	2.1	10/2006	TD14	First edition

Tip!

Current documentation and software updates concerning Lenze products can be found on the Internet in the ”Services & Downloads” area under

http://www.Lenze.com

Important note:

Software is provided to the user ”as is”. All risks regarding the quality of the software and any results obtained from its use remain with the user. The user should take appropriate security precautions against possible maloperation.
We do not accept any responsibility for direct or indirect damage caused, e.g. loss of profit, loss of orders or adverse commercial effects of any kind.
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1 Preface

1.1 Introduction

The competitive situation in the mechanical and system engineering sector requires new means to optimise the production costs. This is why modular machine and system engineering is becoming increasingly more important, since individual solutions can now be set up easily and cost-effectively from a single modular system.

Lenze fieldbus systems in industrial applications

For an optimal communication between the single modules of a system, fieldbus systems are increasingly used for process automation. Lenze offers the following communication modules for the standard fieldbus systems:

- Profibus DP
- CANOpen

Decision support

The decision for a fieldbus system depends on many different factors. The following overviews will help you to find the solution for your application.

Profibus DP

For bigger machines with bus lengths of more than 100 metres, INTERBUS or PROFIBUS-DP (PROFIBUS-**D**ecentralised **P**eriphery) are frequently used. The PROFIBUS-DP is always used together with a master control (PLC) – here the PROFIBUS master transmits e.g. the setpoints to the single PROFIBUS stations (e. g. Lenze controllers).

When using the data transfer rate of 1.5 Mbits/s typical for the PROFIBUS-DP, the sensors and actuators receive the process data. Due to the data transmission mode and the telegram overhead, a bus cycle time results at 1.5 Mbits/s, which is sufficient to control e. g. conveyors. If, for technical reasons, the process data must be transmitted faster to the sensors and actuators, the PROFIBUS can also be operated with a data transmission rate of maximally 12 Mbit/s.

CANOpen

CANopen is a communication protocol specified to the CiA (**C**AN **i**n **A**utomation) user group. Lenze can provide communication modules for communicating with CANopen masters. These modules are compatible with the specification DS 301 V4.01.

1.2 Comparison of industrial fieldbus systems

	CAN / CANopen	DeviceNet	Profibus DP	AS-i	INTERBUS	INTERBUS-Loop	LON
Topology	Line with terminating resistors	Line with terminating resistors	Line with terminating resistors	Line, tree, ring (possible)	Ring	Ring	Line (2 wire) or any other
Bus management	Multi master	Single master	Single master	Single master	Single master	Only together with INTERBUS-S; single master (bus terminal)	Multi master
Max. number of nodes (master and slaves)	64	64	124 (4 segments, 3 repeaters), max. 32 per segment	124 sensors/actuators 1 master	512 slaves, 1 master	32 slaves	32385 stations distributed to 255 subnetworks with 127 stations each
Max. distance between stations without repeater	Dependent on the baud rate used 1 km (50 kbit/s) 25 m (1 Mbit/s)	100 m (500 kbit/s) 250 m (250 kbit/s) 500 m (125 kbit/s)	1.2 km (93.75 kbit/s) 100 m (12 Mbit/s)	100 m	1.5 m (local bus) 400 m (remote bus) 2.5 km (optical fibre)	10 m (max. 100 m cable length without repeater)	2 km at 78 kbit/s (twisted pair), 6.1 km at 5.48 kbit/s (optical fibre plastics)
Max. distance between stations with repeater	General length reduction, dependent on the repeater used	Not specified	10 km (93.75 kbit/s)	300 m (2 repeaters)	13 km (remote bus), 100 km (optical fibre)	No repeater required	Almost any, expandable by subnetworks (no repeater)
Transmission medium	Shielded, twisted pair cable	Shielded, twisted pair cable	Shielded, twisted pair cable	Unshielded, untwisted flat pair cable	Shielded, twisted 5-wire cable Optical fibre, infrared	Unshielded, twisted pair cable	Unshielded, untwisted pair cable Radio, optical fibre, power supply system (Powerline)
Auxiliary energy supply via bus cable	Possible via additional wires in the bus cable	Possible via additional wires in the bus cable	Possible via additional wires in the bus cable	Current supply via data cable (2 to 8 A)	Separate, Group via bus terminal (remote bus)	Current supply via data cable (ca. 1.5 A)	possible via additional wires in the bus cable
Baud rate	10 kbit/s - 1 Mbit/s	125 kbit/s, 250 kbit/s, 500 kbit/s	9.6 kbit/s - 12 Mbit/s	167 kbit/s	500 kbit/s or 2 Mbit/s	500 kbit/s	78 kbit/s - 1.25 Mbit/s
Typical update time (e.g. 8 stations, 4 Bytes user data)	Approx. 1.32 ms at 1 Mbit/s (high priority)	Approx. 2.64 ms at 500 kbit/s (high priority)	Approx. 2.5 ms at 500 kbit/s	Typically 5 ms (4 bits each)	At least 2 ms (process data)	At least 2 ms (process data)	Approx. 70 ms
Telegram length (user data)	0 to 8 bytes	0 to 8 bytes	0 to 246 bytes	4 bits	1 to 64 bytes data, up to 246 bytes parameters	1 to 64 bytes data, up to 246 bytes parameters	1 to 228 bytes data, Typically approx. 11 bytes
Telegram length (total)	106 bits at 8 bytes user data	106 bits at 8 bytes user data	User data + 6 to 11 bytes	21 bits, of which: 14 bits master, 7 bits slave	User data + 6 bytes	User data + 6 bytes	max. 255 bytes, User data + 27 bytes
Bus access methods	CSMA/CA message-oriented	CSMA/CA message-oriented	Cyclic polling	Cyclic polling	Time base / distributed shift register	Time base / distributed shift register	Modified CSMA/CD

Tab. 1 Comparison of industrial fieldbus systems

1.3 About this Communication Manual

Target group

This Manual is intended for all persons who plan, install, commission, and set servo inverters of the 931M/W series.

Together with the catalogue, it forms the basis for project planning for the mechanical engineer and system engineer.

Contents

The PROFIBUS Manual complements the Mounting Instructions and Software Manual included in the scope of supply:

- The features and functions are described in detail.
- It provides detailed information on possible applications.
- Parameter setting is clarified by means of examples.
- In case of doubt, the supplied Mounting Instructions are always valid.

How to find information

- The table of contents and the index help you to find information on a certain topic.
- Descriptions and data with regard to further Lenze products can be gathered from the respective catalogues, Operating Instructions, and Manuals.
- You can request Lenze documentation from your responsible Lenze sales partner or download it as a PDF file from the Internet.

1.4 Legal regulations

Labelling	**Nameplate**	**CE identification**	**Manufacturer**
	Lenze drive controllers are definitely identified by the contents of the nameplate.	In compliance with the EC Low-Voltage Directive	Lenze GmbH & Co KG small drives Postfach 10 13 52 D-31763 Hameln
Application as directed	**931M/W servo inverters** ● must only be operated under the operating conditions prescribed in these instructions. ● are components – for the open and closed loop control of variable speed drives, – for installation in a machine, – for assembly with other components to form a machine. ● comply with the requirements of the Low-Voltage Directive. ● are not machines for the purpose of the Machinery Directive. ● are not to be used as domestic appliances, but only for industrial purposes. **Drive systems with 931M/W servo inverters** ● comply with the EMC Directive if they are installed according to the guidelines of CE-typical drive systems. ● can be used – for operation on public and non-public mains – for operation in industrial premises. ● The user is responsible for the compliance of his application with the EC directives. **Any other use shall be deemed inappropriate!**		
Liability	● The information, data, and notes in these instructions met the state of the art at the time of printing. Claims on modifications referring to controllers which have already been supplied cannot be derived from the information, illustrations, and descriptions. ● The specifications, processes, and circuitry described in these Instructions are for guidance only and must be adapted to your own specific application. Lenze does not take responsibility for the suitability of the process and circuit proposals. ● Lenze does not accept any liability for damage and operating interference caused by: – disregarding the Operating Instructions – unauthorised modifications to the controllers – operating errors – improper working on and with the drive controllers		
Warranty	● Terms of warranty: see Sales and Delivery Conditions of Lenze GmbH & Co KG Kleinantriebe. ● Warranty claims must be made to Lenze immediately after detecting the deficiency or fault. ● The warranty is void in all cases where liability claims cannot be made.		
Disposal	**Material**	**Recycle**	**Dispose**
	Metal	●	-
	Plastic	●	-
	Assembled PCBs	-	●

2 Safety instructions

2.1 Persons responsible for safety

Operator

An operator is any natural or legal person who uses the drive system or on behalf of whom the drive system is used.

The operator or his safety personnel is obliged

- to ensure the compliance with all relevant regulations, instructions and legislation.
- to ensure that only qualified personnel works on and with the drive system.
- to ensure that the personnel has the Operating Instructions available for all work.
- to ensure that all unqualified personnel are prohibited from working on and with the drive system.

Qualified personnel

Qualified personnel are persons who - due to their education, experience, instructions, and knowledge about relevant standards and regulations, rules for the prevention of accidents, and operating conditions - are authorised by the person responsible for the safety of the plant to perform the required actions and who are able to recognise potential hazards.
(Definition for skilled personnel to VDE 105 or IEC 364)

2.2 General safety instructions

- These safety information are not claimed to be complete. In case of questions and problems, please contact your Lenze representative.
- At the time of delivery the servo inverter meets the state of the art and is generally safe to operate.
- The information given in these Operating Instructions refer to the specified hardware and software versions of the modules.
- The servo inverter is a source of danger if:
  – unqualified personnel work on and with the servo inverter.
  – the servo inverter is used improperly.
- The specifications, processes, and circuitry described in these Instructions are for guidance only and must be adapted to your own specific application.
- Make sure by appropriate measures that in the event of failure of the servo inverter no personal injury or material damage is caused.
- Operate the drive system only when it is in proper state.
- Modifications or redesigns of the servo inverter are basically prohibited. In all cases the manufacturer must be contacted.

2.3 Definition of notes used

The following signal words and symbols are used in this documentation to indicate dangers and important information:

Safety instructions

Structure of safety instructions:

Danger!
(characterises the type and severity of danger)
Note
(describes the danger and gives information about how to prevent dangerous situations)

Pictograph and signal word	Meaning
Danger!	**Danger of personal injury through dangerous electrical voltage.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
Danger!	**Danger of personal injury through a general source of danger.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
Stop!	**Danger of property damage.** Reference to a possible danger that may result in property damage if the corresponding measures are not taken.

Application notes

Pictograph and signal word	Meaning
Note!	Important note to ensure trouble-free operation
Tip!	Useful tip for simple handling
	Reference to another documentation

3 Technical data

3.1 General data and operating conditions

General data

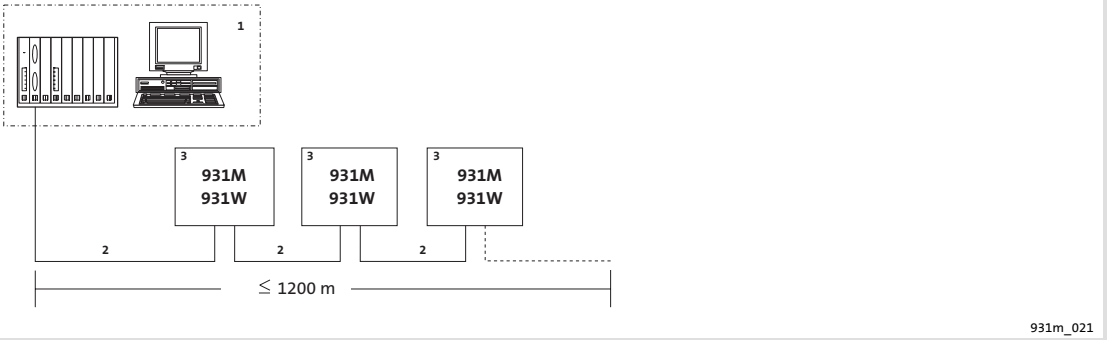
Area	Values
Communication profile (DIN 19245 part 1 and part 3)	PROFIBUS-DP-V0
Communication medium	RS485
Drive profile	Profidrive
Network topology	Without repeater: Line / with repeaters: line or tree
PROFIBUS-DP station	Slave
Baud rate (in kbits/s)	9.6, 19.2, 93.75, 187.5, 500, 1500
Max. cable length per bus segment	1200 m (depending on the baud rate and cable type used)
External DC voltage supply	+24 V DC ±10 %
Enclosure	IP54

Operating conditions

Ambient conditions		
Climatic		
Storage	IEC/EN 60721-3-1	1K3 (deviation: -25 ... +70 °C)
Transport	IEC/EN 60721-3-2	2K3 (deviation: -25 ... +70 °C)
Operation	IEC/EN 60721-3-3	3K3 (deviation: 0 ... +40 °C)
Cooling		Passively via housing surface and heatsink
Pollution	EN 61800-5-1	Degree of pollution 2
Site altitude		< 1000 m amsl

4 Electrical installation

Structure of a PROFIBUS-DP network with RS485 cabling without repeater



No.	Element	Note
1	Master computer	e.g. PC or PLC with PROFIBUS-DP master interface module
2	Bus cable	Adapt baud rate to the length of the bus cable.
3	PROFIBUS-DP slave	Applicable basic device

Note!

When using a repeater, max. 125 stations can communicate via the PROFIBUS.

EMC-compliant wiring

For wiring according to EMC please observe the following points:

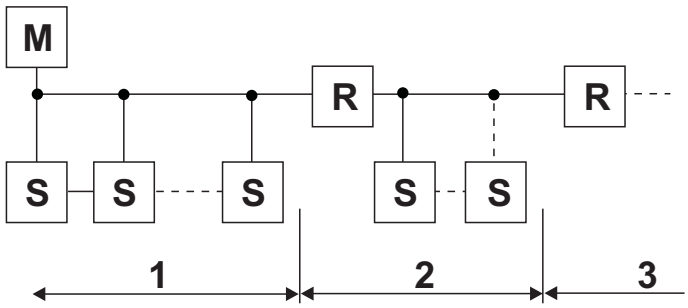
Note!

- ► Separate control cables from motor cables.
- ► Connect the shields of the control or data cables as follows:
  – *On both sides* for cables with *digital signals*.
- ► Further notes on wiring according to EMC can be obtained from the instructions of the basic unit.

