OPERATING INSTRUCTIONS

CANopen - Protocol with Device Profile in accordance with CiA DSP 408

Revision 6

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1 CANopen® Technology

CANopen® is an independent of the manufacturer, open fieldbus standard with a wide range of application in manufacturing– and process automation. Independence of the manufacturer and openness are guaranteed by the physical interface in accordance with ISO 11898 and CiA DS-102. With this, the basis is given for a worldwide CAN (Controller Area Network) distribution embracing all manufacturers.

CANopen® provides functionally graded communication protocols (communication profiles), The *WANDFLUH* -Electronics uses the device profile DSP-408 "Device Profile Fluid Power Technology".

1.1 EDS Files

The characteristic communication features of a CANopen® – device are defined in the form of an electronic data sheet (Electronic Data Sheet, EDS file). *WANDFLUH* makes available the corresponding EDS.

The EDS files expand the open communication right to the user level. All modern planning tools make it possible to read-in the EDS files during the configuration. As a result, the integration into the CANopen® -system becomes simple and user friendly.

1.2 General

The present operating instructions represent a CANopen®–specific extension of the The *WANDFLUH* -Electronics operating instructions.

Remark: Please read the operating instructions of the the *WANDFLUH* -Electronics beforehand.

First of all it is important to familiarize oneself with the CANopen®–terms, which occur time and again in these operating instructions. On principle, two CANopen® profiles are referred to:

- The CANopen®–communication profile regulates the "how" of the communication. It specifies elements for the exchanging of real-time data and parameter data as well as a simplified network management.

- The CANopen®–device profile describes the "what" of the communications. The objective of device profiles is to define the data contents independent of the manufacturer, so that the basic functionality of the different device classes can be uniformly addressed.

1.3 Technical Data

The physical interface corresponds to the standard ISO 11898.

The CAN–protocol in accordance with ISO 11898 corresponds to the data connection layer Layer 2 in the ISO/OSI–reference model and supports a multi-master operation, i.e., every participant can request the communication through the serial bus.

Used as application layer is the protocol CANopen®, which is standardized in the International Manufacturers and Users Association CAN in Automation (CiA).

Device Profile	DSP-408 (CiA)
Application Layer • CANopen® communication profile (DS-301) • Timing, communication services, network management	**ISO / OSI** Layer 7
These layers are not used	Layer 3 ... 6
Data Link Layer	Layer 2

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• Message validation • Bus-arbitration • Build-up of the message frame • Receipt acknowledgement (Acknowledge) • Error identification, signaling and suppression • Transmission speed and bus timing	
Physical Layer • Signal level and bit representation • Transmission medium	Layer 1

1.3.1 Physical Layer

The transmission medium is an electric two-wire. The signal transmission takes place differentially (3.5/1.5V dominant //2.5V recessive).
The CAN- bus has to be terminated at both ends with a 120 Ohm resistor. The *WANDFLUH* -Electronics itself does not have a termination resistor. After the installation of the CAN-bus and the termination resistors, the resistance between the two lines should be measured with an ohmmeter; it has to be within the range of 60...70 Ohm.

1.3.2 Fieldbus Wiring

The bus wires may be routed parallel, twisted and/or shielded, depending on the EMC requirements. The wiring topology should be as close as possible to a single line structure, in order to minimize reflections. The cable stubs for connection of the bus nodes should be as short as possible, especially at high bit rates. At 1Mbit/s, the length of the cable stubs should not exceed 0,3m (20kBit/s=7,5m, 125kBit/s=3,7m, 500kBit/s=0,7m).

!!FIXME!! The wiring of a CANopen® DSV takes place through the plug X2 on the DSV housing. The pin assignment corresponds to the following table.

Pin	Signal	Beschreibung
A3	CAN_High IN	Bus signal plus
B3	CAN_Low IN	Bus signal minus
C3	CAN_Gnd IN	Masse (CAN)
D3	CAN_High OUT	Bus signal plus
E3	CAN_Low OUT	Bus signal minus
F3	CAN_Gnd OUT	Masse (CAN)

1.3.3 Transmission Speeds

The transmission speed and the maximum admissible bus lengths mutually influence one another:

Fieldbus cable length	Line resistance	Bus-Line cross-section	Termination Resistance	Max. bit rates
0...40m	70mΩ/m	0,25 ... 0,34mm^2 (AWG23, AWG22)	124Ω (1%)	1000 kBit/s at 40m
40...300m	< 60mΩ/m	0,34 ... 0,6mm^2 (AWG22, AWG20)	127Ω (1%)	<= 500 kBit/s at 100m
300...600m	< 40mΩ/m	0,50 ... 0,6mm^2	150Ω...300Ω	<= 100 kBit/s at 500m

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		(AWG20)		
600...1000m	< 26mΩ/m	0,75 ... 0,8mm^2 (AWG18)	150Ω...300Ω	<= 50 kBit/s at 1000m

To minimize the voltage drop on long distances the termination resistor should be higher than in the ISO 11898-2 standard.

Remark: The transmission speed can be parameterized on the *WANDFLUH* -Electronics, resp. set via the parameterization software PASO (menu "Fieldbus→Fieldbus-Info").

1.3.4   Other connectors

For all other connectors, please refer to the appropriate operating manual e.g. "Operating instructions *WANDFLUH* -Electronics".

1.4   Fieldbus Settings

The following settings can be made either via the parameterization software PASO (menu "Fieldbus") or directly from the master via the CANopen® Master:
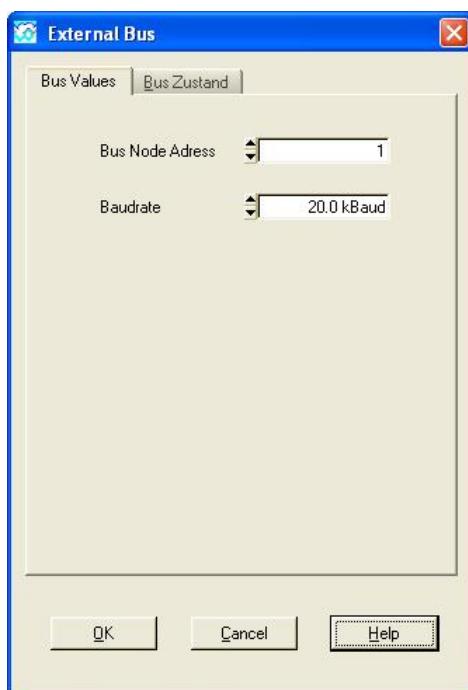
Field	Parameter Description	Display
Node address	With this parameter, the required node address for the CAN-Slave *WANDFLUH* –Electronics can be set. The value set is saved on the *WANDFLUH* -Electronics in the non-volatile memory.	1 ... 127
Baud rate	With this parameter, the required baud rate for the CAN-Slave *WANDFLUH* -Electronics can be set. The value set is saved on the *WANDFLUH* -Electronics in the non-volatile memory.	10, 20, 50,125, 250, 500, 1000kbaud

Note: The factory setting for the node address is 1.

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The factory setting for the node baudrate is 20kBit/s

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1.5 Fieldbus Diagnostics

A diagnosis of the fieldbus is possible at any time via the parameterization software PASO. This takes place through the menu point "Fieldbus_Fieldbus-Info".
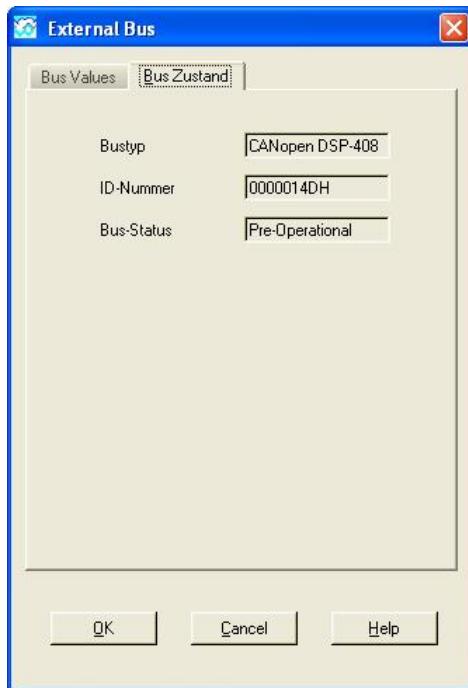
The following bus statuses are displayed:

Field	Parameter description	Display
Bustype	The type of fieldbus connected and the device profile used are displayed here.	CANopen® DSP-408
ID - number	The identification number of the CAN-Slave *WANDFLUH*-Electronics. This number is predefined fixed.	
Bus - status	The status of the communication state machine is displayed in this field. **The corresponding description of the individual statuses can be found in the chapter "Start of the controlling (Boot-Up)".**	Initialization Pre-Operational Operational Stopped

1.6 CAN-Bus Parameters

The menu item "Fieldbus - CAN-Bus parameters" in the parameterization software PASO allows the setting of the PDO communication and PDO mapping parameters (refer to "Communication parameter RxPDO1 – RxPDO" page 38). These parameters can only be changed in the bus status "Stop" or "pre-operational" (refer to "Device Control Services" page 18).