Wiring procedure

1. Do not change the bus topology, i.e. do not use stubs.
2. Observe the wiring notes given in the documentation for the control system.
3. Only use cables which correspond to the listed specifications.
4. Activate the bus terminating resistors at the first and last physical station.

Number of bus stations



Segment	Master (M)	Slave (S)	Repeater (R)
1	1 2	31 30	- -
2	-	30	1
3	-	30	1

Tip!

Repeaters do not have a station address but in the calculation of the number of stations they reduce the number of stations by 1 on each side of the segment.

Repeaters can be used to build up line and tree topologies. In this case, the maximum total bus system expansion depends on

- ► the baud rate used
- ► the number of repeaters used

Baud rate / length of the bus cable

Baud rate [kbit/s]	Length [m]
9.6 - 93.75	1200
187.5	1000
500	400
1500	200

Note!

The baud rate, depending on data volume, cycle time, and number of stations, should be only as high as required for the application.

Tip!

For high baud rates we recommend to check the use of optical fibres.

Advantages of the optical fibre:

- External electromagnetic interferences have no effects on the transmission path.
- Bus lengths of several kilometres are also possible with higher baud rates. The bus length
  - does not depend on the baud rate.
  - depend on the optical fibre used.

Specification of the transmission cable

Please observe our recommendations for signal cables.

Bus cable specification	
Cable resistance	135 - 165 Ω/km, (f = 3 - 20 MHz)
Capacitance per unit length	≤ 30 nF/km
Loop resistance	< 110 Ω/km
Wire diameter	> 0.64 mm
Wire cross-section	> 0.34 mm^2
Wires	double twisted, insulated and shielded

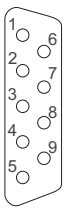
4.1 Electrical connection of the servo inverter with the PROFIBUS master

To meet the requirements of the enclosure IP 54, the servo inverter is equipped with screw connectors with M12 threads.

The connection plan and assignment of the power connector of the devices can be obtained from the Operating Instructions 931 M / W.

The following shows the assignment of a 9-pole Sub-D socket the most PROFIBUS masters are equipped with for connecting field devices.

Connection of the PROFIBUS to 9-pole SubD socket

View	Pin	Designation	Explanation
	1	free	—
	2	free	—
	3	RxD/TxD-P	Data line B (Receive / transmit data plus)
	4	RTS	Request To Send (receive / transmit data, no differential signal)
	5	M5V2	Data ground (5 V)
	6	P5V2	DC 5 V / 30 mA (bus termination)
	7	free	—
	8	RxD/TxD-N	Data line-A (receive / transmit data minus)
	9	free	—

Tab. 2 Sub-D connection PROFIBUS

5 Commissioning

5.1 Before switching on

Stop!

Before you switch on the basic unit for the first time in the PROFIBUS-DP network, check

- ► the entire wiring for completeness, short circuit, and earth fault.
- ► whether the bus system is terminated at the first and last station with the integrated active bus terminating resistor.

5.2 Activation of PROFIBUS at the servo inverter

Before operating on the PROFIBUS the configuration is carried out via the user interface of the system. If you are not familiar with the user interface, you will find a detailed description in the corresponding documentation (see Software Manual 931 M/W).

Setup

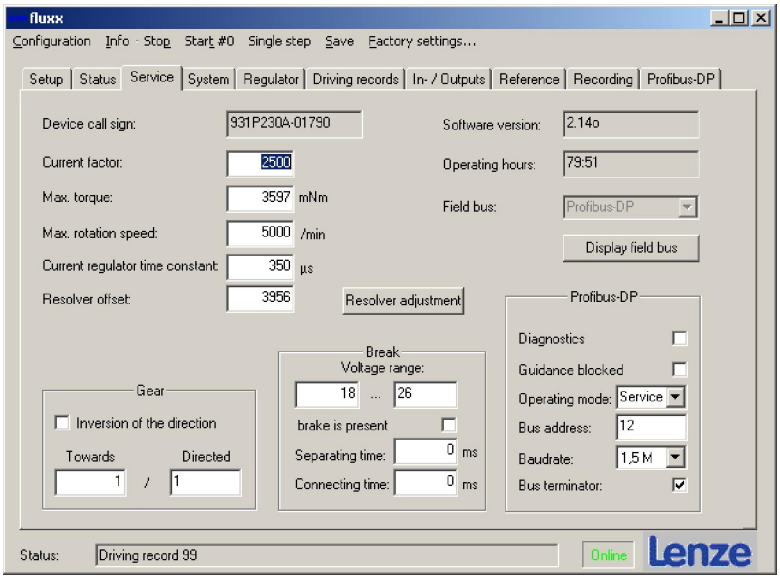
Start the operating program and check the settings of the serial communication interface in the **Setup** menu. The servo inverters are set by default to a baud rate of 1.5 MBaud.

931mPro_001

The Lenze standard RS232 connecting cable is plugged in between the inverter (M8 circular connector, 3-pole) and the COM interface of the PC (Sub-D connector 9-pole). The settings of the COM interface must be checked in the hardware settings of the PC.

Note!

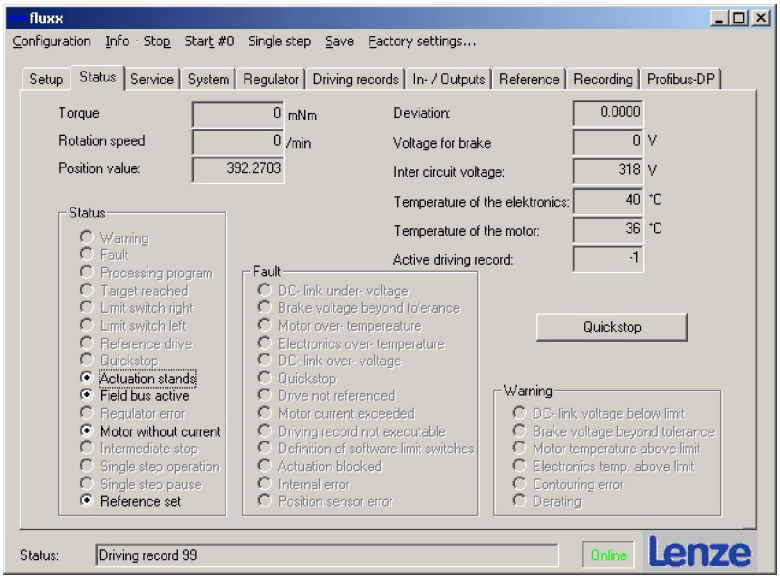
Select from the **Setup** menu **Online Level 4** or **Service**.



931mPro_002

When the **Diagnostics** function is activated, the diagnostic alarm is switched on. As soon as a diagnostic alarm is triggered, the drive automatically sends 4 bytes of diagnostic data and its start address to the control. This serves to obtain information about if and when an error occurred in the servo inverter and the data in the control can be evaluated.

The **Guidance blocked** serves to exclude the PROFIBUS master from the access to the drive. As soon as the PROFIBUS master requests the control authority via the drive, the drive can only be started via the bus system (in the **Status** tab the message "Fieldbus active" appears in the status field)



931mPro_003

This prevents a simultaneous access to the bus system and the operating program.

The access authorisations of the control to the inverter can be set via the operating mode on the **Setup** tab. Restrictions of the access depth like before the access on the inverter by the operating program are carried out. See Software Manual ”Access authorisations via access levels.

Note!

- ► In order that the PROFIBUS master has full access to the inverter (slave), select the **Service** operating mode. In this mode, the process and parameter data can be changed.
- ► For the parameter setting of the inverter, select from the **Setup** tab **Online Level 4** or **Service**.

Operating mode	Access	Restrictions
Online level 1	Observing the drive	No write access, no change of parameters or process data possible.
Online level 3	Access to process data. (Setpoint selection)	No access to parameter data (controller settings, bus settings, basic drive configuration)
Online level 4	Access to process data and parameter data (controller settings, bus settings)	No access to basic drive settings (maximum speed, maximum torque, …)
Service	Full access	No restriction

Tab. 3 Operating modes

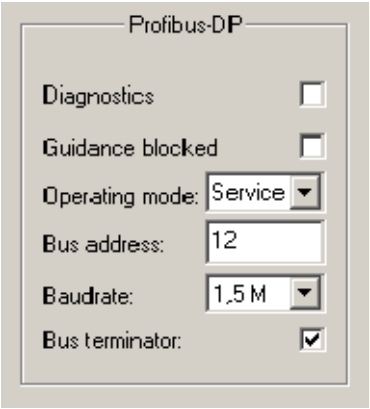
In the lower part of the **Service** tab, in the **PROFIBUS-DP** field, the PROFIBUS address and the baud rate can be set. Possible are baud rates of 9.6k (k = Kilobyte / 124 bytes) , 19.2k, 93.75k, 187.5k, 500k, 1.5M (M = Megabyte).

In case of the servo inverters, the bus system can be looped through. The devices have a bus input (X4.1) and a bus output (X4.2). If a device shall be connected to the end of the bus line, a terminating resistor can be activated.

Note!

To prevent reflections of the signals, the last node must be equipped with a terminating resistor.

In the **Service** tab, the checkmark must be set after ”Bus terminator” and activated via ”Save” in the menu bar.

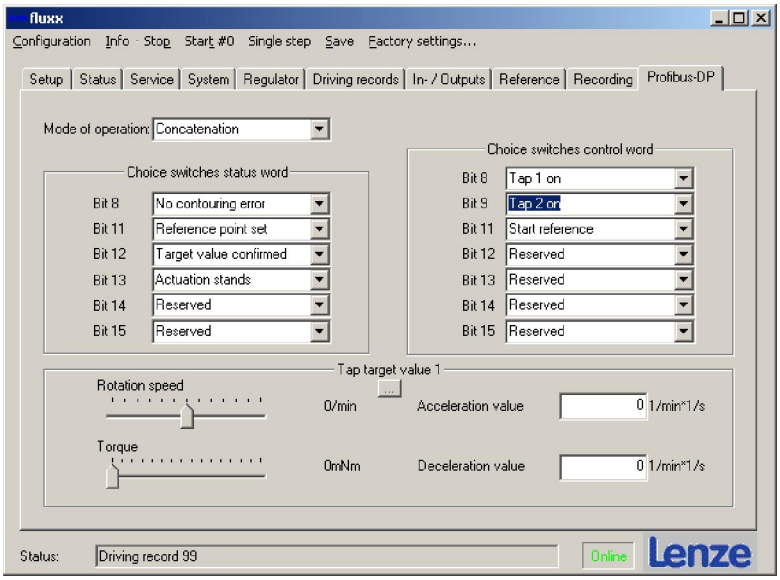


931mPro_005

5.3 PROFIBUS settings in the operating program

Profibus DP

In the operating program, yet further settings can be made for the PROFIBUS operation in the **PROFIBUS-DP** tab.



931mPro_004

In case of an access authorisation higher than level 3, settings can be made here which can also be executed directly via PROFIBUS. To make access easier for the users, this tab is inserted. After saving via PROFIBUS and re-reading the travel data records, the settings can be displayed.

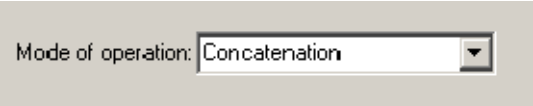
In the upper left of the operating program in the **Operating mode** field the following control modes can be selected. You can change-over between the following modes:

- Speed + position
- Speed
- Position
- Concatenation (following error operation / speed control)

This change-over has the same effect as using the parameter number 930 (PNU930).

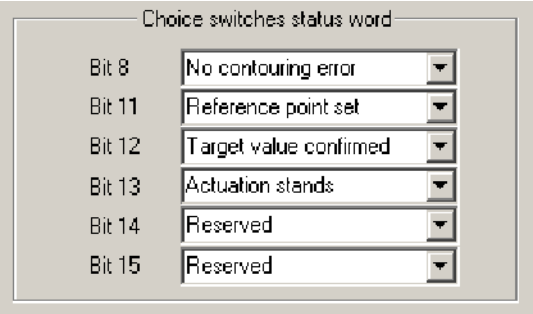
Note!

If a series of travel data records is to be started via the PROFIBUS which is written into the drive via the operating program, the **concatenation** mode must be selected. In the other operating modes, no series of travel data records is executed. The drive only carries out single-step operation!



931mPro_006

The operating program also offers the option to display further binary drive data in the status word.. The bits 8, 11, 12, 13 and 14 can be assigned with other functions than set by default.



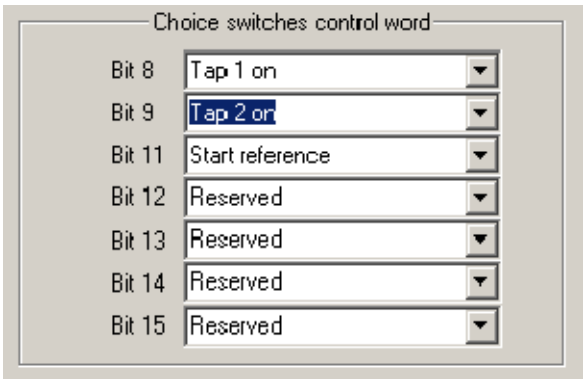
931mPro_007

The following display functions listed in the table are available:

Function	Description
Brake engaged	Brake is applied
Limit switch, left	Left limit switch is activated
Limit switch, right	Right limit switch is activated
Quick stop	Quick stop has been initiated
Reference switch	The reference switch is activated
Reference window	
Edit data record	Data record is being edited / control is active
Digital output	Display output of a device with I/O option
Application box output	Display application box output of a device with Local CAN option
Digital input	Display input of a device with I/O option
Application box 1-BCD	Display application box of a device with Local CAN option (see description of application box)
Application box 2-BCD	
Application box 4-BCD	
Application box 8-BCD	
Application box 10-BCD	
Application box 20-BCD	
Application box 40-BCD	
Application box 80-BCD	
Application box start	Display application box start of a device with Local CAN option (see description of application box)
Application box stop	Display application box stop of a device with Local CAN option (see description of application box)
Application box - left limit switch	Address left application box limit switch of a device with Local CAN option (see description of application box)
Application box - right limit switch	Display right application box limit switch of a device with Local CAN option (see description of application box)
Application box - quick stop	Display application box quick stop of a device with Local CAN option (see description of application box)
Application box input	Display application box of a device with Local CAN option (see description of application box)

Tab. 4 Additional functions - status word

In addition to the display functions, it is possible to set other actions in the control word which can be addressed.