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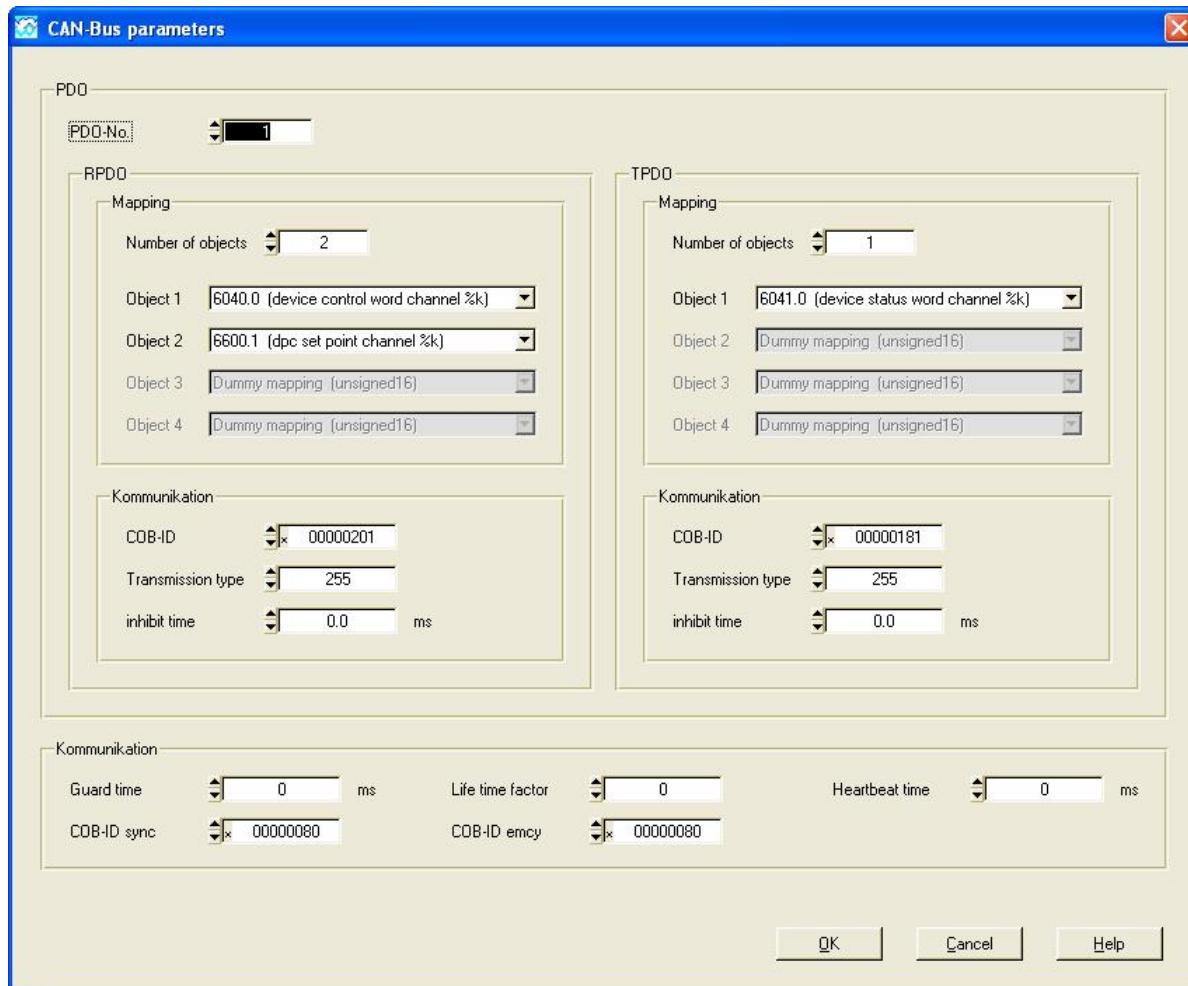
The settings of the PDO mapping is done individually per PDO. In the selection "PDO-No." can be selected, which PDO-setting should be changed.

Only the mapping and the communication parameters can be set per PDO. In the bottom of the window are global communications parameters which are not PDO-dependent.

1.7   Connection Example

As a connection example, reference is made to the operating instructions of the *WANDFLUH* -Electronics.

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2 Representation of a CAN Message

In the operating instructions, CAN–messages are described in detail in tables, such as are illustrated below. The split-up corresponds to the usual standard CAN–driver of the software interface (2 byte CAN-Header, 8 byte user data and 3 byte transmission failure detection).

Serial data stream:

	Identifier	RTR	DLC	useful dates	CRC	ACK	EOF
No. of bits	11	1	4	0...64	15	2	7

CAN Header

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
M-Byte 0	ID 10	ID 9	ID 8	ID 7	ID 6	ID 5	ID 4	ID 3
M-Byte 1	ID 2	ID 1	ID 0	RTR	DLC 3	DLC 2	DLC 1	DLC 0

CAN Data

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
M-Byte 2	Data	Data	Data	Data	Data	Data	Data	Data
M-Byte 3	Data	Data	Data	Data	Data	Data	Data	Data
M-Byte 4	Data	Data	Data	Data	Data	Data	Data	Data
M-Byte 5	Data	Data	Data	Data	Data	Data	Data	Data
M-Byte 6	Data	Data	Data	Data	Data	Data	Data	Data
M-Byte 7	Data	Data	Data	Data	Data	Data	Data	Data
M-Byte 8	Data	Data	Data	Data	Data	Data	Data	Data
M-Byte 9	Data	Data	Data	Data	Data	Data	Data	Data

CAN Trailer

M-Byte 10	CRC 14	CRC 13	CRC 12	CRC 11	CRC 10	CRC 9	CRC 8	CRC 7
M-Byte 11	CRC 6	CRC 5	CRC 4	CRC 3	CRC 2	CRC 1	CRC 0	ACK 1
M-Byte 12	ACK 0	EOF 6	EOF 5	EOF 4	EOF 3	EOF 2	EOF 1	EOF 0

M-Byte x :Message Byte x
ID 10 ... ID 0 :CAN-Identifier (COB-ID)
RTR :Remote transmission request-bit
DLC 3 ... DLC 0 :Data length code, length of the user data (value range 0...8, binary coded)
Data :User data
CRC 14 ... CRC 0 :Cyclic redundancy check
ACK 1 ... ACK 0:Acknowledge
EOF 6 ... EOF 0:End of frame

For the following documentation the CAN messages are represented in the following format. Only relevant dates like COB-ID and data bytes are shown.

M-Byte 0...1 (CAN Header)	M-Byte 2...9 (CAN data)	M-Byte 10...12 (CAN Trailer)
COB-ID	**Byte 0...7 (user data)**	**Not used in further descriptions**
e.g. 384 + node address	e.g. Status word	

2.1 Data Coding with CAN / CANopen®

Fundamental rule of the data coding for CAN / CANopen®:
- **First** transmitted is: the highest value bit of the lowest value byte.
- **Last** transmitted is: the lowest value bit of the highest value byte.

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→ **This corresponds to the description known as "Intel" format.**

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3 Communication Profile

The CANopen®–communication profile (CiA DS-301) regulates the "how" of the communication. It specifies elements for the exchanging of real-time data and parameter data as well as a simplified network management. In this, particular attention has been paid to the resource-saving implementability and with this to the good performance of the corresponding software layer.

CANopen® uses the following services for the different types of data. The communication profile contains:

- PDO (Process Data Object)
  for real-time data, max. 8 bytes (1 telegram), high priority telegram.
- SDO (Service Data Object)
  for system parameters, data split-up over several telegrams, low priority telegram.
- NMT (Boot_Up)
- Node-guard (life-/node guarding)
- Emergency (status)
- SYNC (synchronization)

3.1 Default- Identifier-Distribution

After switching-on the *WANDFLUH* -Electronics control system, it has a default–identifier–distribution in accordance with the CANopen® standard CiA DS 301. The following table provides an overview of this distribution from the point of view of the control system:

Object	Identifier (binary)	resulting COB - ID (decimal / hex)	Function	Objects for Comm. parameter / Mapping parameter
Broadcast objects				
NMT	00000000000	0	Boot-Up	-
SYNC	00010000000	128 (80h)	Synch	1005h, 1006h, 1007h
TIME Stamp	00100000000	256 (FFh)	Time stamp object	1012h, 1013h
Point to point objects (referred to node address)				
Emergency	0001xxxxxxx	128 (80h) + node address	Emergency telegram	1014h, 1015h
Rx_PDO1	0100xxxxxxx	512 (200h) + node address	Receive PDO1	1400h / 1600h
Rx_PDO2	0110xxxxxxx	768 (300h) + node address	Receive PDO2	1401h / 1601h
Rx_PDO3	1000xxxxxxx	1024 (400h) + node address	Receive PDO3	1402h / 1602h
Rx_PDO4	1010xxxxxxx	1280 (500h) + node address	Receive PDO4	1403h / 1603h
Tx_PDO1	0011xxxxxxx	384 (180h) + node address	Transmit PDO1	1800h / 1A00h
Tx_PDO2	0101xxxxxxx	640 (280h) + node address	Transmit PDO2	1801h / 1A01h
Tx_PDO3	0111xxxxxxx	896 (380h) + node address	Transmit PDO3	1802h / 1A02h
Tx_PDO4	1001xxxxxxx	1152 (480h) + node address	Transmit PDO3	1803h / 1A03h
Tx_SDO	1011xxxxxxx	1408 (580h) + node address	Transmit SDO (Parameter)	1200h
Rx_SDO	1100xxxxxxx	1536 (600h) + node address	Receive SDO (Parameter)	1200h

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NMT Error Control	1110xxxxxxx	1792 (700h) + node address	Life - /node guarding	1016h, 1017h

xxxxxx = Control - ID = node address settable via parameterization software PASO

3.2 Process Data Communication (PDO)

The real-time data transfer is performed by means of "Process Data Objects (PDO)". The transfer of PDOs is performed with no protocol overhead. CANopen® also defines the default settings for the process data exchange, such as, e.g. identifiers used, data assignment and communication behavior. The default setting for the data assignment (default-mapping) can be modified through so-called mapping parameters.

PDOs can be transmitted either event-controlled (asynchronous) or synchronized. Also the requirements via the CAN-Feature "Remote-Transmit-Request" are supported. With this, it is possible to flexibly meet the requirements of the application.

There are two kinds of use for PDOs. The first is data transmission and the second is data reception. It is distinguished in Transmit-PDOs (TPDOs) and Receive-PDOs (RPDOs).

3.2.1 PDO Communication Parameters

The PDO communication parameters (index 1400...1403 and 1800...1805) describe the transmission behavior of the PDOs. There the PDO identifiers, the type of transmission, the transmission inhibit time and the CMS priority group are listed.

Sub-index	Field in the PDO structure	Data type
0	Number of entries	Unsigned8
1	COB-ID	Unsigned32
2	Type of transmission	Unsigned8
3	Transmission inhibit time	Unsigned16

The type of transmission (sub-index 2) defines the transmission-/receiving characteristics of a PDO. A differentiation between a synchronous and an asynchronous transmission type is made. The asynchronous PDOs are transmitted event-controlled or in case of a remote request, the synchronous ones are triggered through a SYNC signal or transmitted by means of a time control.

Type of transmission:

Type of transmission	PDO transmission					
(decimal)	Cyclic	Acyclic	Synchro-nous	Asynchro-nous	RTR only	Remarks
0		X	X			Transmission related to SYNC.
1-240	X		X			Transmission related to SYNC, 1...240 x SYNC for one PDO.
241-251	Reserved					
252			X		X	Transmission only on remote transmission request
253				X	X	Transmission only on remote transmission request.
254				X		Only for TPDOs. Manufacturer specific.
255				X		Defined in the Device-Profile (TPDO immediate after RPDO).

COB-ID Code:

Bit number	Value	Description

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31 (MSB)	0 1	PDO available PDO not available
30	0 1	RTR permitted RTR not permitted
29	0 1	11-bit ID 29-bit ID
28 – 11	0 X	If bit 29 = 0 If bit 29 = 1, COB-ID
10 – 0 (LSB)	X	COB-ID

A remote transmission request (RTR) must always be transmitted with the number of requested data bytes (DLC), otherwise the *WANDFLUH* -Electronics answers without any data bytes.
Note: The CiA does not recommend using RTR.

Important: The designation of the process data objects takes place from the point of view of the *WANDFLUH* -Electronics control system.

The representation of a CANopen® message for a PDO can be seen from the following table.

COB-ID	Byte 0 ... 7
384 + node address	Mapped Tx_PDO1 bytes (refer to object 1A00H)

COB-ID	Byte 0 ... 7
512 + node address	Mapped Rx_PDO1 bytes (refer to object 1600H)

The corresponding COB-ID is calculated as follows:
        COB-ID_TX-PDO1 = 384 + node address
        COB-ID_RX-PDO1 = 512 + node address

3.2.2   Example for WANDFLUH -Electronics PDO:

RPDO1 Output data (controlword and command value, refer to object 1600h):

With Control Mode 1, 3 and 4:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
512 + node address	controlword Channel 1	Command value VPOC Channel 1	Not used	Not used

RPDO1 Output data (controlword and command value, refer to object 1601h):

With Control Mode 1, 3 and 4:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
768 + node address	controlword Channel 2	Command value VPOC Channel 2	Not used	Not used

RPDO1 Output data (controlword and command value, refer to object 1602h):

With Control Mode 1, 3 and 4:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
1024 + node address	controlword Channel 3	Command value VPOC Channel 3	Not used	Not used

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RPDO1 Output data (controlword and command value, refer to object 1603h):

With Control Mode 1, 3 and 4:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
1280 + node address	controlword Channel 4	Command value VPOC Channel 4	Not used	Not used

TPDO1 Input data (statusword, refer to object 1A00h):

With Control Mode 1 and 3:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
384 + node address	statusword Channel 1	Not used	Not used	Not used

TPDO2 Input data (statusword, refer to object 1A01h):

With Control Mode 1 and 3:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
640 + node address	statusword Channel 2	Not used	Not used	Not used

TPDO3 Input data (statusword, refer to object 1A02h):

With Control Mode 1 and 3:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
896 + node address	statusword Channel 3	Not used	Not used	Not used

TPDO4 Input data (statusword, refer to object 1A03h):

With Control Mode 1 and 3:

COB-ID	Byte 0 + 1	Byte 2 + 3	Byte 4 + 5	Byte 6 + 7
1152 + node address	statusword Channel 4	Not used	Not used	Not used

3.3 Service Data Communication (SDO)

The device parameters in the object directory are read and written via service data objects. Service data objects (SDO) are data structures of any size. In the case of CANopen®, they are addressed via a 16-bit - index and an 8-bit sub-index.
The *WANDFLUH* –Electronics control systems operate as servers, at the request of the client (e.g., SPS), they make data available (upload), or receive data from the client (download). A transmission with the number of data bytes <= 4 byte is called *Expedited Transfer* and a transmission with the number of data bytes > 4 byte is called *Segmented Transfer*.

Upload:
- The client requests data together with index and sub-index of the required device parameter.
- The server responds with device parameters (including index and sub-index).

Download:
- The client transmits date together with the index and sub-index.
- The server confirms the correct receipt.

The representation of a CANopen® message for an SDO can be seen from the following illustration.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...7

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1408 + node address	Control word value xxH	Index low-byte	Index high-byte	Sub-index	Data bytes

The corresponding COB-ID is calculated as follows:

COB-ID_SDOTX = 1408 + node address
COB-ID_SDORX = 1536 + node address

On principle a handshake takes place between the client and the server. If the parameter to be transmitted comprises up to 4 bytes, then a single handshake is sufficient (a telegram pair).

During the download, the client transmits the data together with the index, sub-index and the server confirms the receipt. During the upload, the client requests the data, in that it transmits the index and sub-index of the required parameter and the server transmits the parameter (incl. index and sub-index) in its response telegram. For upload and download the same identifier pair is used.

3.3.1   Upload SDO Protocol

Client → Server, Initiate Upload Request

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...7
1536 + node address	Control word value 40H	Index low-byte	Index high-byte	Sub-index	reserved

Server → Client, Upload Response (Expedited Transfer)

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...7
1408 + node address	Control word value 40H + ((4 – noB) * 4 + 3)	Index low-byte	Index high-byte	Sub-index	Data bytes

Server → Client, Upload Response (Segmented   Transfer)

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...7
1408 + node address	Control word value 41H	Index low-byte	Index high-byte	Sub-index	Number of bytes to be uploaded

Client → Server, Upload Request (only for segmented Transfer)

COB-ID	Byte 0	Byte 1...7
1536 + node address	Control word value 60H or 70H (toggle bit)	reserved

Client → Server, Upload Response (only for segmented Transfer)

COB-ID	Byte 0	Byte 1...7
1408 + node address	Control word value 00H or 10H (toggle bit) if no more segments + ((7 – noB) * 2 + 1)	Segmented data bytes

noB: number of valid data bytes (min. 1)

3.3.2   Download SDO Protocol

Client → Server, initiate Download Request (Expedited Transfer)

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...7
1536 +	Control word value	Index	Index	Sub-index	Data bytes

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| node address | 20H + ((4 – noB) * 4 + 3) | low-byte | high-byte | | |

Server → Client, Download Response

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...7
1408 + node address	Control word value 60H	Index low-byte	Index high-byte	Sub-index	reserved

3.3.3 Abortion of a Parameter Communication

In the case of a faulty parameter communication, it is aborted. To do this, the client, resp. the server transmits an SDO telegram with the following structure:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4 + 5	Byte 6	Byte 7
1408 + node address	Control word value 80H	Index low-byte	Index high-byte	Sub-index	Additional code	Error code	Error class

The following error descriptions from DS 301 are supported by the *WANDFLUH* control system:

Error class	Error code	Additional code	
0x05	0x03	0x0000	Toggle-bit error
0x06	0x01	0x0000	Not supported access to an object
0x06	0x02	0x0000	Object does not exist in the object dictionary
0x06	0x04	0x0041	Object cannot be mapped to the PDO
0x06	0x04	0x0042	PDO length exceeded
0x06	0x04	0x0043	Value invalid
0x06	0x04	0x0047	Initialization error
0x06	0x06	0x0000	Access failed due to an hardware error
0x06	0x07	0x0010	Data type, length of service parameter does not match
0x06	0x07	0x0012	Data type, length of service parameter too high
0x06	0x07	0x0013	Data type, length of service parameter too low
0x06	0x09	0x0011	Sub-index does not exist
0x06	0x09	0x0031	Value of parameter written too high
0x06	0x09	0x0032	Value of the parameter written too low
0x08	0x00	0x0020	Data cannot be transferred or stored to the application
0x08	0x00	0x0021	No data transfer because of local control
0x08	0x00	0x0022	No data transfer because of present device state
0x08	0x00	0x0000	General error

3.4 Emergency Objects (EMCY)

If an internal error occurs, then the *WANDFLUH* -Electronics transmits an 8 byte long emergency telegram. This telegram is transmitted with the highest priority. An emergency object is transmitted only once per "error event". As long as no new errors on the device occur, no further emergency objects are transmitted.

3.4.1 Emergency Object Data

The emergency telegram consists of the following 8 bytes:

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COB_ID	Byte 0 + 1	Byte 2	Byte 3...7
128 + node address	Error code (refer to the table below)	Error register (object 1001h)	Manufacturer-specific errors

The part "Manufacturer-specific errors" is not used.

Error Code

In the case of an error on the *WANDFLUH* -Electronics, here a value corresponding to the error is indicated. In the object 1003H the last occurring errors are filed. In doing so, the sub-index 0 indicates the number of the current errors. The following table lists all possible errors with the corresponding error code:

Error code (Hex)	Name	Description	Reaction
0000	No error	No error is present	
1000	General error	A general error is present	FAULT
3412	Power supply voltage too low	The *WANDFLUH* -Electronics supply voltage is too low	FAULT
2311	Valve	Solenoid driver 1 cable break or short-circuit	FAULT
2312		Solenoid driver 2 cable break or short-circuit	FAULT
3422	Control voltage too low	The control (analog command signal) voltage is too low or there occurred a cable break	FAULT
8100	Communication	Communication Reset or stop node transition (see communication state machine)	FAULT

Error Register

As long as an error is present, it can be read out through the object 1001H (description under "Error register (Flag) 29 ").