931mPro_008

The functions are as follows:

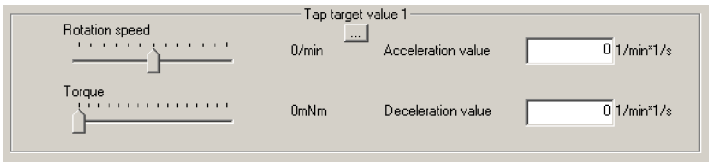
Function	Description
Engage brake	Trigger brake
Activate left limit switch	Activate left limit switch
Activate right limit switch	Activate right limit switch
Quick stop	Activate quick stop
Activate reference switch	Activate reference switch
Activate reference window	Activate reference window
Activate digital output	Activate output of a device with I/O option
Activate application box output	Activate application box output of a device with Local CAN option.

Tab. 5 Additional functions - control word

In the lower part of the PROFIBUS DP field values for the jogging mode can be entered. Speed, torque, acceleration value and deceleration value for both jogging setpoints can be entered for the jogging mode, which is designed as a mechanical setting-up operation. The change-over between jogging setpoint 1 and jogging setpoint 2 is done via the field ” ...”.

Danger!

In the jogging mode it is possible to traverse beyond the mechanical limit switches! The software limit switches are active.



931mPro_009

5.4 PROFIBUS communication

5.4.1 GSE file for PROFIBUS connection

The device data base file (GSE) for DP slaves (e.g. servo inverter of type 931) contains characteristic device features of the DP components. Here, it is stored, for instance, which baud rates and special DP modes are supported by the slave.

Each master needs the corresponding device data base file for a non-ambiguous identification of slaves on the bus. The GSE file for the servo inverters of the Fluxxtorque series is attached in the appendix and can also be downloaded from www.Lenze.com.

5.4.2 Hardware configuration

Steps for installing the hardware in the PROFIBUS project:

- ► Install the GSE file ”93MW058F.GSE” (version 1.0) according to the settings of the project planning software for the DP master. After the installation is completed, the ”931_M_W” device appears among the slave nodes.
- ► Insert the fieldbus interface module into the PROFIBUS structure using the name ”931_M_W” and assign the PROFIBUS address.
- ► Select the process data configuration required for your application (🕮 26).
- ► Indicate the I/O address for the projected data widths.
- ► Save the configuration.
- ► Expand your user program by the data exchange with the servo inverter.
- ► After the project is saved and loaded into the DP master (e.g. an S7 control of the Fa. Siemens) and the DP master is started, the LED ”Bus-F” of the MFP/MQP should go off. If not, check the wiring and terminating resistors of the PROFIBUS as well as the project planning, especially the PROFIBUS address.

5.4.3 Structure of communication channel

Generally, only communication functions can be set under the HW configuration which are also supported by the servo inverter. The bandwidth of this communication is defined via the process data configuration. The parameter process data objects (PPOs) serve to select a pre-defined write and read access to the control and status word by certain ”modules”.

Depending on the selected PPO a certain number of input and output areas, or combined input and output areas are available. Furthermore, the area selection also determines the consistency check, data length, and the unit of the data to be transmitted.

PPOs which are sent to the slave by the master are interpreted as output data (Write-PPO). Master -> data -> slave: Output data.

PPOs which are received by the master from the slave are interpreted as input data (Read-PPO). Slave -> data -> master: Input data.

Four different module combinations (PPOs) are available for the process data configuration:

	PPO type 3	PPO Write type 3 PPO Read type 4	PPO type 1	PPO Write type 1 PPO Read type 2
Process data input (input data)				
PZD1: Status word	X	X	X	X
PZD2: Active travel data record	X	X	X	X
PZD3: Speed	—	X	—	X
PZD4: Torque	—	X	—	X
PZD5 ... 6: Position	—	X	—	X
Process data output (output data)				
PZD1: Control word	X	X	X	X
PZD2: Actual value = active travel data record	X	X	X	X
Parameter data input (input data/PPO Read)				
Number	—	2	2	6
Parameter data output (output data/PPO Write)				
Number	—	—	2	2

Tab. 6 Configuration of the PPO types

The configurations ”PPO Write type 3, PPO Read type 4“ and ”PPO type 3” cannot be used for parameterising the drive. These configurations, however, only provide a lower utilisation of the bus system, which means a lower data volume. They transmit 16 bytes less data (8 bytes transmitted data and 8 bytes received data) per telegram than the PPOs 3 and 4.

Note!

In case of some PROFIBUS master systems HIGH and LOW byte of the process data and parameter data channel are exchanged!

6 Control word and status word (Profidrive state machine)

6.1 General information

The servo inverter is controlled via two different access types:

1. The parameters of the inverter are accessed via the acyclic parameter channel DP-V1. This serves to adapt, change, or set e.g., the controller settings or the driving records. (📖 41).
2. The state of the drive is changed via the state machine. The control word (STW) and the status word (ZSW) are especially important here. The control word, which is sent as process data cyclically from the PROFIBUS master (e.g. of a control) to the servo inverter, changes the state of the drive. This change is detected and confirmed by the status word which is transmitted from the servo inverter to the master. A master control can use this information on the drive status to manage the servo drive.

According to the Profidrive profile 2 control words (STW1 and STW2) and 2 status words (ZSW1 and ZSW2), the single bits of which are defined in this standard with regard to their meaning, to control the drive. Regarding the control, only the control word 1 (STW1) and status word 1 (ZSW1) are important for the 931M/W servo inverter. For this reason, only control and status word 1 will be explained in the following, leaving out the figure ”1” in the description.

The next three subchapters describe in detail the structure of the control and status word as well as the state machine and status changes. The change of parameters via the parameter channel will be explained in the chapter ”Parameter channel” (📖 41).

6.2 Control word

The meaning of the single bits of the control word partly depends on the control selected. Two control types, speed and positioning control, are available (concerning this see the parameter PNU 930). In the Tab. 7 those bits of the control word are explained the meaning of which are firmly defined irrespective of the controller type. The Tab. 8 and Tab. 9 describe the bits with a controller type-specific meaning. The Tab. 8 contains a detailed description of the bits for a speed-controlled system and the Tab. 9 describes a position-controlled system.

To address the inverter via the PROFIBUS master, first the control authority must be requested by setting the bit 10 in the control word. Without the control authority the drive cannot be accessed. The control authority enables the user to e.g. to start and stop a drive via the control word or the state machine. (📖 33). The user cannot change parameters with the control authority (e.g. driving records or control parameters). For this purpose, the parameter change rights must be requested, see PNU 927 (📖 52). The following chapters describe in detail the connection between the control authority and the parameter change rights.

Bit	Value	Significance	Meaning
0	1	ON	Condition for the S3 status ”Ready for operation”: In this status the output stage is supplied with voltage but not yet connected through (no voltage at the motor).
	0	OFF 1	Switched-off status: The drive returns to S2 status ”Ready to switch on”. When the drive is switched on it is braked along a ramp to zero speed. When the drive is at standstill, the output stage will be switched off.
1	1	No OFF 2	No coasting of the drive is requested.
	0	OFF 2 (coasting of the drive)	Coasting of the drive: The output stage is switched off and the motor coasts without control to zero speed. After that, the drive changes to the S1 status ”Switch-on inhibit”.
2	1	No OFF 3	No quick stop of the drive is requested.
	0	OFF 3 (quick stop)	Quick stop: The drive is braked with maximum power to 0 min^{-1}. A quick stop command cannot be cancelled once it has been issued. After quick stop is terminated, the drive changes to the S1 status ”Switch-on inhibit”.
3	1	Enable operation	The pulses for the output stage are switched on and the drive changes to S4 status ”Operation enabled”. A voltage is applied to the motor terminals. If a setpoint has been accepted before (see bit 6 STW), this setpoint is approached.
	0	Disable operation	The drive is braked along the set deceleration ramp to 0 min^{-1}. After that, the drive changes to S3 status ”Ready for operation”.
7	1	Acknowledging error (0 → 1)	An error is acknowledged by a positive edge (0→1) on bit 7. The response of the drive depends on the severity of the error. In case of fatal errors the drive changes to S1 status ”Switch-on inhibit”.
	0		
10	1	Control via PLC (requesting control authority)	Requesting control authority: When a control authority is requested, the status can be changed by a PLC via the PROFIBUS.
	0	No control via PLC	No control authority via the drive. Drive status cannot be influenced by the PLC.
12-15		Device-specific	These device-specific bits are not used.

Tab. 7 Overview of the non-controller-type specific bits of the control word

Bit	Value	Significance	Meaning
4	1	Switched-on ramp generator	The ramp generator which prevents an abrupt rise of the speed setpoint is active.
	0	Reset of the ramp generator	The output of the ramp generator is set to 0 min^{-1}. The drive brakes considering the current limitation.
5	1	Standard ramp generator	No impact (standard function of the ramp generator)
	0	Freezing of the ramp generator	The current setpoint of the ramp generator is ”frozen”.
6	1	Accept the setpoint	The setpoint which is defined via the current driving record is accepted and transmitted to the ramp function generator.
	0	Do not accept the setpoint	The setpoint for the ramp function generator is set to 0.
8	1	JOG1 on	Jogging: If JOG1 is switched on from the S4 status ”Operation enabled”, the drive (JOG setpoint selection: see XXX) runs until JOG1 is switched off.
	0	JOG1 off	No jogging: If a jogging mode is running it will be terminated. The drive is braked to standstill along the deceleration ramp. Afterwards the drive changes to the S4 status ”Operation enabled”.
9	1	JOG2 on	Jogging: If JOG1 is switched on from the S4 status ”Operation enabled”, the drive (JOG setpoint selection: see XXX) runs until JOG1 is switched off.
	0	JOG2 off	No jogging: If a jogging mode is running it will be terminated. The drive is braked to standstill along the deceleration ramp. Afterwards the drive changes to the S4 status ”Operation enabled”.
11		Device-specific	This device-specific bit is not used.

Tab. 8 Overview of the controller-type specific bit of the control word for a speed-controlled drive

Bit	Value	Significance	Meaning
4	1	Do not reject the setpoint	The selected setpoint which is accepted with an edge of bit 6 is approached.
	0	Reject the setpoint	The drive is braked with maximum acceleration ? to zero speed and remains on this position.
5	1	No intermediate stop	No intermediate stop is made. The selected setpoint which is accepted with the edge of bit 6 is approached.
	0	Intermediate stop	The drive is braked to zero speed from the active positioning along the deceleration ramp. The standstill position is held with a holding torque. By resetting bit 5 the running positioning is continued.
6		Accept the setpoint (Edge, 0 → 1 or 1 → 0)	An edge serves to accept or start a new positioning job or setpoint. A new setpoint shall only be accepted if a homing process (bit 1 of the status word) and the previous driving request (bit 12 of the status word) have been terminated before.
8	1	JOG1 on	Jogging: If JOG1 is switched on from the S4 status ”Operation enabled”, the drive (JOG setpoint selection: see XXX) runs in a speed-controlled mode until JOG1 is switched off.
	0	JOG1 off	No jogging: If a jogging mode is running it will be terminated. The drive is braked to standstill along the deceleration ramp. Afterwards the drive changes to the S4 status ”Operation enabled”.
9	1	JOG2 on	Jogging: If JOG1 is switched on from the S4 status ”Operation enabled”, the drive (JOG setpoint selection: see XXX) runs in a speed-controlled mode until JOG1 is switched off.
	0	JOG2 off	No jogging: If a jogging mode is running it will be terminated. The drive is braked to standstill along the deceleration ramp. Afterwards the drive changes to the S4 status ”Operation enabled”.
11		Device-specific	This device-specific bit is not used.

Tab. 9 Overview of the controller-type specific bit of the control word for a position-controlled drive

6.3 The status word (ZSW)

The current status of the drive is output in the status word and made available to the master control or PLC. By analogy with the explanation of the control word, first the meanings of the controller type independent bits of the status word are explained in Tab. 10. Then the bits with the controller type-specific meaning are explained in Tab. 11 (speed control) and Tab. 12 (position control).

Bit	Value	Significance	Meaning
0	1	Ready to switch on	Device is power-supplied, electronics is initialised. Pulses for power section are suppressed.
	0	Not ready to switch on	Drive is in the S1 status "Switch-on inhibit".
1	1	Ready for operation	The drive is ready for operation (status S2). In this status, the output stage is supplied with voltage but not yet enabled (see bit 0 of the control word).
	0	Not ready for operation	The device is not ready for operation.
2	1	Operation enabled	The drive is in S4 status "Operation enabled". The current setpoint is processed (see bit 3 of the control word).
	0	Operation not enabled	Either the pulses are switched off (no voltage at the motor) or the drive does not follow the setpoint.
3	1	Error is pending	A non-acknowledged error (see bit 7 of the control word) or an error that cannot be acknowledged is pending at the drive. The response of the drive is error and device-specific. In case of a fatal error it is changed to status S1 "Switch-on inhibit". The error can - if the cause has been removed - be cancelled by an acknowledgement.
	0	No error	No error is currently pending.
4	1	Coasting function is deactivated (no OFF 2)	The coasting function (see bit 1 "OFF 2" of the control word) is not active (bit 1 STW = 1).
	0	Coasting function is active (OFF 2)	The coasting function (see bit 1 "OFF 2" of the control word) is active (bit 1 STW = 0).
5	1	Quick stop function is deactivated (no OFF 3)	The quick stop function (see bit 2 "OFF 3" of the control word) is not active (bit 2 STW = 1).
	0	Quick stop function is active (OFF 3)	The quick stop function (see bit 2 "OFF 3" of the control word) is active (bit 2 STW = 0).
6	1	Switch-on inhibit	The drive can only change from the S1 state "Switch-on inhibit" to the S2 state "Ready to switch on" by changing the control word (no OFF2 (bit 1 STW) and no OFF3 (bit 2 STW) followed by ON (bit 0 STW)). After that the bit 6 of the ZSW returns to 0 (no switch-on inhibit).
	0	No switch-on inhibit	The drive is in a higher status than S1 "Switch-on inhibit".
7	1	Warning is active	A warning is pending. The warning does not need to be acknowledged.
	0	No warning	No warning is pending.
9	1	Control authority is required	The control authority is required for the control (PLC) communicating via PROFIBUS (see bit 10 of the control word). The drive can be commissioned via the PROFIBUS.
	0	Control authority is not required	The drive cannot be controlled via the control (PROFIBUS). Either the control authority must be requested (see bit 10 of the control word) or the drive must be commissioned via another interface (see parameterisation software Fluxx).
14-15		Device-specific	These device-specific bits are not used.