3.5   Network Management Objects (NMT)

The Network Management (NMT) is node oriented and follows a master-slave structure. NMT objects are used for executing NMT services. Through NMT services, nodes are initialised, started, monitored, resetted or stopped. All nodes are regarded as NMT slaves.
NMT requires that one device in the network fulfils the function of the NMT Master.

3.5.1   Device Control Services

CANopen® makes it possible to start the control system with a single telegram. When switching-on (Power-On), the control system carries out an initialization and switches into the status PRE-OPERATIONAL.
With a single telegram (Start_Remote_Node), the control system now can be switched into the status OPERATIONAL.

COB-ID	Byte 0	Byte 1
0 (NMT)	Command specifier	Node address

The following states and state commands are possible:

Designation	Command-specifier	Function
Start_Remote_Node	1(dec) = 01(hex)	Starts the control system, enables the

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		outputs, starts the transmission of PDOs
Stop_Remote_Node	2(dec) = 02(hex)	Stops the communication. Only NMT objects can still be transmitted.
Enter_Pre-Operational_State	128(dec) = 80(hex)	Stops the PDO transmission, SDO continues to be active
Reset_Node	129(dec) = 81(hex)	Carries out a control system reset
Reset_Communication	130(dec) = 82(hex)	Carries out a reset of the communication functions

Status	Description
Initialisation	This state is divided into three sub-states in order to enable a complete or partial reset of the node. • Reset-Application: In this state the manufacturer specific parameters and the profile area parameters are set to their power-on values. After this, the state Reset Communication is entered autonomously. • Reset-Communication: In this state the parameters of the communication profile area are set to their power-on values. After this the state Initialising is entered autonomously. • Initialising: This is the first sub-state the device enters after power-on. After finishing the basic node initialisation the device executes the write boot-up object service and enters the state Pre-Operational autonomously.
Pre-Operational	• All communication objects are allowed, with the exception of the PDO objects • PDO communication is not allowed • Device parameters and allocation of applications objects (PDO-mapping) are allowed
Operational	• All communication objects are allowed, resp. active • Access via SDO is possible, the application, resp. device state machine can, however, disable certain objects
Stopped	• In this status the whole communication is stopped, only the node guarding and heartbeat objects are still active.

States and Communication Object Relation

The table below shows the relation between communication states and communication objects. Services on the listed communication objects may only be executed if the device is in the appropriate communication state.

	INITIALISING	PRE-OPERATIONAL	OPERATIONAL	STOPPED
PDO			X	
SDO		X	X	
Synchronisation Object		X	X	
Emergency Object		X	X	
Boot-up Object	X			
Network Management Object		X	X	X

Communication state machine:

Transition	Description
C1	When switching-on the power supply, the control system automatically passes into the initialization status
C2	Initialization completed – automatic change into the status PRE-OPERATIONAL
C3, C6	Start_Remote_Node indication

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C4, C7	Enter_Pre-Operational_State indication
C5, C8	Stop_Remote_Node indication
C9, C10, C11	Reset_Node indication
C12, C13, C14	Reset_Communication indication
C15	Application reset carried out
C16	Communication reset carried out

3.5.2   Error Control Services

Through Error control services the NMT detects failures in a CAN-based Network. This is principally achieved through periodically transmitting of messages by a device. There exist two possibilities to perform the error control. It is not possible to use both error control mechanisms (Node Guarding Protocol and Heartbeat Protocol) at the same time.

Heartbeat Protocol
The *WANDFLUH* -Electronics can produce a cyclic heartbeat; this can be read by the master, in order to see whether the valve is still "alive" and in what condition it is. The heartbeat protocol defines an error service, which does not require a remote frame. The cycle time for the heartbeat is set through the object 1017H, with the time 0 the heartbeat is switched off.

COB-ID	DLC	Byte 0
1792 + node address	1	0 = Boot-up 4 = Stopped 5 = Operational 127 = Pre-operational

It is not possible to use the Heartbeat Protocol if the Node Guarding Protocol is active.

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Node Guarding Protocol

The guarding is achieved through transmitting guarding requests (Node guarding protocol) by the NMT Master. If a NMT Slave has not responded within a defined span of time (Node life time) or if the NMT Slave's communication status has changed, the NMT Master informs its Application about that event.

COB-ID	RTR	DLC
1792 + node address of the *WANDFLUH* -Electronics to be monitored	1	1

The *WANDFLUH* -Electronics addressed responds with the following telegram:

COB-ID	DLC	Byte 0
1792 + node address of the *WANDFLUH* -Electronics addressed	1	State of the *WANDFLUH* -Electronics 4 / 132(toggled) = stopped 5 / 133(toggled) = operational 127 / 255(toggled) = pre-operational The bit 7 is toggled after every telegram. If the bit is not toggled, then the NMT-Master assumes an error of this node.

The Guard Time is filed in the object 100Ch and the Life Time Factor in the object 100Dh. These entries can be read and changed by the master NMT-Master by means of an SDO - access. The time, which may pass between the node guarding telegrams until the *WANDFLUH* -Electronics issues an error, is called Life Time.
Calculation of the Life Time:
Life Time = Guard Time x Life Time factor

If the Life Time is exceeded, the NMT-Master does not transmit a node guarding anymore, then the *WANDFLUH* -Electronics transmits a corresponding emergency telegram.

It is not possible to use the Node Guarding Protocol if the Heartbeat Protocol is active.

3.5.3   Bootup Service

Through this service, the NMT slave indicates that a local state transition occurred from the state INITIALISING to the state PRE-OPERATIONAL.

COB-ID	Byte 0
1792 + node address	0

3.6   Synchronous Transmission (SYNC)

Synchronous transmission of message means that the transmission of the message is fixed in time with respect to the transmission of the SYNC telegram. The synchronous message is transmitted within a given time window with respect to the SYNC transmission, and at most once for every period of the SYNC.
The synchronous mechanism is intended for transferring commanded values and actual values on a fixed timely base.
In general the fixing of the transmission time at synchronous PDO messages coupled with the periodicity of transmission of the SYNC message guarantees that devices may arrange to sample process variables from a process environment and apply their actuation in a co-ordinated fashion.

The SYNC telegram is a CAN-Message with high priority and without process dates. One device in the network generates the SYNC telegram (SYNC producer), all other devices with a synchronous PDO behavior (refer to the PDO transmission type) react to it.

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To transmit a synchronous command value, the value has to be transmitted with a synchronous receive-PDO (transmit type 0...244) first. The command value will be processed until the next SYNC telegram is received. Likewise a synchronous transmit-PDO will only be sent after a SYNC telegram received.

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4 The Device Profile DSP-408 (in accordance with CiA)

The device profile explains the data and their format, which are exchanged between the CANopen® master and the *WANDFLUH* -Electronics Electronics (slave). The device profile is based on the specification of the profile "Fluid Power Technology" as defined by the VDMA (the German Engineering Federation). The device profile has been defined for hydraulic devices, such as: proportional valves, hydrostatic pumps and hydrostatic drives.

4.1 Device architecture
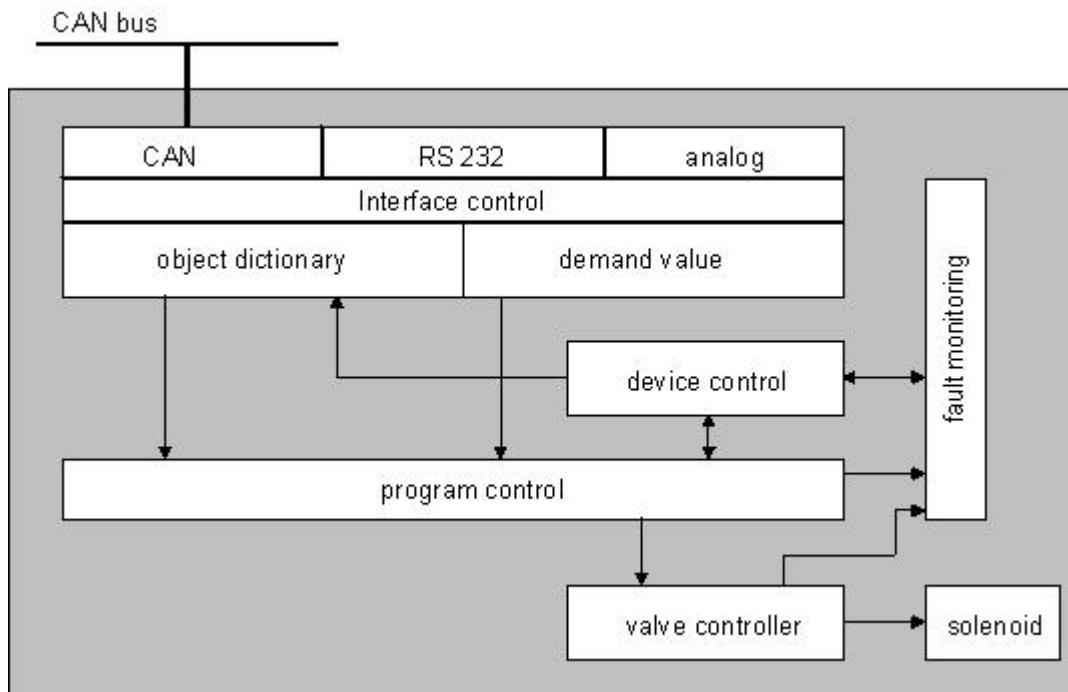
The DP-Slave controller card contains the complete Hardware of the *WANDFLUH*-Electronics. This Hardware includes the interface for the Fieldbus and the interface for the parameterisation software PASO. Also included are the solenoid outputs for the cylinder.

The Fieldbus control is made through a higher level Fieldbus Master.

The local control can be made via the parameterisation software PASO.

4.2 Device Control

The following picture shows the principle function of the CAN-Slave controller card.

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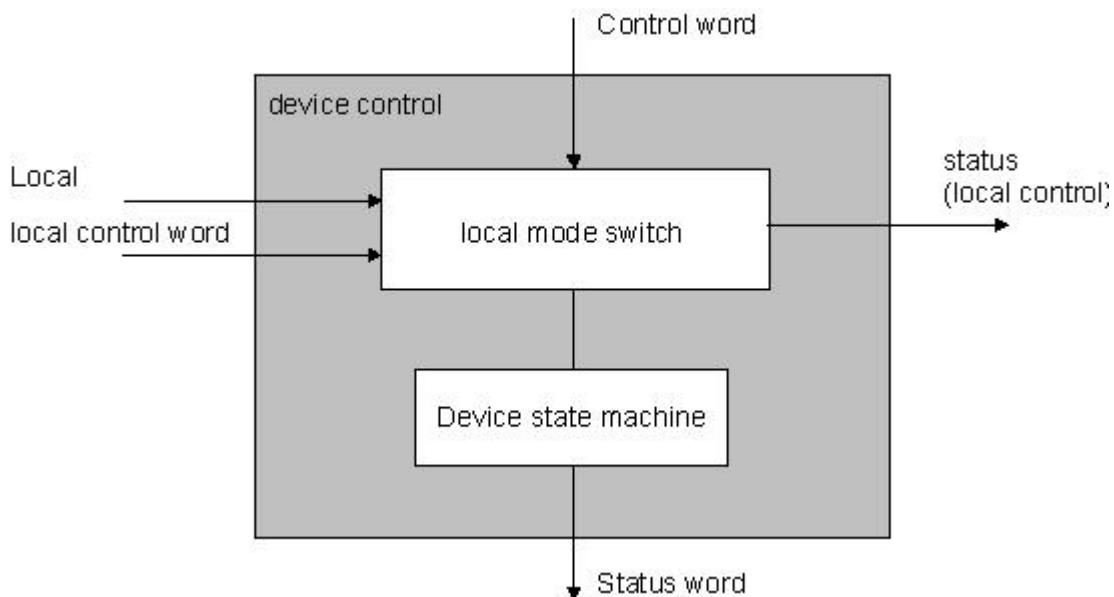
4.2.1   Local control

Local mode ("local")
The local mode has 2 states: "Disabled" and "Enabled", switch over through the digital input.
To activate the Local mode from the PASO, the PASO parameter "Operating mode = local" (window "Valve operation") must be sent (condition: *WANDFLUH*–Electronics -state "Init" or "Disabled").
To activate the Local mode from the bus, the bus parameter "Device local" = 1 must be sent via the Fieldbus (condition: *WANDFLUH*-Electronics -state "Init" or "Disabled").

PASO mode ("Remote PASO")
The local mode has 2 states: "Disabled" and "Enabled", switch over through the PASO command "Enable" resp. "Disable".
To activate the PASO mode from the bus resp. local mode, the PASO command "Valve operation" must be activated (condition: Device-state "Init" or "Disabled").

Bus mode ("Remote")
In the Bus mode, the control commands will be set resp. displayed through the Fieldbus. The Bus mode has several states (refer to chapter "Device State Machine 23 "), switch over through the Bus parameter "Device control word".
To activate the Bus mode from the PASO mode, the PASO command "Local" must be activated (condition: *WANDFLUH*-Electronics -state "Init" or "Disabled").
To activate the Bus mode from the local mode, the bus parameter "Device local=0" must be sent via the CAN-bus (condition: *WANDFLUH*-Electronics -state "Init" or "Disabled").

This picture shows the different possibilities of switch over the different states.

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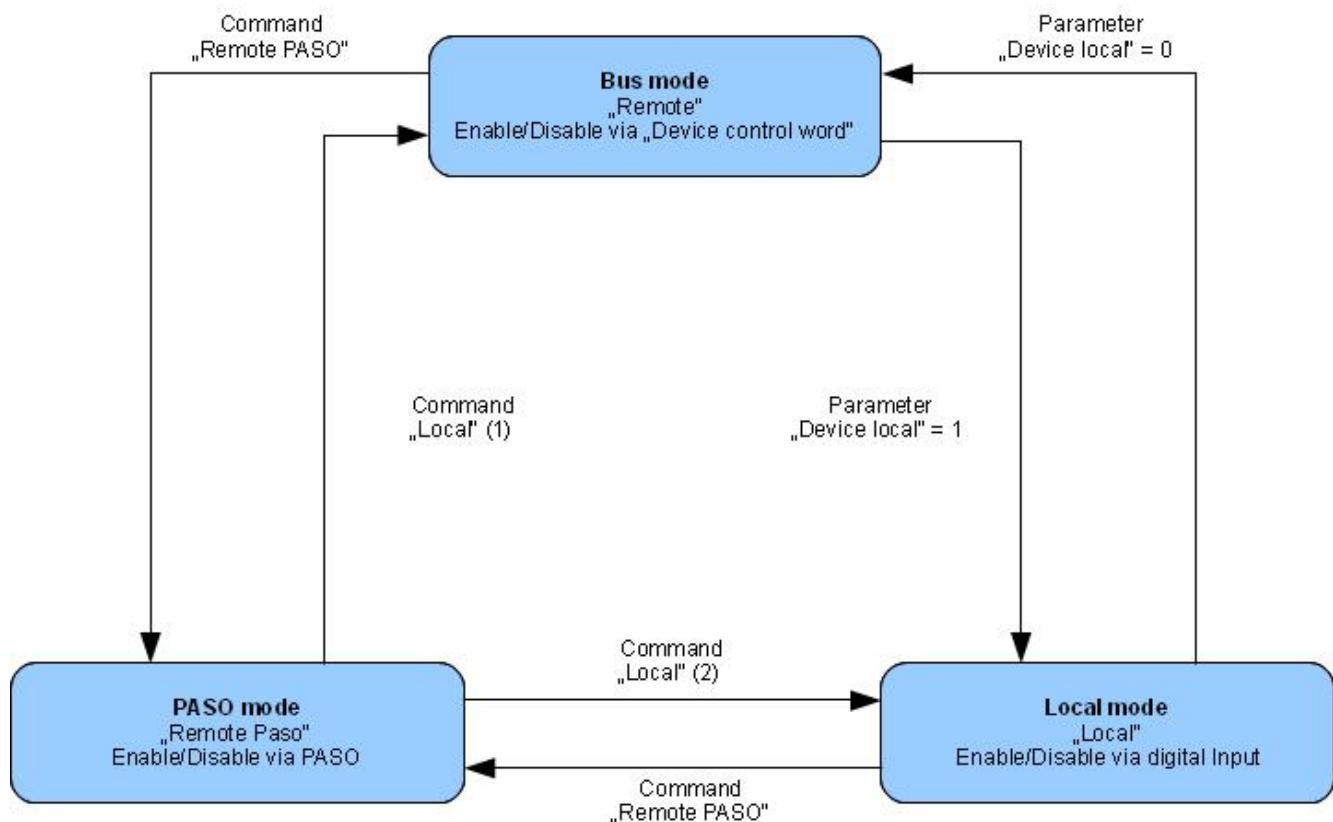
- A transition to a new mode is only possible if the device is in state "Init" or "Disable".

- (1) if "Device local" = 0
- (2) if "Device local" = 1

- In state „PASO mode" sending of parameter "Device local" through fieldbus also possible.

4.2.2   Device State Machine

In the following, with the help of a status diagram it is described, how the start-up of the CANopen®-slave *WANDFLUH*-Electronics takes place and which statuses are reached when and how. Certain transitions are automatically forced by the communication state machine (refer to the chapter "Boot-up").

The following table describes the possible states and what is done in these states:

Status	Description
NOT_READY	• The supply voltage is present on the *WANDFLUH*-Electronics • Self test is running • The device functions are disabled
INIT	• Device parameters can be set • Initialisation of device parameters with stored values • The device functions are disabled
DISABLED	• Device parameters can be set • The device functions are disabled • In this state, the different device modes like "Device Mode", "operating mode" and "Device Local mode" can be set.
HOLD	• Device parameters can be set • The last set-point value present is maintained active

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	• The set-point value of the status DEVICE_MODE_ACTIVE is not active • Device modes setting is disabled
DEVICE_MODE_ACTIVE	• Device parameters can be set • The operating mode selected with the parameter "Control Mode" and the device mode selected with the parameter "Device Mode" are active • Changing the operating mode is not possible (the writing of the parameter "Device Mode" is responded to negatively)
FAULT_HOLD	• Device parameters can be set • The actual value present is read or the set-point value of the HOLD status is active • To leave this state, the corresponding transitions in the table below have to be executed.
FAULT	• Device parameters can be set • The device functions are disabled • To leave this state, the corresponding transitions in the table below have to be executed.
FAULT_REACTION	This status is reached, if the device is not anymore ready for operation • Device parameters can be set • The device function can be disabled or enabled

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The finish state will be reached from any other state in case of power off

```
                    ● TR_0
                    │
            ┌───────────────────┐
            │  NOT_READY        │
            │  do: RMHD = 0000  │
            └───────────────────┘
                    │ TR_1
            ┌───────────────────┐
            │  INIT             │
            │  do: RMHD = 1000  │
            └───────────────────┘
             TR_7 ↑   │ TR_2
            ┌───────────────────┐         ┌───────────────────┐
            │  DISABLED         │◄─TR_10──│  FAULT            │
            │  do: RMHD = 1001  │         │  do: RMHD = 0001  │
            └───────────────────┘         └───────────────────┘
             TR_6 ↑   │ TR_3                        ↑ TR_12
            ┌───────────────────┐         ┌───────────────────┐
            │  HOLD             │◄─TR_11──│  FAULT_HOLD       │
            │  do: RMHD = 1011  │         │  do: RMHD = 0011  │
            └───────────────────┘         └───────────────────┘
             TR_5 ↑   │ TR_4                        ↑ TR_9
   ┌────────────────────────┐  TR_8  ┌───────────────────┐
   │ DEVICE_MODE_ACTIVE     │───────►│ FAULT_REACTION    │
   │ do: RMHD = 1111        │        │ do: RMHD = 0111   │
   └────────────────────────┘        └───────────────────┘
                          TR_8 ↗↗↑
                          TR_8
                          TR_8
```