Tab. 10 Overview of the non-controller-type specific bits of the status word (ZSW)

Bit	Value	Significance	Meaning
8	1	Setpoint inside a tolerance margin	The setpoint is inside a required tolerance margin.
	0	Setpoint outside the tolerance margin	The setpoint is outside the required tolerance margin.
10	1	Setpoint reached	The setpoint speed (n) or setpoint frequency (f) has been reached.
	0	Setpoint not reached	The setpoint speed (n) or setpoint frequency (f) has not been reached.
11-13		Device-specific	These device-specific bits are not used.

Tab. 11 Overview of the controller-type specific bit of the status word for a speed-controlled drive

Bit	Value	Significance	Meaning
8	1	Following errors inside the following error window	The following error is inside the required following error window.
	0	Following errors outside the following error window	The following error is outside the required following error window.
10	1	Target position reached	The current position corresponds to the position setpoint, considering the position window.
	0	Target position not reached	Position setpoint and actual value do not correspond, considering the position window.
11	1	Reference set	Homing has been executed and a home position has been set.
	0	Reference has not been set	No valid home position exists.
12		Edge for setpoint acceptance (0 → 1, 1 → 0)	An edge of this bit indicates that a new setpoint / driving record has been accepted (see bit 6 of the control word)
13	1	Drive in standstill	The drive stands due to a stop / intermediate stop or because the target position has been reached.
	0	Drive is moving	Positioning is carried out ($n \neq 0\ min^{-1}$).

Tab. 12 Overview of the controller type-specific bits of the status word for a position-controlled drive.

6.4 The Profidrive state machine

6.4.1 State machine and general state diagram

The status of the drive can be changed via the state machine. The single state transitions are carried out depending on the control word or error management. Basically, the following states exist according to the Profidrive profile:

- S1: Switch-on inhibit
- S2: Ready to switch on
- S3: Ready for operation
- S4: Operation enabled
- S5: Switching-off/braking

In addition to these states the following substates can be defined which permit a further concretion of the states mentioned above.

- Not ready to switch on (initialisation phase of the inverter)
- Fault (drive stands due to an error, acknowledgement is required)
- Fault reaction is active (braking process is active due to an error)
- Quick stop is active

The control and positioning processes take place in the S4 status (”Operation enabled”). To reach this status, the other single states must be passed before by changing the corresponding bits of the control word.

Note!

To change states, the control authority is required (see bit 10 of the control word)!

Fig. 1 shows the state machine in the form of a state diagram. To provide a better overview, only the main states from S1 to S5 are represented. For the sake of simplicity, the state transitions marked by arrows are provided with the required changes of the bits of the control word.

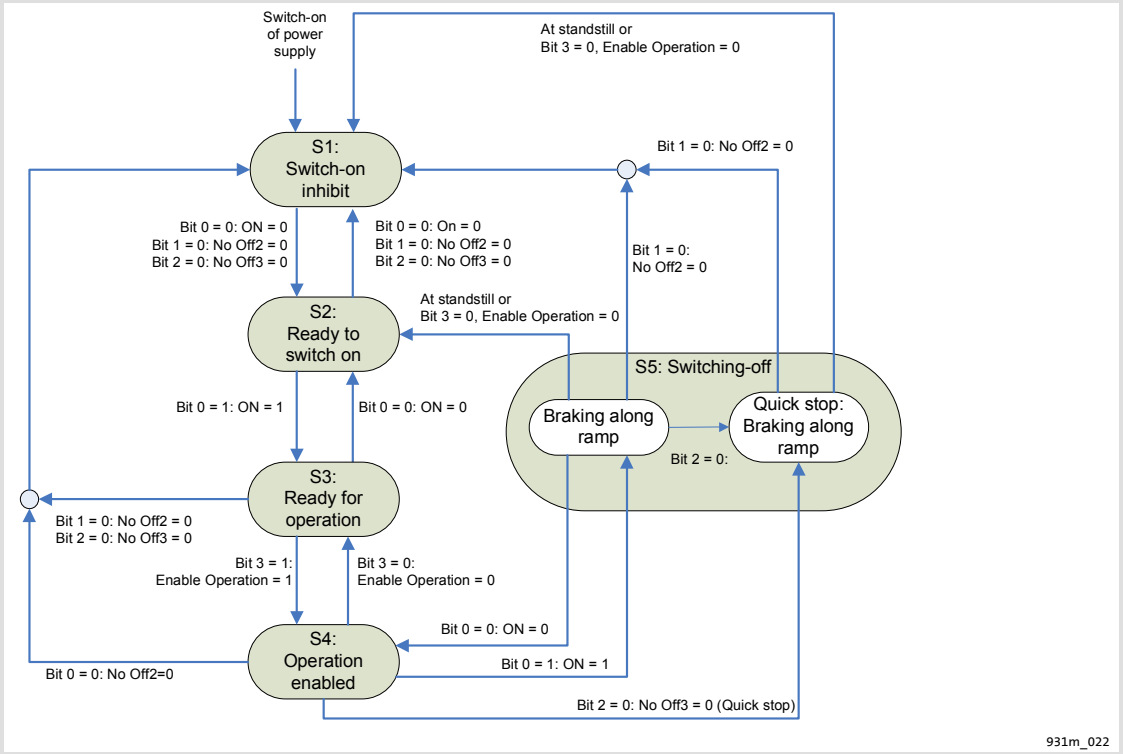


Fig. 1 General representation of the state diagram

The current status of the drive can be obtained from the status word (ZSW) of the drive. In the Tab. 13 the single bits of the status word and the states are listed.

Status	Bit 6	Bit 5	Bit 3	Bit 2	Bit 1	Bit 0
	Switch-on inhibit	Quick stop	Fault	Enable operation	Ready for operation	Ready to switch on
S1 switch-on inhibit	1	X	0	0	0	0
S2 ready to switch on	0	1	0	0	0	1
S3 ready for operation	0	1	0	0	1	1
S4 operation enabled	0	1	0	1	1	1
S5 switch-off	0	X	X	1	1	1
Not ready to switch on	0	X	0	0	0	0
Fault	0	X	1	0	0	0
Fault response is active	0	X	1	1	1	1
Quick stop is active	0	0	0	1	1	1

Tab. 13 Confrontation of the states of the device and the status word (ZSW) in bit format

In all states - despite the ”Not ready to switch on” status, which is only pending a short while after switching on the voltage supply (self-initialisation) - the parameters of the servo inverters may be reparameterised by the parameter channel if the parameter change rights (see PNU 927) was requested before. The changes of the control word required for the status changes are shown in Fig. 1.

Note!

For safety reasons the servo inverter can only be operated from an interface. This means that the parameter change rights may either be occupied by the Fluxx operating program or the control (PROFIBUS).

If an operating program with level 2 or higher has been selected at the inverter, no parameter change rights can be requested via the PROFIBUS. In this case it is required to change the operating mode of the Fluxx program on level 1 (monitoring) or offline.

As aforementioned, the real control process takes place in the status S4 ”operation enabled”. To, e.g. accept a setpoint or start homing, further changes of the control word are required. Since these changes depend on the set control, the state diagrams for a speed-controlled and a position-controlled system will be described separately.

6.4.2 Example: State machine for speed operation

In this example, the drive is to be commissioned with the predefined driving record no. 1 (n = 2400 1/min; M = 1320 mNm) with speed control.

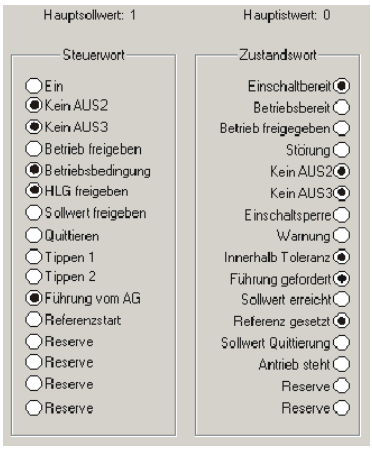
The selected PPO type 3 permits the writing and reading of the control word / status word and the selection of the pre-programmed driving records. The selected PPO type determines the input and output addresses of the registers to be described (”buffer”) in the frequency inverter. It is mandatory for the state transitions to write the control words stepwise; the following table displays the bit patterns for a better understanding:

Status	High byte STEW (1. address)	Low byte STEW (2. address)
s1	0000 0100	0011 0110
S2	0000 0100	0011 0111
S3	0000 0100	0111 1111
S4	0000 0100	1011 1111
S5	0000 0100	1011 1110

Tab. 14 Control word state transitions - speed example

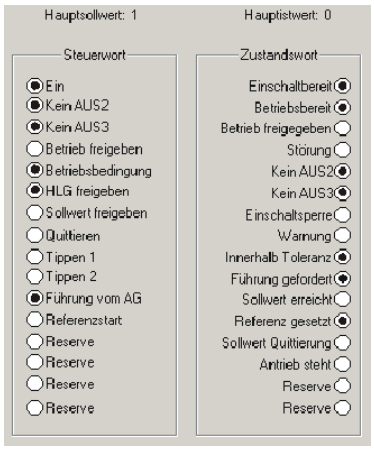
As aforementioned, it is possible to open a PROFIBUS monitor via the ”Display fieldbus” field in the ”Service” tab of the operating program. The following screenshots illustrate the single steps of the state machine by means of the PROFIBUS monitor:

Status S1: Switch-on inhibit



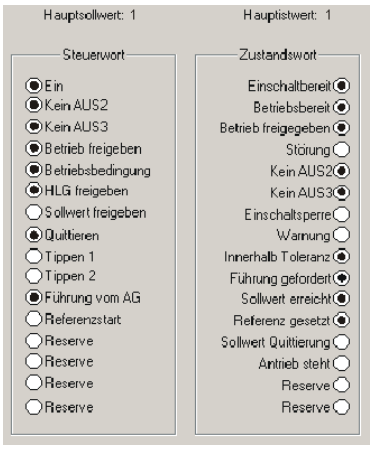
931mPro_010

Status S2: Ready to switch on

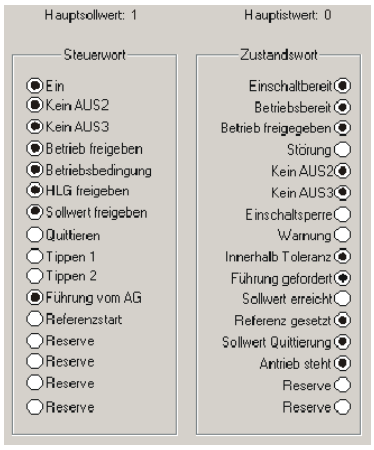


931mPro_011

Status S3: Ready for operation



Status S4: Operation enabled



S5: Switching off / Braking -> identical with S4 except for bit no. 0.

6.4.3 State diagram for positioning

Fig. 2 shows the state machine for a position-controlled drive in the basic state ”Operation enabled”.

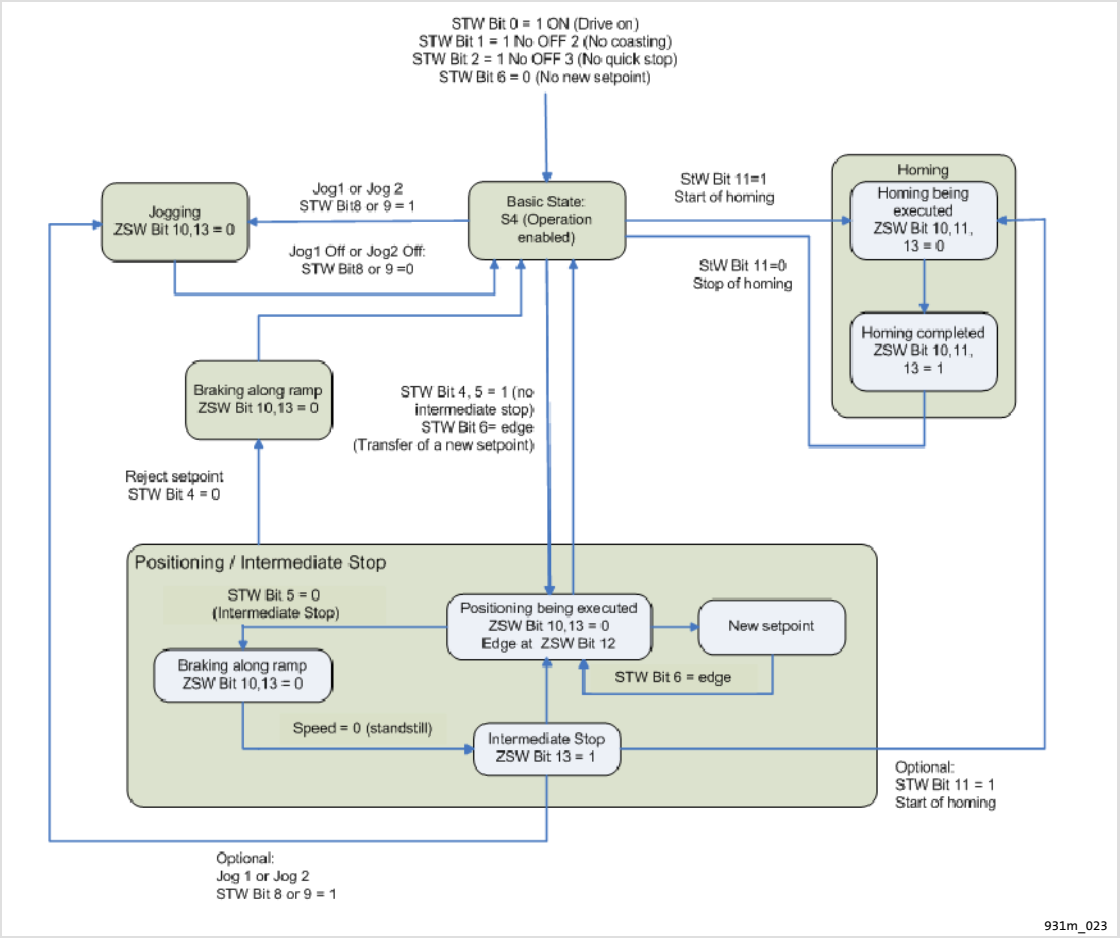


Fig. 2 State machine ins the ”positioning” mode

In this operating status, the following actions can be executed via the control word:

1. Via bit 11 of the STW homing can be started. Bit 11 in the ZSW ”Home position is set” indicates if a home position is set (valid). If homing is started, the display ”Homing set” (bit 11) is cancelled. The type of homing (direction, speed, etc.) is application and device-specific and is hence not described in the profile. For this purpose the parameters required for homing (PNU 101) must be checked before.
2. To accept a new setpoint or change a driving record, the edge of bit 12 of STW ”Setpoint acknowledgement” must be changed. This starts and executes the positioning mode.
3. Via the function JOG1 and JOG2 (bit 8 and bit 9 of STW) a jogging mode can be carried out.