RMHD = R: Status word "Ready" (bit 3)
      M: Status word "Device mode active enable" (bit 2)
      H: Status word "Hold enable" (bit 1)
      D: Status word "Disable" (bit 0)

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The following table describes the transitions from one status to the next one:

Transition	Description	Control word bit							
		7	6	5	4	3 R	2 M	1 H	0 D
TR_0	Switching-on the supply voltage	Internal transition							
TR_1	Device initialization successfully completed	Internal transition							
TR_2	Bit "Disable" active	x	x	x	x	x	x	x	1
TR_3	Bit "Hold enable" active	x	x	x	x	x	x	1	1
TR_4	Bit "Device mode active enable" active	x	x	x	x	x	1	1	1
TR_5	Bit "Device mode active enable " not active	x	x	x	x	x	0	x	x
TR_6	Bit "Hold enable" not active	x	x	x	x	x	0	0	x
TR_7	Bit "Disable" not active	x	x	x	x	x	0	0	0
TR_8	Error present. This transition can also be forced by the communication state machine (transition C5, C8, C12, C13, C14)	Internal transition							
TR_9	Error reaction successful (HOLD active)	Internal transition							
TR_10	Error reset (return to the status DISABLED). The "reset fault" bit in the controlword imperatively has to change from 0 to 1	x	x	x	x	0	x	0	x
		?							
		x	x	x	x	1	x	0	x
TR_11	Error reset (return to status HOLD). The "reset fault" bit in the controlword imperatively has to change from 0 to 1	x	x	x	x	0	x	1	x
		?							

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			x	x	x	x	1	x	1	x

TR_12	Error reaction successful (DISABLED active)	Internal transition
TR_567	This transition can be forced by the communication state machine (transition C9, C10, C11). Or else by the input Enable from 1 → 0	x x x x x 0 0 0

RMHD = R: Controlword "Reset Fault" (Bit 3)
       M: Controlword "Device mode active enable" (Bit 2)
       H: Controlword "Hold enable" (Bit 1)
       D: Controlword "Disable" (Bit 0)

4.3   Program Control

The *WANDFLUH*-Electronics through the fieldbus can be set to the following operating modes; in doing so, one differentiates between the Control mode and the Device mode:

Controle mode	Description
Local operating mode	The *WANDFLUH*-Electronics is operated through the local possibilities such as e.g. the digital inputs and outputs or PASO.
Spool position control open loop vpoc (1)	A proportional spool valve is driven with a set-point value, the set-point value is proportional to the valve opening. The spool position is not recorded and controlled (open loop). **This control mode is only selectable with amplifier.**
Pressure control valve open loop vprc (3)	A proportional pressure control valve is driven with a set-point value; the set-point value is proportional to the valve pressure. The pressure is not measured and controlled with a pressure sensor (open loop). **This control mode is selectable with amplifier and controller.**
Pressure control valve closed loop vprc (4)	A proportional pressure control valve with 1 solenoid is driven with a set-point value; the set-point value is proportional to the valve pressure. The pressure is measured and controlled with a pressure sensor (closed loop). **This control mode is only selectable with controller.**
Open loop movement dcol (6)	A proportional spool valve is driven with a set-point value; the set-point value is proportional to the position of the axis. The Position is not measured and controlled with a position sensor (open loop). **This control mode is only selectable with controller.**
Velocity control axis dsc (7)	A proportional flow valve is driven with a set-point value; the set-point value is proportional to the valve flow. The flow is measured and controlled with a flow sensor (closed loop). **This control mode is only selectable with controller.**
Position control axis dpc (9)	A proportional spool valve is driven with a set-point value; the set-point value is proportional to the position of the axis. The position is measured and controlled with a position sensor (closed loop). **This control mode is only selectable with controller.**
Pressure control valve	**Wandfluh - specific**

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closed loop 2-solenoids (-5)	A proportional pressure control valve with 2 solenoids is driven with a set-point value; the set-point value is proportional to the valve pressure. The pressure is measured and controlled with a pressure sensor (closed loop). **This control mode is only selectable with controller.**
2-Point controller with 1 solenoid. (-6)	**Wandfluh – specific** Control of a 1-solenoid valve with a switching solenoid in closed loop (with feedback signal). It can only be activated one solenoid (correspond to solenoid driver 1). **This control mode is only selectable with controller.**
2-Point controller with 2 solenoids. (-7)	**Wandfluh – specific** Control of a 2-solenoid valve with switching solenoids resp. of two 1-solenoid valves with one switching solenoid each in closed loop (with feedback signal). Two solenoids can be activated. **This control mode is only selectable with controller.**
3-Point controller with 2 solenoids. (-8)	**Wandfluh – specific** Control of a 1-solenoid valve with a switching solenoid in closed loop (with feedback signal). It can only be activated one solenoid (correspond to solenoid driver 1). **This control mode is only selectable with controller.**

Device mode	Description
Set-point value setting through the bus	The set-point-value setting for the *WANDFLUH*-Electronics takes place through the fieldbus. This corresponds to the standard device mode.
Set-point value setting locally	The set-point value setting for the *WANDFLUH*-Electronics takes place locally.

4.4 WANDFLUH-Electronics Object Dictionary

(In accordance with CiA DS-301 and DSP-408 "Device Profile Fluid Power Technology")

The most important part of a device profile is the Object Dictionary description. The Object Dictionary is essentially a grouping of objects accessible via the network in ordered pre-defined fashion. Each object is addressed using a 16-bit index.

The overall layout of the standard Object Dictionary is shown below.

Index (Hex)	Object
0000	Not used
0001 – 001F	Static Data Types
0020 – 003F	Complex Data Types
0040 – 005F	Manufacturer Specific Complex Data Types
0060 – 007F	Device Profile Specific Static Data Types
0080 – 009F	Device Profile Specific Complex Data Types
00A0 – 0FFF	Reserved for further use
1000 – 1FFF	Communication Profile Area [28]
2000 – 5FFF	Manufacturer Specific Profile Area [41]
6000 – 9FFF	Standardised Device Profile Area [88]
A000 – FFFF	Reserved for further use

4.4.1 Communication Profile Area

Parameter	Index

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Device Type [29]	1000h
Error register (Flag) [29]	1001h
Predefined Error Field [30]	1003h
COB-ID SYNC [31]	1005h
Guard Time [31]	100Ch
Life Time Factor [31]	100Dh
Save Parameter [32]	1010h
Restore Defaults [33]	1011h
COB-ID Emergency [34]	1014h
Producer Heartbeat Time [35]	1017h
Identity Object [35]	1018h
Communication parameter RxPDO [36]	1400h 1401h
Mapping RxPDO [37]	1600h 1601h
Communication parameter TxPDO [38]	1800h 1801h
Mapping TxPDO [39]	1A00h 1A01h

4.4.1.1 Device Type

Indicates the sub-assembly type code of the device specified in the device profile (DSP-408).

Object description

Object number	1000h
Variable name	Device Type
Object code	VAR (7h)
Data type index	Unsigned32 (7h)
Length	4

Values-Description

Sub–Index	0
Description	Code of the device type [Read Only] Bit 0-15 = Device profile number (408 dec) Bit 16-30 = reserved Bit 31 = 1 (modular device) Value: 10000198h
Prescribed range	Unsigned32

4.4.1.2 Error register (Flag)

This object is an error register for the device. The device can map internal errors to this byte. The object is a part of the emergency object. These bits are fixed assigned by the standard!

Object description

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Object number	1001h
Variable name	Error register
Object code	VAR (7h)
Data type index	Unsigned8 (5h)

Values-Description

Sub-index	0
Description	Error register [Read Only] Bit 0 = General error Bit 1 = Current Bit 2 = Voltage Bit 3 = Temperature Bit 4 = Communication error Bit 5 = Device profile-specific Bit 6 = Reserved (value always 0) Bit 7 = Manufacturer-specific
Prescribed range	Unsigned8

4.4.1.3 Predefined Error Field

This object contains the occurred errors of the device, which have been indicated through the emergency object. It therefore contains a history of errors.

1. The entry in sub-index 0 indicates the number of the current errors, which have been recorded in the list. This list starts with the sub-index 1 of this object.
2. Every new error is saved in the sub-index 1, the older errors are moved down by one place on the list.
3. If a "0" is written to the sub-index 0, then all history entries are deleted.
4. The error numbers are of the type UNSIGNED32 and they are composed of a 16-bit error code and a 16- bit field with additional error information. The additional error information is manufacturer-specific error information and it is located in the higher 2 bytes (MSB). The error code is located in the lower 2 bytes (LSB). If the object is supported, then it has to consist of at least two entries: the length entry in the sub-index 0 as well as at least one error entry in the sub-index 1.

Object description

Object number	1003h
Variable name	Predefined Error Field
Object code	ARRAY (8h)
Data type index	Unsigned32 (7h)

Values-Description

Sub – Index	00h
Description	Number of errors [Read/Write]
Default Value	0
Prescribed range	0 - 254

Sub – Index	01h
Description	Standard error field [Read Only]
Default Value	none
Prescribed range	Unsigned32

Sub – Index	02h - FEh

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Description	Standard error field [Read Only]
Default Value	none
Prescribed range	Unsigned32

4.4.1.4 COB-ID SYNC

This object defines the COB-ID of the "SYNC" object (SYNC).