Stop!

In case of a jogging mode (JOG1 and JOG2) the software and hardware limit switches are not evaluated!

The drive is not limited with regard to its permitted travel range!

During the positioning process, several options exist to intervene in the process:

1. A travel request can be interrupted using the command ”Intermediate stop” (bit 5 of STW). The drive brakes along the set deceleration ramp to standstill. The current job request is stopped and can be continued by cancelling the command ”Intermediate stop”.
2. In the ”Intermediate stop” state, homing can be started.
3. A travel request can be cancelled using the command OFF1 (bit 0 of STW: Drive off), OFF2 (bit 1 of STW: Coasting) or OFF3 (bit 2 of STW: Quick stop). The drives brakes depending on the mode selected to standstill and then changes to S1 status ”Switch-on inhibit” (OFF2, OFF3) or S2 ”Ready to switch on”.

A travel request is terminated when the drive has reached its setpoint. This is displayed with the status bit 10 ”Setpoint reached”.

The ”Concatenation” mode enables speed-controlled and positioning driving records to be started without taking special measures. Here, the following driving records and waiting times between the concatenated driving records are considered. Further information can be obtained from the explanation of the object PNU 100.

6.4.4 State diagram for speed control

Fig. 3 shows the state machine for a speed-controlled drive in the basic state S4 "Operation enabled". Many functions of the illustrations shown are similar to the ones of section (📖 38) so that only deviant functions shall be explained here.

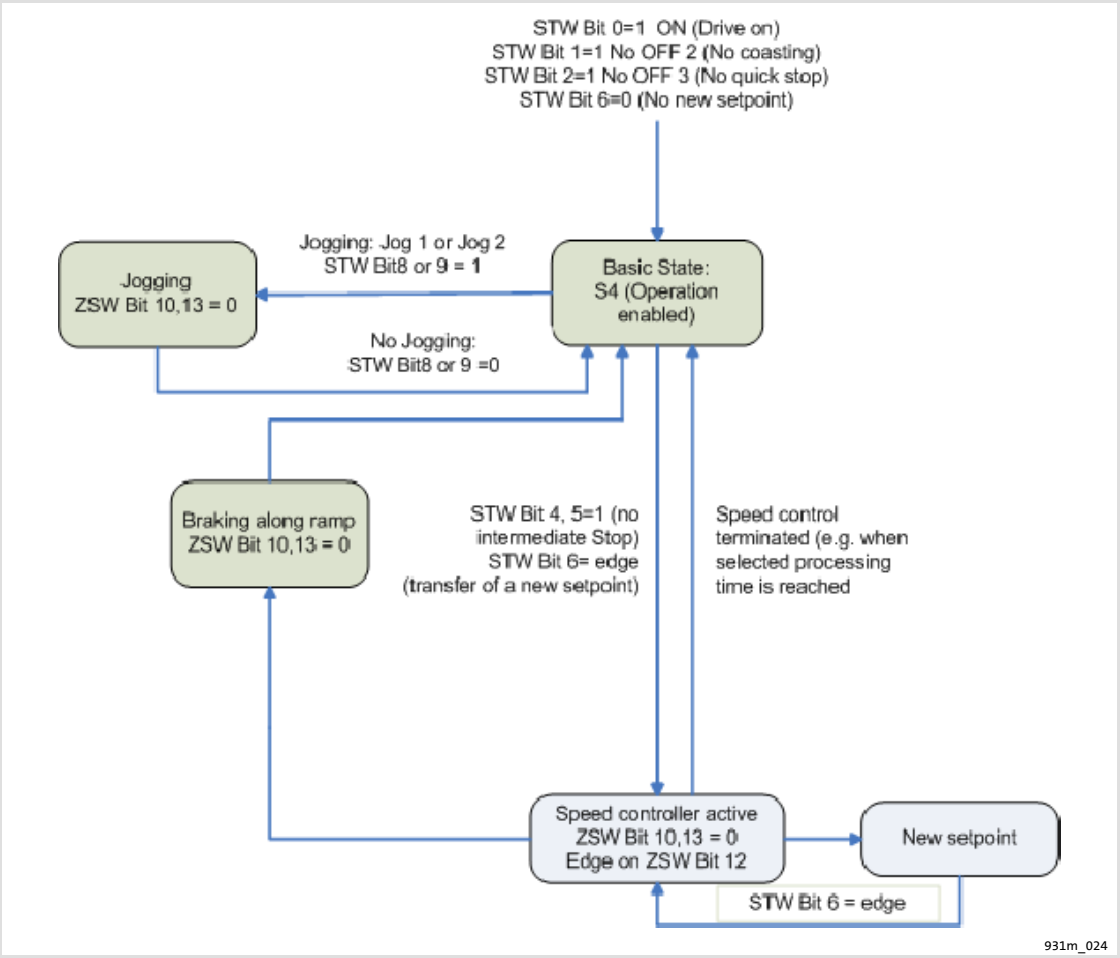


Fig. 3 State machine in the "speed control" mode

As explained in section "State diagram for positioning" (📖 38), the jogging mode can also run in speed-controlled operation.

Through an edge of bit 6 of STW a new speed setpoint or driving record is accepted and executed. The drive can be braked via the functions OFF1, OFF2 and OFF3. (📖 38).

7 Parameter channel (PCV mechanism)

Certain drive functions are further accessed via the parameter characteristic value (PCV) mechanism. The PCV mechanism serves to process parameters in cyclic data exchange. The PCV mechanism is used to:

- operate and observe parameters (master -> slave).
- transfer spontaneous messages (slave -> master -> slave).

Moreover, it serves to, e.g.:

- set control authority and parameter change rights
- define setpoints
- read out status information
- configure limit switches.

In the PCV mechanism, the master defines a job, the slave processes the job and formulates the response. Jobs and responses cannot be blocked. Each PPO-Write contains exactly one job and each PPO-Read contains exactly one response. Hence, maximally 4 user data bytes can be transmitted with one job or one response. In the parameter ID, job/response and the corresponding parameters are coded.

7.1 Access authorisation

Since the parameter characteristic value mechanism (PCV) serves to access setpoints and parameters, the user should pay attention to the access authorisation. For setpoint selection, the PROFIBUS master requires the parameter change rights over the servo inverter. A simultaneous access of the operating program and a PROFIBUS master is neither possible nor sensible.

In the ”Level 0” operating mode, the operating program can be used to observe the drive. When commissioning, the current status of the drive can be observed at the same time. If the operating program is logged on the servo inverter with an operating mode higher than ”Level 1”, an access conflict occurs and the PROFIBUS master cannot access the drive.

The operating program enables the user to configure the access authorisation of the PROFIBUS master to the servo inverter, as described in chapter ”Activation of PROFIBUS at the servo inverter”. (📖 18) .

7.2 Structure of the parameter characteristic value

When processing the PCV, a job identification, the corresponding PNU (parameter number) and a value are transmitted. The job identification indicates if data of different sizes are to be written or requested. The single job identifications are listed in Tab. 19. The PNUs which are specified subsequently serve to define the object, the value to be changed and the access. The PNU number (represented decimally) must be first converted into a hexadecimal numerical format and can thus be processed directly or entered binary. Then the basic structure of the PCV mechanism is shown. The procedure is to be explained using an example.

Area		Description
Parameter characteristic value (PCV)		
	PKE	Parameter number (PNU) and job or response identification
	IND	Subindex and reserved area
	PWE	Since the higher-order bits (bits 16 ... 31) are not used, they must be set to ”0”. Lower-order bits (bits 0 ... 15): Parameter values.

Tab. 15 Abbreviations - PCV mechanism

7.2.1 Structure of parameter identification (PKE)

The following table shows the binary structure of the PCV message:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
					SPM											
	Job identification															
	Parameter number (PNU)															

Tab. 16 Structure of parameter identification

Job identification	Job or response identification (value range 0 ... 15)
SPM	Toggle bit for spontaneous message processing
PNU	Parameter number (value range 1 ... 1999)

7.2.2 Subindex

The subindex serves to ensure, e.g., an assignment to the correct parameter value in an array

Bit	7	6	5	4	3	2	1	0
Value								

Tab. 17 Subindex

7.2.3 Parameter value

The values of the individual objects are transmitted with the parameter value.

Byte	7	6	5	4	3	2	1	0
Value								

Tab. 18 Parameter value

7.3 Job and response processing

The job and response processing is defined so that the identification shows which fields of the PCV interface (IND,PWE) must be evaluated. Moreover, a distinction is made between parameter value and parameter description.

7.3.1 Job identification (master -> slave)

To change a parameter value the slave must receive a job identification from the master (see Tab. 19). This job identification depends on the data type or format to be changed (word, double word, array).

After the slave has received and executed the job successfully, a corresponding response is generated (see Tab. 20), which also shows transmission errors. The response data is available at the slave as long as a new job is transmitted.

Job identification	Function	Response identification	
		Positive	Negative
0	No job	0	
1	Request parameter value	1, 2	7
2	Change parameter value (word)	1	7, 8
3	Change parameter value (double word)	2	7, 8
4	Request describing element (double word)	3	7
5	Change describing element	3	7, 8
6	Request parameter value (array)	4, 5	7
7	Change parameter value (array word)	4	7, 8
8	Change parameter value (array double word)	5	7, 8
9	Request number of array elements	6	7

Tab. 19 Overview of job identifications

7.3.2 Response identification (slave -> master)

The response shows if the transmission was successful or if a transmission error occurred. The response helps to exactly locate the error. The following table contains all responses to the implemented job identifications.

Note!

If a parameter of the slave in double word format is to be changed, but the job identification refers to a change of a parameter in word format, the slave responds with a corresponding error message / number (see Tab. 21).

Response identification	Function
0	No job
1	Transmit parameter value (word)
2	Transmit parameter value (double word)
3	Transmit describing element
4	Transmit describing element (array word)
5	Transmit describing element (array double word)
6	Transmit number of array elements
7	Job cannot be executed (with error number)
8	No parameter change rights for PCV interface
9	Spontaneous message - word
10	Spontaneous message - double word

Tab. 20 Overview of response identifications

If jobs cannot be executed, the slave responds with an error number.

7.3.3 Error numbers at response

Error number	Information	Detailed description
0	Impermissible PNU	The parameter number is not assigned.
1	Parameter value cannot be changed	This is a non-writable object, e.g. an actual value.
2	Lower or upper value limit exceeded	The permissible writable limit range of the object has been exceeded. Please observe object limits.
3	Faulty subindex	The indicated subindex of the object does not exist or a format error exists. Check entries.
4	No array	The addressed object is no array type.
5	Wrong data type	The object has been addressed as a wrong data type. See job identification table.
6	No setting permitted (only resettable)	No setting permitted (only resettable)
7	Describing element cannot be changed	Elements such as the serial numbers cannot be changed.
8	PPO - Write requested in the IR is not available	When installing the hardware a wrong data type was selected. Please check the HW settings.
9	Description data not available	
10	Wrong access group	Access error! The PROFIBUS interface has no parameter change rights. See PNU 927. Possible error: Parameter change rights have not been requested. The operating program and PROFIBUS master try to access the drive simultaneously. Wrong software settings in the operating program. (See activation of PROFIBUS)
11	No parameter change rights	Parameter change rights not requested or access not possible.
12	Wrong password	A password has been assigned which must be entered for processing. See password.
13	Text in cyclic traffic cannot be read	
14	Name in cyclic traffic cannot be read	
15	No text array available	
16	PPO - Write is missing	When installing the hardware a wrong data type was selected. Please check the HW settings.
17	Job cannot be executed due to operating status	Check operating status. Is an error pending at the drive? Errors can be observed via the software in the online level 1 under Status.
18	Other errors	
19 ... 100	Date in the cyclic traffic cannot be read	

Tab. 21 Overview of error messages - job identifications

The error numbers 0 ... 100 are defined or reserved profile-oriented.

7.3.4 Examples of PCV mechanism

Example 1: Request parameter change rights:

To request the parameter change rights a parameter value must be transmitted, so the job identification is 2. The PNU number is 927. This corresponds to 39F in the hexadecimal data format. The value 1 is transmitted as parameter value. The parameter value serves to transmit the control authority to the PROFIBUS master. After this action, the operating program cannot access the servo inverter anymore.

Parameter identification:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	0	1	0	0	0	1	1	1	0	0	1	1	1	1	1
Hexadecimal value	2				3				9				F			
	Request parameter value				PNU											

Subindex

Bit	7	6	5	4	3	2	1	0
Binary value	0	0	0	0	0	0	0	0

Parameter value

Byte	7	6	5	4	3	2	1	0
Value	0000	0000	0000	0000	0000	0000	0000	0001

As response identification the value 1 is output as job identification, see Tab. 20. This means: Transmission of parameter values.

Response identification :

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	0	0	1	0	0	1	1	1	0	0	1	1	1	1	1
Hexadecimal value	1				3				9				F			
	Transmit parameter value				PNU											

In the subindex, the response contains a zero and in the parameter value of the response the requested value, in this case 1, is returned.

Example 2: Reading the set speed

To read the set maximum speed out of the drive, the parameter is requested from the inverter.

Here, the parameter identification consists of the value 6 in the job identification for requesting the parameter value, see Tab. 19, and the driving record number as PNU, e.g. driving record 1, see chapter data type driving record 1 to 100 (📖 61). The subindex contains the number of the parameter to be requested, see (📖 61), subindex 1 for maximum speed.

Parameter identification:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hexadecimal value	6				0				0				1			
	Request parameter value				PNU											

Subindex

Bit	7	6	5	4	3	2	1	0
Binary value	0	0	0	0	0	0	0	1

Parameter value

Byte	7	6	5	4	3	2	1	0
Value	0000	0000	0000	0000	0000	0000	0000	0000

As response identification a 4 is output as job identification, and the PNU, in this case 001 is output for driving record 1, see Tab. 20. This means: Transmit parameter value (array word).

Response identification :

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hexadecimal value	4				0				0				1			
	Transmit describing element				PNU											

Subindex

Bit	7	6	5	4	3	2	1	0
Binary value	0	0	0	0	0	0	0	1

Parameter value, e.g. for 6000 1/min

Byte	7	6	5	4	3	2	1	0
Value	0000	0000	0000	0000	0001	0111	0111	0000

Example 3: Change of the set speed

To change the speed in a driving record, a similar procedure like requesting parameter values is selected. As job identification, a 7 must be entered here (job identification 7 – change parameter value).

To continue to let the drive run with a changed speed, the edge at bit 6 of the control word must be changed for acknowledgement after changing the setpoint. The new setpoint is accepted after every edge change (0 after 1 and 1 after 0).

Parameter identification:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1
Hexadecimal value	7				0				0				1			
	Change parameter value				PNU											

Subindex

Bit	7	6	5	4	3	2	1	0
Binary value	0	0	0	0	0	0	0	1

The subindex indicates the parameter to be addressed.

Parameter value

Byte	7	6	5	4	3	2	1	0
Value	0000	0000	0000	0000	0000	0000	0110	0100

In this example, the parameter value is the speed. Here, a value of 100 1/min is selected.

As response identification a 4 is output as job identification, and the PNU, in this case 001 is output for driving record 1, see Tab. 20. This means: Transmit parameter value (array word).

Response identification :

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hexadecimal value	4				0				0				1			
	Transmit describing element				PNU											

Subindex

Bit	7	6	5	4	3	2	1	0
Binary value	0	0	0	0	0	0	0	1

Parameter value, e.g. for 100 1/min

Byte	7	6	5	4	3	2	1	0
Value	0000	0000	0000	0000	0000	0000	0110	0100

Example 4: Reversal

To change the direction of rotation, the subindex 6 of the data type driving record 1 to 100 (PNU 1 to 100) is addressed. The table lists as data type the subindex 6 bit […]. The number which is listed in parenthesis, corresponds to the bit which must be set to change the status.The subindex 6 serves to change, e.g. the acceleration ramp form, brake ramp, controller type, driving direction and direction of rotation. In our example, bit 4 is addressed to cause a reversal of rotation direction.

Parameter identification:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1
Hexadecimal value	7				0				0				1			
	Change parameter value				PNU											

Subindex

Bit	7	6	5	4	3	2	1	0
Binary value	0	0	0	0	0	1	1	0

The subindex indicates the parameter to be addressed.

Parameter value

Byte	7	6	5	4	3	2	1	0
Value	0000	0000	0000	0000	0000	0000	0001	0000

In this example, the parameter value (Bit 4 =1) reverses the direction of rotation.

As response identification a 4 is output as job identification, and the PNU, in this case 001 is output for driving record 1, see Tab. 20. This means: Transmit parameter value (array word).

Response identification :

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hexadecimal value	4				0				0				1			
	Transmit describing element				PNU											

Subindex

Bit	7	6	5	4	3	2	1	0
Binary value	0	0	0	0	0	1	1	0

Parameter value like parameter requirement.

Byte	7	6	5	4	3	2	1	0
Value	0000	0000	0000	0000	0000	0000	0001	0000

To convert the reversal of rotation direction into an action, an edge at bit 6 of the control word is changed.

7.3.5 Transfer of PPO with PROFIBUS-DP

The DP function Data_Exchange

In case of PROFIBUS-DP the cyclic data exchange with PPOs is available only. For this purpose, DP provides the function Data_Exchange, which serves to transmit cyclic data to the slave and collect them at the same time. The input or output data exchanged with Data_Exchange correspond to the PPO types described. However, changing the PPO type during the operation is not possible.

The DP function Set_Prm

This function serves to transmit 7 bytes of PROFIBUS-DP-specific information to the slave. The option to transmit device-specific parameters (User_Prm_Data) from byte 8 to 244 is not used.

The DP function Slave_Diag

This function serves to read 6 bytes of PROFIBUS-DP-specific diagnostic information and 2 further bytes Ext_Diag_Data out of the slave. The Ext_Diag_Data provides a device-specific diagnostics, in which error messages of the slave are displayed. The output of the drive-specific diagnostics can be switched off by parameter setting.

Synchronisation of several devices, the DP_function Global Control

The DP function Global Control serves to synchronise several drives. If a master sends a sync control command, the outputs of the addressed slaves are frozen to the momentary value. In the following user data transmissions, the output data are stored in the slaves, the output data remains unchanged. When giving the next sync control command the stored output data are transmitted to the outputs. An unsync control command serves to exit the sync operation.

By analogy with this, the freeze control command enables the input states to be frozen to the momentary value and to be collected with the next user data transmission. The input data are only updated again, when the DP master transmits the next freeze control command to the devices concerned. The freeze operation is exited with an unfreeze control command.

The DP function Set_Slave-Add

This optional function is not implemented.

8 Parameter numbers

Parameter numbers defined in the ”Profidrive” PROFIBUS profile

The parameter numbers 900 to 999 are defined or reserved to profile specifications.

Overview of the parameter numbers defined in the ”Profidrive” PROFIBUS profile.

PNU	Meaning	Data type
918	Station address	Unsigned 16
927	Parameter change rights (PCV)	Unsigned 16
928	Control authority (PZD)	Unsigned 16
930	Selection for operating mode	Unsigned 16
947	Fault number	Unsigned 16
970	Load parameters	Unsigned 16
971	Transfer into non-volatile memory	Unsigned 16

Tab. 22 Profidrive parameter numbers

8.1 Explanation of the parameter numbers

The single PNUs, their functions and structure are described in the following paragraph:

How to read the tables

Column	Meaning
PNU	Parameter number
Subindex	Subindex
Description	Description of the parameter number
Lenze	Lenze setting of the parameter number
Selection	minimum value [smallest increment/unit] maximum value
Data type	• Integer 16 • Unsigned 16

Tab. 23 Explanation of the tables

8.1.1 Node address (PNU 918)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
918	0	**Station address**			Unsigned 16
				2 126	

Selection	Meaning	Description
2 ... 126		After the station address has been changed, the PROFIBUS-DP interface makes a reset in the drive.

8.1.2 Parameter change rights (PNU 927)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
927	0	**Parameter change rights (PCV)**			Unsigned 16
				0 1	

Selection	Meaning	Description
0	No parameter change rights for the PROFIBUS interface	This value serves to request the parameter change rights for the PROFIBUS interface. Two errors may occur: ● The parameter change rights apply for the operating program (operating mode ≥ ”Online Level 3”), i.e. the operating mode must be ≤ 2 ● The PCV level in the PROFIBUS parameters (PNU106) is set to 0. If the master wants to write PCV values without parameter change rights, an error message occurs.
1	Parameter change rights for the PROFIBUS interface	

8.1.3 Control authority (PNU 928)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
928	0	**Control authority (PZD)**			Unsigned 16
				0 2	

Selection	Meaning	Description
0	Control authority for operating program	The control authority is obligatory to activate the state machine of the drive. It serves to transmit start commands to activate driving records. The control authority is required to carry out setpoint selections (see PNU 927).
1	Control authority for PROFIBUS interface	
2	Control authority for local I/O	

8.1.4 Selector switch for operating mode (PNU 930)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
930	0	**Selector switch for operating mode**			Unsigned 16
				1 0x8000	

Selection	Meaning	Description
1	Speed control mode	The drive can only be operated speed-controlled in the speed mode. When a driving record is started with ”Positioning” control type, the drive travels following error-controlled.
2	Positioning mode	With this configuration, the drive can only execute positioning driving records. When you try to start a driving record with the speed control, the fault signal ”Driving record” is displayed.
0x8000	Concatenation mode	The concatenation mode permits speed-controlled and positioning driving records to be started via a DP master. Here, also following driving records and waiting times between chained driving records are considered.

8.1.5 Selector switch - control word bit 8 (PNU 931)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
931	0	**Selector switch - control word bit 8**			Unsigned 16
				1 0x8020	

Selection	Meaning	Description
1	Jogging 1 ON / OFF	When the drive is ready to start and the control bit 8 is activated, the jogging mode is started with the set jogging setpoints. When the bit is reset, the jogging process is stopped again.
0x8000	Engage / disengage the brake	When the corresponding control word bit is activated which is assigned to the "Engage brake" function, the brake is closed. This can happen while a driving record is executed or during position control back-up time at standstill. During travel the output stage is switched off simultaneously, at standstill after the engagement time. After activation, the brake will only be released again, when the bit is reset and a travel job is activated, or the external signal "Releasing the brake" is pending. If the bit is set the start of a travel job will be ignored and not carried out.
0x8001	Left limit switch is active / inactive	These functions permit the simulation of an activated limit switch per control software
0x8002	Right limit switch is active / inactive	
0x8003	Quick stop is active / inactive	An activated quick stop brakes the motor with the maximum possible torque to zero speed.
0x8004	Reference switch is active / inactive	This function serves to simulate an activated limit switch per control software.
0x8005	Reference window is active / inactive	This function is not implemented
0x8010	Controller output is active / inactive	The application box output is switched to HIGH level when the control word bit with the function "Activate application box output" is set. Resetting the bit switches the output to LOW level again.
0x8020	IO box output is activated / deactivated	

8.1.6 Selector switch - control word bit 9 (PNU 932)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
932	0	**Selector switch - control word bit 9**			Unsigned 16
				1 0x8020	

Selection	Meaning	Description
1	Jogging 2 ON / OFF	When the drive is ready to start and the control bit 8 is activated, the jogging mode is started with the set jogging setpoints. When the bit is reset, the jogging process is stopped again.
0x8000 ... 0x8020	See PNU 931	

8.1.7 Selector switch - control word bit 11 (PNU 933)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
933	0	**Selector switch - control word bit 11**			Unsigned 16
				1 0x8020	

Selection	Meaning	Description
1	Start homing / cancel homing	This function serves to start or stop the homing mode via the control word bit 11.
0x8000 ... 0x8020	See PNU 931	

8.1.8 Selector switch - control word bit 12 ... 15 (PNU 934 ... 937)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
934 ... 937	0	**Selector switch - control word Bit 12 ... 15**			Unsigned 16
				1 0x8020	

Selection	Meaning	Description
1	Reserved	
0x8000 ... 0x8020	See PNU 931	

8.1.9 Selector switch - status word bit 8 (PNU 938)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
938	0	**Selector switch - status word bit 8**			Unsigned 16
				1 0x804d	

Selection	Meaning	Description
1	No following error / following error	If the status word, bit 8, is assigned to this function, a HIGH level indicates ”no following error” and a LOW level indicates a following error.
0x8000	Brake engaged / disengaged	Here, a HIGH level indicates an activated/engaged brake, whereas a LOW level indicates a disengaged brake.
0x8001	Left limit switch is activated / deactivated	This function serves to assign the limit switch status to the status word bit. A HIGH level of the limit switch is indicated through the bit value ”1”.
0x8002	Right limit switch is activated / deactivated	
0x8003	Activate / deactivate quick stop	The quick stop status can be read out at this point. The bit value ”1” indicates an active quick stop and bit value ”0” indicates that no quick stop is active.
0x8004	Activate / deactivate reference switch	The limit switch status can be read out using this function. The bit value ”1” indicates an activated reference switch, bit value ”0” indicates that the reference switch is not active.
0x8005	Activate / deactivate reference window	
0x8006	Driving record is active / inactive	As soon as a driving record is processed by the motor, this will be indicated by ”1”on the status word bit assigned to this function.
0x8010	Inverter output is activated / deactivated	Here, the status of the inverter output can be monitored. Bit value ”1” indicates an activated output, bit value ”0” indicates a deactivated output.
0x8020	Inverter output **Output** is activated / deactivated	Here, the status of the inverter output can be activated. Bit value ”1” indicates an activated output, bit value ”0” indicates a deactivated output.
0x8030	Inverter input is activated / deactivated	Here, the status of the inverter input can be monitored. Bit value ”1” indicates an activated input, bit value ”0” indicates a deactivated input.
0x8040	Inverter input **1-BCD** is activated / deactivated	This function serves to transmit the physical levels of the I/O box inputs to the status word bit. The bit value ”0” indicates a LOW level, bit value ”1” indicates a HIGH level.
0x8041	Inverter input **2-BCD** is activated / deactivated	
0x8042	Inverter input **4-BCD** is activated / deactivated	
0x8043	Inverter input **8-BCD** is activated / deactivated	
0x8044	Inverter input **10-BCD** is activated / deactivated	
0x8045	Inverter input **20-BCD** is activated / deactivated	
0x8046	Inverter input **40-BCD** is activated / deactivated	
0x8047	Inverter input **80-BCD** is activated / deactivated	
0x8048	Inverter input **Start** is activated / deactivated	

Selection	Meaning	Description
0x8049	Inverter input **Stop** is activated / deactivated	
0x804a	Inverter input **Limit left** is activated / deactivated	
0x804b	Inverter input **Limit right** is activated / deactivated	
0x804c	Inverter input **Quick stop** is activated / deactivated	
0x804d	Inverter input **Input** is activated / deactivated	

8.1.10 Selector switch - status word bit 11 (PNU 939)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
939	0	**Selector switch - status word bit 11**			Unsigned 16
				1 0x804d	

Selection	Meaning	Description
1	Home position is set / no home position is set	Here the bit value ”1” of the status word indicates a set home position, the bit value ”0” indicates that no home position is set.
0x8000 ... 0x804d	See PNU 938	

8.1.11 Selector switch - status word bit 12 (PNU 940)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
940	0	**Selector switch - status word bit 12**			Unsigned 16
				1 0x804d	

Selection	Meaning	Description
1	Setpoint acknowledgement (edge)	Here the status word, bit 12, is set to its original function ”setpoint acknowledgement”. This bit reflects bit 6 of the control word which activates a positioning driving request by an edge.
0x8000 ... 0x804d	See PNU 938	

8.1.12 Selector switch - status word bit 13 (PNU 941)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
941	0	**Selector switch - status word bit 13**			Unsigned 16
				1 0x804d	

Selection	Meaning	Description
1	Drive is standing / drive is running	The bit value ”1” indicates that the drive is standing, bit value ”0” indicates that the drive is running.
0x8000 ... 0x804d	See PNU 938	

8.1.13 Selector switch - status word bit 14 (PNU 942)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
942	0	**Selector switch - status word bit 14**			Unsigned 16
				1 0x804d	

Selection	Meaning	Description
1	Reserved	
0x8000 ... 0x804d	See PNU 938	

8.1.14 Selector switch - status word bit 15 (PNU 943)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
943	0	**Selector switch - status word bit 15**			Unsigned 16
				1 0x804d	

Selection	Meaning	Description
1	Reserved	
0x8000 ... 0x804d	See PNU 938	

8.2 Device-specific parameter numbers

8.2.1 Data type - jogging setpoint 1 and 2 (PNU 107 und 108)

PNU	Subindex	Description	Possible settings				Data type
			Lenze	Selection			
107 108		**Jogging setpoint 1 and 2**					Array
	1	Speed		1	[1/min]	6000	Integer 16
	2	Maximum torque		1	[mNm]	1500	Unsigned 16
	3	Dead time			[ms]	Unused	
	4	Acceleration		1	[1/60*s²]	65536	Unsigned 32
	5	Braking deceleration		1	[1/60*s²]	65536	

Tab. 24 Data type - jogging setpoint 1 and 2 (PNU 107 and 108)

These two parameter numbers serve to define the setpoints for the jogging mode without the pre-assignment of which the ”jogging” mode would not function.