Object description

Object number	1005h
Variable name	COB-ID SYNC message
Object code	VAR (7h)
Data type index	Unsigned32 (7h)
Length	4

Values-Description

Description	COB-ID used by the SYNC [Read / Write]
Prescribed range	Unsigned32
Default Value	80h

4.4.1.5 Guard Time

The guard time together with the life time factor defines the cycle time for the life guarding protocol, in case of the value 0, the life guarding is switched-off. The time is indicated in ms.
This object can only be changed if the producer heartbeat time is set to 0. If not, the device send a abort SDO transfer (abort code: 060A 0023h).

Object description

Object number	100Ch
Variable name	Guard Time
Object code	VAR (7h)
Data type index	Unsigned16 (6h)
Length	2

Values-Description

Sub–Index	0
Description	Value in ms
Prescribed range	Unsigned16

4.4.1.6 Life Time Factor

The life time factor multiplied with the guard time results in the cycle time for the life guarding protocol, in the case of the 0, the life guarding is switched-off.
This object can only be changed if the producer heartbeat time is set to 0. If not, the device send a abort SDO transfer (abort code: 060A 0023h).

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Object description

Object number	100Dh
Variable name	Life Time Factor
Object code	VAR (7h)
Data type index	Unsigned8 (5h)

Values-Description

Sub–Index	0
Description	Value as multiplier for the guard time
Prescribed range	Unsigned8

4.4.1.7 Save Parameter

Through this object, the changed parameters can be saved in the EEPROM of the *WANDFLUH*-Electronics. Through sub-index 1, all parameters can be saved. In order to save more selectively, the parameters in addition have been classified in groups:

1. Communication parameters (sub-index 2): This group comprises the communication-specific parameters in the object directory range 1000h...1FFFh. Saved here are the following parameters:

Parameter	Index	Sub-Index
Communication parameter RxPDO1	1400h	01h, 02h
Communication parameter RxPDO2	1401h	01h, 02h
Communication parameter TxPDO1	1800h	01h, 02h
COB-ID SYNC object	1005h	00h
Guard time	100Ch	00h
Life time factor	100Dh	00h
COB-ID Emergency object	1014h	00h
Producer heartbeat time	1017h	00h

2. Application parameters (sub-index 3): this group comprises the parameters in the object directory range 6000h...9FFFh as well as the manufacturer-specific parameters 2000h...5FFFh.

In order to prevent an inadvertent saving, a certain signature ("save") has to be written to the respective sub-index. In the hex-code, the 32-bit signature has the following appearance:

Signature	MSB			LSB
ASCII	e	v	a	s
hex	65h	76h	61h	73h

If a correct signature is received in the corresponding sub-index, the device saves the parameters and confirms this with an SDO response (initiate download response). If the saving operation has failed, the device responds with an Abort SDO Transfer (abort code: 0606 0000h).
In the case of a wrong signature, the device refuses to save and responds with an Abort SDO Transfer (abort code: 0800 002xh)

In the case of a read access to a sub-index, the subassembly with the value 1h indicates, that the respective parameter group can be selectively saved.
The saved values remain valid after the Reset or Power-On of the device. Through the object 1011h they can be reset to the default values.

Object description

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Object number	1010h
Variable name	Save Parameter
Object code	ARRAY (88h)
Data type index	Unsigned8 (5h)

Values-Description

Sub–Index	00h
Description	Number of elements (sub-indexes) [Read Only]
Prescribed range	Unsigned8
Prescribed range	none

Sub–Index	01h
Description	Saving of all parameters (through signature "save") [Read/Write]
Prescribed range	Unsigned32
Prescribed range	none

Sub–Index	02h
Description	Save communication parameters (through signature "save") [Read/Write]
Prescribed range	Unsigned32
Prescribed range	none

Sub–Index	03h
Description	Save application parameters (through signature "save") [Read/Write]
Prescribed range	Unsigned32
Prescribed range	none

4.4.1.8 Restore Defaults

With this object, the device parameters can be reset to default values in accordance with DS301, resp. DSP 408 and *WANDFLUH*-specific values. Through sub-index 1, all parameters can be set to default values. In order to be able to load more selectively, the parameters additionally have been classified in groups:

1. Communication parameters (sub-index 2): this group comprises the communication-specific parameters in the object directory range 1000h...1FFFh. The list of the parameters can be found at object 1010h.

2. Application parameters (sub-index 3): this group comprises the parameters in the object directory range 6000h...9FFFh as well as the manufacturer-specific parameters 2000h...5FFFh.

In order to prevent an inadvertent resetting, a certain signature ("load") has to be written to the respective sub-index. In the Hex-Code, the 32-bit signature has the following appearance:

Signature	MSB			LSB
ASCII	d	a	o	l
hex	64h	61h	6Fh	6Ch

If a correct signature is received in the corresponding sub-index, the device restores the appropriate parameters and confirms this with an SDO response (initiate download response). If the restoring has failed, then the device responds with an Abort SDO Transfer (abort code: 0606 0000h).

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In case of a wrong signature, the device refuses to restore and responds with an Abort SDO Transfer (abort code: 0800 002xh)
The default values are set valid after the device is reset by a "communication reset". After that the parameters have to be stored to keep them after a power-on.

In case of a read access, the sub-assembly with the value 1h indicates, that the respective parameter group can be selectively reset.
In order to make the default values valid, a reset has to be carried out. If the default values are to be saved, then after the reset a "Save" command has to be transmitted via object 1010h.

Object description

Object number	1011h
Variable name	Restore Defaults
Object code	ARRAY (8h)
Data type index	Unsigned8 (5h)

Values-Description

Sub-index	00h
Description	Number of elements (sub-indexes) [Read Only]
Prescribed range	Unsigned8
Prescribed range	none

Sub-index	01h
Description	Restore all default parameters (through signature "load") [Read/Write]
Prescribed range	Unsigned32
Prescribed range	none

Sub-index	02h
Description	Restore communication default parameters (through signature "load") [Read/Write]
Prescribed range	Unsigned32
Prescribed range	none

Sub-index	03h
Description	Restore application default parameters (through signature "load") [Read/Write]
Prescribed range	Unsigned32
Prescribed range	none

4.4.1.9 COB-ID Emergency

This object defines the COB-ID of the "Emergency" object (EMCY).

Description COB-ID:

Bits	**MSB**				**LSB**
Bits	31	30	29	28-11	10-0
11-bit-ID	0 / 1	0 / 1	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	11-Bit Identifier
29-bit-ID	0 / 1	0 / 1	1	29-Bit Identifier	

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Object description

Object number	1014h
Variable name	COB-ID Emergency Object
Object code	VAR (7h)
Data type index	Unsigned32 (7h)
Length	4

Values-Description

Description	COB-ID by the EMCY [Read / Write]
Prescribed range	Unsigned32
Default Value	80h + Node-ID

4.4.1.10 Producer Heartbeat Time

The producer heartbeat time defines the cycle time for the heartbeat, in case of the value 0, the heartbeat is switched-off.

Object description

Object number	1017h
Variable name	Producer Heartbeat Time
Object code	VAR (7h)
Data type index	Unsigned16 (6h)
Length	2

Values-Description

Description	Value in ms
Prescribed range	Unsigned16

4.4.1.11 Identity Object

The object contains general information about the device. The sub-index 01 contains the Vendor ID. This is a unique value allocated to each manufacturer.

Object description

Object number	1018h
Variable name	Identity Object
Object code	RECORD (9h)
Data type index	IDENTITY (23h)
Length	4

Values-Description

Sub–Index	00h
Description	Number of entries [Read Only]
Prescribed range	Unsigned8 (1 to 4)
Default Value	1

Sub–Index	01h

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Description	Manufacturer identification (CiA Vendor-ID) [Read only]
Prescribed range	Unsigned32
Default Value	0x0000014D

Sub–Index	02h
Description	Product code [Read Only]
Prescribed range	Unsigned32
Default Value	none (this value is not used)

Sub–Index	03h
Description	Revision number [Read Only]
Prescribed range	Unsigned32
Default Value	none

Sub–Index	04h
Description	Serial number [Read Only]
Prescribed range	Unsigned32
Default Value	none

4.4.1.12 Communication parameter RxPDO

Contains the communication parameters from Receive PDO1 (object 1400) to PDO8 (object 1407). The communication parameters can be changed in any way required by the user. The setting can also be made through the PASO.

Description COB-ID:

	MSB				**LSB**
Bits	31	30	29	28-11	10-0
11-bit-ID	0 / 1	0 / 1	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	11-Bit Identifier
29-bit-ID	0 / 1	0 / 1	1	29-Bit Identifier	

Bit Number	Value	Description
31 (MSB)	0	PDO active
	1	PDO not active
30	0	RTR to this PDO permitted
	1	No RTR to this PDO permitted
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID(CAN 2.0B)
28-11	0	If bit 29=0
	X	If bit 29=1: bits 28-11 of the 29-bit-COB_IDs
10-0 (LSB)	X	Bits 10-0 of the COB-ID

The transmission type (refer to sub-index 02) defines the transmission characteristics of the corresponding process data object. The significance is explained in chapter "PDO – Communication Parameters".

Object description

Object number	1400h – 1407h

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Variable name	RxPDO1-8 communications parameter
Object code	RECORD (9h)
Data type index	PDO CommPar (20h)

Values-Description

Sub-index	00h
Description	Number of the communication parameter [Read only]
Prescribed range	Unsigned8
Default Value	2

Sub-index	01h
Description	COB-ID used by the PDO [Read only]
Prescribed range	Unsigned32
Default Value	384 + Node-ID (RxPDO1), 640 + Node-ID (RxPDO2) 896 + Node-ID (RxPDO3), 1152 + Node-ID (RxPDO4)

Sub-index	02h
Description	Transmission type [Read / Write] For details refer to "PDO Communication Parameters" on page 12.
Prescribed range	Unsigned 8
Default Value	255

4.4.1.13 Mapping RxPDO

Receive PDO Mapping. The *WANDFLUH*-Electronics electronics supports dynamic PDO mapping. The mapping of the receive data can be set with the object 1600 to 1607 and through the PASO.