8.2.2 Fault number (PNU 947)

If the bit 3 (fault) is set in the status word, the fault number can be queried in this parameter.

PNU	Subindex	Description	Possible settings			Data type
			Lenze	Selection		
947	0	**Fault number**				Unsigned 16
				0	Trouble-free	
				1	DC-bus voltage below 180V	
				2	DC-bus voltage below 400V	
				3	Motor temperature exceeds 140 °C	
				4	Electronics temperature exceeds 78 °C	
				5	Brake supply voltage is out of range	
				6	Quick stop	
				7	Error occurred during homing	
				8	Motor current is switched off	
				9	Error in the driving record	
				10	Error in the system parameters	
				11	Drive inhibited	

Tab. 25 Fault number (PNU 947)

8.2.3 Load parameter set (PNU 970)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
970	0	**Load parameter set**			Unsigned 16
				-256 100	

Selection	Meaning
0	All parameters are set to default setting
1 ... 100	Driving record 1 is set to default setting Driving record 100 **(0 of the operating program)** is set to default setting
101	Reference parameters are set to default setting
102	I/O settings are set to default setting
103	Control parameters are set to default setting
104	System parameters are set to default setting
105	Service parameters are set to default setting
106	PROFIBUS parameters are set to default setting
-1 ... -100	Load driving record from non-volatile memory Load driving record 100 **(0 of the operating program)** from non-volatile memory
-101	Load reference parameters from non-volatile memory
-102	Load I/O settings from non-volatile memory
-103	Load control parameters from non-volatile memory
-104	Load system parameters from non-volatile memory
-105	Load service parameters from non-volatile memory
-106	Load PROFIBUS parameters from non-volatile memory
-256	Load all parameters from non-volatile memory

Tab. 26 Load parameter set (PNU 970)

8.2.4 Transfer to the non-volatile memory (PNU 971)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
971	0	**Transfer into the non-volatile memory**			Unsigned 16
				0 106	

Selection	Meaning
	Transfer into the non-volatile memory
0	Store all parameters non-volatilely
1 ... 100	Store driving record 1 non-volatilely Store driving record 100 **(0 of operating program)** non-volatilely
101	Store reference parameters non-volatilely
102	Store I/O settings non-volatilely
103	Store control parameters non-volatilely
104	Store system parameters non-volatilely
105	Store service parameters non-volatilely
106	Store PROFIBUS parameters non-volatilely

Tab. 27 Transfer to the non-volatile memory (PNU 971)

8.3 Overview of the device-specific active parameters

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
1 ... 100		Driving record 1 ... 100 **(0 of operating program)**			Array
101		Reference parameters			
102		I/O - settings			
103		Control parameters			
104		System parameter			
105		Service parameters			
106		PROFIBUS parameters			

Tab. 28 Overview of the device-specific active parameters

8.4 Overview of the device-specific passive parameters

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
1000		Status			Array
1001		Information			
1002		Options			

Tab. 29 Overview of device-specific passive parameters

8.5 Data type - travel data record (PNU 1 to 100)

PNU	Subindex	Description	Possible settings				Data type
			Lenze	Selection			
1		**Driving record**					Array
... 100	1	Maximum speed		1	[1/min]	6000	Unsigned 16
	2	Maximum torque		1	[mNm]	1500	Unsigned 16
	3	Controller type 0, 1, 2: Traversing time		0	[ms]	or ∞	Unsigned 32
		Controller type 3: Absolute target position (sign acc. to driving direction)					
		Control type 4: Target position relative to set position (sign acc. to driving direction)					
	4	Acceleration		1	[1/60*s²]	65535	Unsigned 32
	5	Braking deceleration		1	[1/60*s²]	65535	Unsigned 32
	6	Acceleration ramp type:		0	linear		Bit [1 ... 0]
				1	SIN		
				2	sin²		
		Deceleration ramp:		0	linear		Bit [3 ... 2]
				1	SIN		
				2	sin²		
		Driving direction:		0	Positive		Bit [4]
				1	Negative		
		Controller type:		0	Following error		Bit [7 ... 5]
				1	Speed controller		
				2	Torque controller		
				3	Absolute position		
				4	Relative position		
		Activate brake after position control back-up time:		0	No		Bit [8]
				1	Yes		
	7	Next driving record: Driving record is started after elapsed waiting time and with active synchronous input.		- 1	[1]	- 99	Integer 16
		Driving record is terminated after waiting time has elapsed		0			
		Driving record is started after waiting time has elapsed.		1	[1]	+ 99	
	8	Waiting time		1	[ms]	65535	Unsigned 32

Tab. 30 Data type - driving record (PNU 1 to 100)

8.6 Data type - reference parameter (PNU 101)

PNU	Subindex	Description	Possible settings				Data type
			Lenze	Selection			
101		**Reference parameters**					Array
	1	Maximum speed		1	[1/min]	6000	Integer 16
	2	Maximum torque		1	[mNm]	1500	Unsigned 16
	3	Starting position 0 ... 2: Unlimited					Unsigned 32
		Starting position 3					
		Absolute target position (sign acc. to driving direction)					
	4	Acceleration		1	[1/60*s²]	65535	Unsigned 32
	5	Braking deceleration		1	[1/60*s²]	65535	Unsigned 32
	6	Acceleration ramp type:		0	linear		Bit [1 ... 0]
				1	SIN		
				2	sin²		
		Deceleration ramp:		0	linear		Bit [3 ... 2]
				1	SIN		
				2	sin²		
		Driving direction:		0	Positive		Bit [4]
				1	Negative		
		Reference type:		0	None		Bit [7 ... 5]
				1	Mark		
				2	Edge		
				3	Limit switch, right		
				4	Limit switch, left		
				5	Right end stop		
				6	Left end stop		
		Activate brake after position control back-up time:		0	No		Bit [8]
				1	Yes		
		Reference start:		0	Powerup		Bit [11 ... 9]
				1	First start		
				2	Manual start		
				3	Input of reference start		
				4	Unused		
		Starting position:		0	None		Bit [13 ... 12]
				1	Limit switch, right		
				2	Limit switch, left		
				3	Absolute target position		
	7	Absolute resolver position: Not considered		-1			Integer 16
		Absolute resolver position: Considered		0		4096	

Tab. 31 Data type - homing (PNU 101)

8.7 Data type - IO settings (PNU 102)

PNU	Subindex	Description	Possible settings			Data type
			Lenze	Selection		
102		**I/O - settings**				Array
	1	Input: (Object for drive with I/O input functionality. Not for devices with local CAN)		0	Unused	Bit [3 ... 0]
				1	Reference	
				2	Output stage off	
				3	Quick stop	
				4	Goto 99	
				5	Synchronisation	
				6	Intermediate stop	
				7	Single step mode	
		Input: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	Unused	Bit [7 ... 4]
				1	Reference	
				2	Output stage off	
				3	Reference window	
				4	Reference window	
				5	Goto 99	
				6	Synchronisation	
				7	Intermediate stop	
				8	Single step mode	
		Input is active: (Object for drive with I/O input functionality. Not for devices with local CAN)		0	High	Bit [8]
				1	Low	
		Input is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [9]
				1	Low	
		”Left limit switch” is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [10]
				1	Low	
		”Right limit switch” is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [11]
				1	Low	

PNU	Subindex	Description	Possible settings			Data type
			Lenze	Selection		
102	1	”Quick stop” input is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [12]
				1	Low	
		”Start” input is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [13]
				1	Low	
	2	Output mask: Status word & V2 (Object for drive with I/O input functionality. Not for devices with local CAN)				Bit [0]
	3	Fluxxtorque output mask: Status word & V2 (Object for Fluxxtorque drive with additional box. Not for devices with I/O)				Bit [0]
	4	Output is active: (Object for drive with I/O input functionality. Not for devices with local CAN)		0	High	Bit [0]
				1	Low	
		Output is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [1]
				1	Low	
		”Trouble” output is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [2]
				1	Low	
		”Data record is being processed” output is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [3]
				1	Low	
		”Setpoint reached” output is active: (Object for Fluxxtorque drive with additional box. Not for devices with I/O)		0	High	Bit [4]
				1	Low	
		Debounce time for start input		[ms]		Bit [15 ... 8]

Tab. 32 Data type - I/O settings (PNU 102)

8.8 Data type - control parameters (PNU 103)

PNU	Subindex	Description	Possible settings			Data type
			Lenze	Selection		
103		**Control parameters**				Array
	1	Kp		128 (1.0)	12800 (100.0)	Fixed point value E2
	2	Tn		1 [µs]	65535	Unsigned 16
	3	Tv		1 [µs]	65535	
	4	Ta		700 [µs]	5000	
	5	Maximum speed		1 [1/min]	6000	
	6	Maximum torque		1 [mNm]	1500	
	7	Positioning window		1 [incr]	30000	
	8	Following error window		1 [incr]	30000	
	9	Position controller back-up time		1 [ms]	65535	
	10	Kp position controller		2^{-16}	2	

Tab. 33 Data type - control parameter (PNU 103)

8.9 Data type - system parameters (PNU 104)

PNU	Subindex	Description	Possible settings			Data type
			Lenze	Selection		
104		**System parameter**				Array
	1	Reference switch position		[incr]		Integer 32
	2	Left limit switch position		[incr]		
	3	Right limit switch position		[incr]		
	4	Positive direction:		0	right	Bit [0]
				1	left	
		Limit switch:		0	without	Bit [1]
				1	with	
	5	Numerator conversion		1	1000	Unsigned 16
	6	Denominator conversion		1	1000	

Tab. 34 Data type - system parameters (PNU 104)

8.10 Data type - service parameters (PNU 105)

PNU	Subindex	Description	Possible settings				Data type
			Lenze	Selection			
105		**Service parameters**					Array
	1	Resolver offset		0		4095	Unsigned 16
	2	Current controller response time		0	[µs]	1200	
	3	Maximum torque		0	[mNm]	1500	
	4	Maximum speed		0	[1/min]	6000	
	5	Gearbox numerator		1		1000	Integer 16
	6	Gearbox denominator		-1 1		-1000 1000	Unsigned 16
	7	Current factor 24/42 V electronics 230/320 V electronics		1000 307 600	[µNm/‰]	2000 4920 9600	
	8	Brake available		0	No		Bit [0]
				1	Yes		
	9	Brake disengagement time		0	[ms]	5000	Unsigned 16
	10	Brake engagement time		0	[ms]	5000	
	11	Number of pole pairs		0	1 pole pair		Bit [0]
				1	2 pole pairs		Bit [1]
				2	3 pole pairs		Bit [2]
				3	4 pole pairs		Bit [3]
				4	5 pole pairs		Bit [4]
				5	6 pole pairs		Bit [5]
				6	7 pole pairs		Bit [6]
				7	8 pole pairs		Bit [7]
		Direction reversal		0	No		Bit [8]
				1	Yes		
	12	Minimum brake voltage		18	[V]	22	Unsigned 16

Tab. 35 Data type - service parameter (PNU 105)

When a gearbox with reversal of rotation direction is used, enter a negative gearbox nominator.

8.11 Data type - PROFIBUS parameters (PNU 106)

PNU	Subindex	Description	Possible settings			Data type
			Lenze	Selection		
106		**PROFIBUS parameters**				Array
	1	Diagnostics:		0	From	Bit [0]
				1	Yes	
		Guidance blocked:		0	No	Bit [1]
				1	Yes	
		PCV – level:		0	PCV values can only be read	Bit [3 ... 2]
				1	Driving records can be changed	
				2	Only service and PROFIBUS parameters cannot be changed	
				3	All values can be changed	
	2	Station address		2	126	Unsigned 16

Tab. 36 Data type - PROFIBUS parameter (PNU 106)

8.12 Data type status (PNU 1000)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
1000		**Status**			Array
	1	Speed		[1/min]	Integer 16
	2	Motor current		[‰]	
	3	Position		[incr]	Integer 32
	4	Brake supply voltage		[V]	Unsigned 16
	5	DC-bus voltage		[V]	
	6	Electronics temperature		[°C]	Integer 16
	7	Motor temperature		[°C]	
	8	System error		[incr]	
	9	Active travel data set			Unsigned 16
	10	Status word: Group signal - warning			Bit [0]
		Group signal - fault			Bit [1]
		Data record is being processed			Bit [2]
		Setpoint reached			Bit [3]
		Right limit switch is active			Bit [4]
		Left limit switch is active			Bit [5]
		Homing mode is being processed			Bit [6]
		Quick stop is active			Bit [7]
		Drive in standstill			Bit [8]
		Führung vom AG			Bit [9]
		System error			Bit [10]
		Motor deenergised			Bit [11]
		Intermediate stop is active			Bit [12]
		Single step mode is active			Bit [13]
		Single step mode waits for start			Bit [14]
		Home position is set			Bit [15]

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
	11	Warning word: DC bus voltage below 220 V			Bit [0]
		Brake supply voltage < 22 V			Bit [1]
		Motor temperature exceeds 130 °C			Bit [2]
		Electronics temperature exceeds 70 °C			Bit [3]
		Following error			Bit [4]
		Reserved			Bit [5]
					Bit [6]
		Derating			Bit [7]
		Reserved			Bit [8]
					Bit [9]
					Bit [10]
					Bit [11]
					Bit [12]
					Bit [13]
					Bit [14]
					Bit [15]
	12	Fault word: DC-bus voltage below 180 V			Bit [0]
		Brake supply below 20 V			Bit [1]
		Motor temperature exceeds 140 °C			Bit [2]
		Electronics temperature exceeds 78 °C			Bit [3]
		DC-bus voltage exceeds 400 V			Bit [4]
		Quick stop			Bit [5]
		Homing			Bit [6]
		Motor deenergised			Bit [7]
		Driving record			Bit [8]
		System parameter			Bit [9]
		Drive inhibited			Bit [10]
		Reserved			Bit [11]
					Bit [12]
					Bit [13]
					Bit [14]
					Bit [15]
	13	Motor inputs			Bit [0]
	14	Motor outputs			Bit [0]

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
	15	Additional box inputs 1-BCD			Bit [0]
		2-BCD			Bit [1]
		4-BCD			Bit [2]
		8-BCD			Bit [3]
		10-BCD			Bit [4]
		20-BCD			Bit [5]
		40-BCD			Bit [6]
		80-BCD			Bit [7]
		Start			Bit [8]
		Stop			Bit [9]
		Limit left			Bit [10]
		Limit right			Bit [11]
		Quick stop			Bit [12]
		Input			Bit [13]
	16	Additional box outputs Output			Bit [0]
		Error			Bit [1]
		Program active			Bit [2]
		Target reached			Bit [3]

Tab. 37 Data type status (PNU 1000)

In case of the inputs and outputs the bit value ”0” stands for LOW level, the bit value ”1” for HIGH level.

8.13 Data type info (PNU 1001)

The object 1001 serves to carry out a confirmation prompt and an evaluation of the device. The device ID, serial number, software version, and the operating time can be read out. The single objects are classified in the following.

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
1001		**Information**			Array
	1	Device identification		1024 931MPKxx, 24 V DC	Unsigned 32
				1042 931MPKxx, 42 V DC	
				1230 931MPNxx, 230 V AC	
				1320 931MPNxx, 320 V DC	
	2	Serial number			
	3	Version			
	4	Operating time		[min]	

8.14 Data type options (PNU 1002)

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
1002		**Options**			Array
	1	Reserved			

8.15 Overview of all PNUs

PNU	Subindex	Description	Possible settings				Data type
			Lenze	Selection			
918	0	**Station address**					Unsigned 16
927	0	**Parameter change rights (PCV)**					
928	0	**Control authority (PZD)**					
930	0	**Selection for operating mode**					
947	0	**Fault number**					
970	0	**Load parameters**					
971	0	**Transfer into non-volatile memory**					
931	0	**Selector switch - control word bit 8**					
932	0	**Selector switch - control word bit 9**					
933	0	**Selector switch - control word bit 11**					
934	0	**Selector switch - control word bit 12**					
935	0	**Selector switch - control word bit 13**					
936	0	**Selector switch - control word bit 14**					
937	0	**Selector switch - control word bit 15**					
938	0	**Selector switch - status word bit 8**					
939	0	**Selector switch - status word bit 11**					
940	0	**Selector switch - status word bit 12**					
941	0	**Selector switch - status word bit 13**					
942	0	**Selector switch - status word bit 14**					
943	0	**Selector switch - status word bit 15**					
107		**Jogging setpoint 1**					Array
	1	Speed		1	[1/min]	6000	Integer 16
	2	Maximum torque		1	[mNm]	1500	Unsigned 16
	3	Dead time			[ms]	Unused	
	4	Acceleration		1	[1/60*s^2]	65536	Unsigned 32
	5	Braking deceleration		1	[1/60*s^2]	65536	

PNU	Subindex	Description	Possible settings				Data type
			Lenze	Selection			
108		**Jogging setpoint 2**					Array
	1	Speed		1	[1/min]	6000	Integer 16
	2	Maximum torque		1	[mNm]	1500	Unsigned 16
	3	Dead time			[ms]	Unused	
	4	Acceleration		1	[1/60*s²]	65536	Unsigned 32
	5	Braking deceleration		1	[1/60*s²]	65536	
947	0	**Fault number**					Unsigned 16
970	0	**Load parameter set**					Unsigned 16
971	0	**Transfer to the non-volatile memory**					Unsigned 16
1		**Driving record**					Array
... 100	1	Maximum speed		1	[1/min]	6000	Unsigned 16
	2	Maximum torque		1	[mNm]	1500	
	3	Controller type		0	[ms]	or ∞	Unsigned 32
	4	Acceleration		1	[1/60*s²]	65535	
	5	Braking deceleration		1	[1/60*s²]	65535	
	6	Further settings					Bit [8 ... 0]
	7	Next travel data set		- 99	[1]	+ 99	Integer 16
	8	Waiting time		1	[ms]	65535	Unsigned 32
101		**Reference parameters**					Array
	1	Maximum speed		1	[1/min]	6000	Integer 16
	2	Maximum torque		1	[mNm]	1500	Unsigned 16
	3	Starting position			[incr]		Unsigned 32
	4	Acceleration		1	[1/60*s²]	65535	Unsigned 32
	5	Braking deceleration		1	[1/60*s²]	65535	Unsigned 32
	6	Further settings					Bit [13 ... 0]
	7	Absolute resolver position					Integer 16
102		**I/O settings (not for local CAN)**					Array
	1	Input					Bit [13 ... 0]
	2	Output					Bit [0]
	3	Fluxx output mask					Bit [0]
	4	Output					Bit [15 ... 0]
103		**Control parameters**					Array
	1	Kp		128 (1.0)		12800 (100.0)	Fixed point value E2
	2	Tn		1	[µs]	65535	Unsigned 16
	3	Tv		1	[µs]	65535	
	4	Ta		700	[µs]	5000	
	5	Maximum speed		1	[1/min]	6000	
	6	Maximum torque		1	[mNm]	1500	
	7	Positioning window		1	[incr]	30000	
	8	Following error window		1	[incr]	30000	
	9	Position controller back-up time		1	[ms]	65535	
	10	Kp position controller		2^{-16}		2	

PNU	Subindex	Description	Possible settings			Data type
			Lenze	Selection		
104		**System parameter**				Array
	1	Reference switch position		[incr]		Integer 32
	2	Left limit switch position		[incr]		
	3	Right limit switch position		[incr]		
	4	Positive direction:		0 right		Bit [0]
				1 left		
		Limit switch:		0 without		Bit [1]
				1 with		
	5	Numerator conversion		1	1000	Unsigned 16
	6	Denominator conversion		1	1000	
105		**Service parameters**				Array
	1	Resolver offset		0	4095	Unsigned 16
	2	Current controller response time		0 [µs]	1200	
	3	Maximum torque		0 [mNm]	1500	
	4	Maximum speed		0 [1/min]	6000	
	5	Gearbox numerator		1	1000	Integer 16
	6	Gearbox denominator		-1 1	-1000 1000	Unsigned 16
	7	Current factor 24/42 V electronics 230/320 V electronics		1000 [µNm/‰] 307 600	2000 4920 9600	
	8	Brake available		0 No		Bit [0]
				1 Yes		
	9	Brake disengagement time		0 [ms]	5000	Unsigned 16
	10	Brake engagement time		0 [ms]	5000	
	11	Number of pole pairs		0 1 pole pair		Bit [0]
				1 2 pole pairs		Bit [1]
				2 3 pole pairs		Bit [2]
				3 4 pole pairs		Bit [3]
				4 5 pole pairs		Bit [4]
				5 6 pole pairs		Bit [5]
				6 7 pole pairs		Bit [6]
				7 8 pole pairs		Bit [7]
		Direction reversal		0 No		Bit [8]
				1 Yes		
	12	Minimum brake voltage		18 [V]	22	Unsigned 16

PNU	Subindex	Description	Possible settings		Data type
			Lenze	Selection	
106		**PROFIBUS parameters**			Array
	1	Diagnostics:		0 From	Bit [0]
				1 Yes	
		Guidance blocked:		0 No	Bit [1]
				1 Yes	
		PCV – level:		0 PCV values can only be read	Bit [3 ... 2]
				1 Driving records can be changed	
				2 Only service and PROFIBUS parameters cannot be changed	
				3 All values can be changed	
	2	Station address		2 126	Unsigned 16
1000		**Status**			Array
	1	Speed		[1/min]	Integer 16
	2	Motor current		[‰]	
	3	Position		[incr]	Integer 32
	4	Brake supply voltage		[V]	Unsigned 16
	5	DC-bus voltage		[V]	
	6	Electronics temperature		[°C]	Integer 16
	7	Motor temperature		[°C]	
	8	System error		[incr]	
	9	Active travel data set			Unsigned 16
	10	Status word			Bit
	11	Warning word			
	12	Fault word			
	13	Motor inputs			
	14	Motor outputs			
	15	Additional box inputs			
	16	Additional box outputs			
1001		**Information**			Array
	1	Device identification		1024 931MPKxx, 24 V DC	Unsigned 32
				1042 931MPKxx, 42 V DC	
				1230 931MPNxx, 230 V AC	
				1320 931MPNxx, 320 V DC	
	2	Serial number			
	3	Version			
	4	Operating time		[min]	
1002		**Options**			Array
	1	Reserved			

9 Troubleshooting and fault elimination

Error message	Cause	Remedy
System parameter	The direction of the specified setpoints outside the software limit switches, e.g. positioning behind a limit switch.	Check settings of the software limit switches.
Homing	No homing has been executed yet, although a homing mode has been set or is required (positioning mode).	Check homing settings/execute homing.
Homing	The following homing settings have been made ● Reference type: None ● Reference start: Manually If no homing is to be executed, no manual start must be set.	Check homing settings. Select homing mode or set homing start to power up.
Travel data record	When accessing the bus interface and the operating program a logic conflict occurs.	Check entries via PROFIBUS and operating program.

10 Appendix

10.1 Data formats

Information area	Data type
1 bit	Bool
8 bits	Byte, Char
16 bits	Word, INT, DATE
32 bits	DWord, DINT, REAL, TIME, TOD

10.2 GSE file

```
;=====================================================================
;Configuration file for ”Fluxxtorque” as DP slave
;Lenze GmbH&Co.KG Kleinantriebe, D-32699 Extertal, Hans-Lenze-Straße 1
;Status Version 0.1 from 31 September 2004
;Format: GSE file revision 1.0
;Name: 931MW058F.GSE
;=====================================================================
#Profibus_DP
GSE_Revision = 2
Vendor_Name=”Fluxxtorque”; vendor
Model_Name=”931_M/W”; model name
Revision=”VERSION 1.0”; model revision
Ident_Number = 0x058F; ident number
Protocol_Ident=0; PROFIBUS_DP Protocol
Station_Type=0; slave station
Slave_Family=1@Positionierantrieb@3000rpm
FMS_supp = 0; DP-/FMS-Mixed mode not supported
Hardware_Release=”V 1.1”; up to 32 characters
Software_Release=”V 1.3”; up to 32 characters
9.6_supp = 1; baudrate 9.6kB supported
19.2_supp = 1; baudrate 19.2kB supported
93.75_supp = 1; baudrate 93.75kB supported
187.5_supp = 1; baudrate 187.5kB supported
500_supp = 1; baudrate 500kB supported
1.5M_supp = 1; baudrate 1.5MB supported
```

MaxTsdr_9.6 = 60; max. response time at 9.6kB
MaxTsdr_19.2 = 60; max. response time at 19.2kB
MaxTsdr_93.75 = 60; max. response time at 93.75kB
MaxTsdr_187.5 = 60; max. response time at 187.5kB
MaxTsdr_500 = 150; max. response time at 500kB
MaxTsdr_1.5M = 300; max. response time at 1,5MB
Redundancy = 0; no redundancy
Repeater_Ctrl_Sig = 0; not connected
24V_Pins = 0; not connected
Freeze_Mode_supp = 1; supported
Sync_Mode_supp = 1; supported
Auto_Baud_supp=0; supported
Set_Slave_Add_supp = 0; not supported
Min_Slave_Intervall = 50; max. every 5ms a new DP data exchange telegram
Modular_Station = 1; modular device;
Max_Module = 1
Max_Input_Len = 20
Max_Output_Len = 12
Max_Data_Len = 32
Module="PPO Typ3" 0xf1
EndModule
Module="PPO-Write Typ3, PPO-Read Typ4" 0xf1,0xd3
EndModule
Module="PPO Typ1" 0xf3,0xf1
EndModule
Module="PPO-Write Typ1, PPO-Read Typ2" 0xf3,0xf1,0xd3
EndModule
Max_Diag_Data_Len = 9
Unit_Diag_Bit(0) = "DC-bus voltage < 180V"
Unit_Diag_Bit(1) = "Operating voltage < 20V"
Unit_Diag_Bit(2) = "Motor temperature > 140°C"
Unit_Diag_Bit(3) = "Electronics temperature > 78°C"
Unit_Diag_Bit(4) = "DC-bus voltage > 400V"
Unit_Diag_Bit(5) = "Quick stop fault"
Unit_Diag_Bit(6) = "Fault - homing"

Unit_Diag_Bit(7) = ”Fault - drive deenergised”
Unit_Diag_Bit(8) = ”Driving record error”
Unit_Diag_Bit(9) = ”Error in the system parameters”
Unit_Diag_Bit(10) = ”Drive blocked”
Unit_Diag_Bit(11) = ”reserve”
Unit_Diag_Bit(12) = ”reserve”
Unit_Diag_Bit(13) = ”reserve”
Unit_Diag_Bit(14) = ”reserve”
Unit_Diag_Bit(15) = ”reserve”

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Notes

CE

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