To set the mapping objects, the following information about the mapped object are required:
- object index (4 Byte)
- object sub-index (2 Byte)
- object size in Bit (2Byte)

These values are put together to a hex-value.

Example for object 6040 (Device control word channel 1):
- object index: 0x6040
- object sub-index :   0x00
- object size: 16 [Dez] → 0x10 [Hex]

As a result the value 0x60400010 is the value for the mapping entry.

For changing the mapping, first the PDO must be blocked (refer to "Communication parameter RxPDO 36 ") and the number of mapping (sub-index 0) entries must be set to 0.

The following tabel shows the standard mapping.
The RxPDO 5-8 are deactivated as standard.

PDO	Object 1	Object 2	Object 3	Object 4	Transmission type	Device control mode
RxPDO1	Controllword Channel 1	Command Value VPOC Channel 1	-	-	255	1, 3

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RxPDO2	Controllword Channel 2	Command Value VPOC Channel 2	-	-	255	1, 3
RxPDO3	Controllword Channel 3	Command Value VPOC Channel 3	-	-	255	1, 3
RxPDO4	Controllword Channel 4	Command Value VPOC Channel 4	-	-	255	1, 3

Object description

Object number	1600-1607h
Variable name	RxPDO1 – RxPDO8 Mapping
Object code	RECORD (9h)
Data type index	PDO mapping parameter (21h)

Values-Description

Sub-index	00h
Description	Number of mapped objects [Read/Write]
Prescribed range	Unsigned8 (0 to 64)
Default Value	Refer to above table

Sub-index	01h
Description	1. mapped object [Read/Write]
Prescribed range	Unsigned32
Default Value	Refer to above table

Sub-index	02h
Description	2. mapped object [Read/Write]
Prescribed range	Unsigned32
Default Value	Refer to above table

Sub-index	03h
Description	3. mapped object [Read/Write]
Prescribed range	Unsigned32
Default Value	Refer to above table

Sub-index	04h
Description	4. mapped object [Read/Write]
Prescribed range	Unsigned32
Default Value	Refer to above table

4.4.1.14 Communication parameter TxPDO

Contains the communication parameters from Transmit PDO1 (object 1800) to PDO8 (object 1807). The communication parameters can be changed in any way required by the user. The setting can also be made through the PASO.

Description COB-ID:

MSB	**LSB**

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Bits	31	30	29	28-11	10-0
11-bit-ID	0 / 1	0 / 1	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	11-Bit Identifier
29-bit-ID	0 / 1	0 / 1	1	29-Bit Identifier	

Bit Number	Value	Description
31 (MSB)	0	PDO active
	1	PDO not active
30	0	RTR to this PDO permitted
	1	No RTR to this PDO permitted
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID(CAN 2.0B)
28-11	0	If bit 29=0
	X	If bit 29=1: bits 28-11 of the 29-bit-COB_IDs
10-0 (LSB)	X	Bits 10-0 of the COB-ID

The transmission type (refer to sub-index 02) defines the transmission characteristics of the corresponding process data object. The significance is explained in chapter "PDO – Communication Parameters ⌐11⌐".

Object description

Object number	1800h – 1807h
Variable name	TxPDO1-8 communications parameter
Object code	RECORD (9h)
Data type index	PDO CommPar (20h)

Values-Description

Sub-index	00h
Description	Number of the communication parameter [Read only]
Prescribed range	Unsigned8
Default Value	2

Sub-index	01h
Description	COB-ID used by the PDO [Read / Write]
Prescribed range	Unsigned32
Default Value	384 + Node-ID (TxPDO1), 640 + Node-ID (TxPDO2) 896 + Node-ID (TxPDO3), 1152 + Node-ID (TxPDO4)

Sub-index	02h
Description	Transmission type [Read / Write] For details refer to "PDO Communication Parameters" on page 12.
Prescribed range	Unsigned 8
Default Value	255

4.4.1.15 Mapping TxPDO

Transmit PDO Mapping. The *WANDFLUH*-Electronics electronics supports dynamic PDO mapping. The mapping of the receive data can be set with the object 1600 to 1607 and through the PASO.

To set the mapping objects, the following information about the mapped object are required:
- object index (4 Byte)
- object sub-index (2 Byte)

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- object size in Bit (2Byte)

These values are put together to a hex-value.

Example for object 6040 (Device control word channel 1):
- object index: 0x6040
- object sub-index :   0x00
- object size: 16 [Dez] → 0x10 [Hex]

As a result the value 0x60400010 is the value for the mapping entry.

For changing the mapping, first the PDO must be blocked (refer to "") and the number of mapping (sub-index 0) entries must be set to 0.

The following tabel shows the standard mapping.
The TxPDO 5-8 are deactivated as standard.

PDO	Object 1	Object 2	Object 3	Transmission type	Device control mode
TxPDO1	Statusword Channel 1	-	-	255	1, 3
TxPDO2	Statusword Channel 2	-	-	255	1, 3
TxPDO3	Statusword Channel 3	-	-	255	1, 3
TxPDO4	Statusword Channel 4	-	-	255	1, 3

Object description

Object number	1A00h - 1A07h
Variable name	TxPDO1 – TxPDO8 Mapping
Object code	RECORD (9h)
Data type index	PDO Mapping parameter (21h)

Werte-Beschreibung

Sub-index	00h
Description	Number of mapped objects [Read/Write]
Prescribed range	Unsigned8 (0 to 64)
Default Value	Refer to above table

Sub-index	01h
Description	1. mapped object [Read/Write]
Prescribed range	Unsigned32
Default Value	Refer to above table

Sub-index	02h
Description	2. mapped object [Read/Write]
Prescribed range	Unsigned32
Default Value	Refer to above table

Sub-index	03h
Description	3. mapped object [Read/Write]
Prescribed range	Unsigned32

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Default Value	Refer to above table

Sub-index	04h
Description	4. mapped object [Read/Write]
Prescribed range	Unsigned32
Default Value	Refer to above table

4.4.2 Manufacturer Specific Profile Area

Index	Sub-Index	Description	Controlmode	Datatype	min. Value	max. Value	PDO-Mapping
2000h	0	Device node address [47]		UINT8	1	127	No
2001h	0	Device node baudrate [47]		UINT16	-32768	32767	No
2002h	0	Device temperature [47]		INT16			No
2200h	0	actual value mode [47]	n-point vprc (closed-loop) dpc dsc	UINT8	1	2	Yes
2201h	0	actual value input 16 bits [47]	n-point vprc (closed-loop) dpc dsc	INT16	-32768	32767	Yes
2202h	0	actual value input 32 bits [48]	n-point vprc (closed-loop) dpc dsc	INT32	-2147483648	2147483647	Yes
2220h	0	actual value signal type [48]	n-point vprc (closed-loop) dpc dsc	UINT8	0	4	No
2221h	0	used analogue input for actual value [48]	n-point vprc (closed-loop) dpc dsc	INT8	-1	3	No
2222h	0	used digital input for actual value [48]	n-point vprc (closed-loop) dpc dsc	INT8	-1	1	No
2224h	0	Actual value cablebreak detection [48]	n-point vprc (closed-loop) dpc dsc	UINT8	0	1	No
2225h	0	Actual value cablebreak detection lower limit [48]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
2226h	0	Actual value cablebreak detection upper limit [49]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
2227h	0	actual value min interface [49]	n-point vprc (closed-loop) dpc dsc	INT32	-2147483648	2147483647	No
2228h	0	actual value max interface [49]	n-point vprc (closed-loop) dpc dsc	INT32	-2147483648	2147483647	No
2229h	0	actual value min bus interface [49]	n-point vprc (closed-loop) dpc dsc	INT32	-32768	32767	No

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Index	Sub-Index	Description	Controlmode	Datatype	min. Value	max. Value	PDO-Mapping
222Ah	0	actual value max bus interface [49]	n-point vprc (closed-loop) dpc dsc	INT32	-32768	32767	No
222Bh	0	actual value min reference [50]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
222Ch	0	actual value max reference [50]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
2240h 2940h	0	Channel enablement [50]		UINT8	0	2	No
2241h 2941h	0	used digin for channel enablement [51]		INT8	-1	1	No
2242h 2942h	0	Mode of operation [51]	vprc (open-loop) dcol vpoc	UINT8	0	3	No
2243h 2943h	0	Used digin for solenoid B [51]	vprc (open-loop) dcol vpoc	INT8	-1	1	No
2244h 2944h	0	Solenoid type [51]		UINT8	0	2	No
2245h 2945h	0	Error handling mask [52]		UINT16	0	65535	No
2246h 2946h	0	Error handling reaction [52]		UINT8	0	3	No
2247h 2947h	0	Error handling used digout [52]		UINT8	-1	0	No
2248h 2948h	0	Function handling mask [52]		UINT8	0	255	No
2249h 2949h	0	Function handling used digout [53]		UINT8	-1	0	No
224Ah 294Ah	0	Valve type [53]		UINT8	0	1	No
2250h 2950h	0	Used digin for ramp enable [53]	vprc (open-loop) dcol vpoc	UINT8	-1	1	No
2280h	0	n-point controller set point [53]	n-point	INT32	-2147483648	2147483647	Yes
2281h	0	n-point controller actual value [53]	n-point	INT32			Yes
22A0h	0	n-point controller threshold value 1 [54]	n-point	INT32	-2147483648	2147483647	Yes
22A1h	0	n-point controller threshold value 2 [54]	n-point	INT32	-2147483648	2147483647	Yes
22A2h	0	n-point controller threshold value 3 [54]	n-point	INT32	-2147483648	2147483647	Yes
22A3h	0	n-point controller threshold value 4 [55]	n-point	INT32	-2147483648	2147483647	Yes
22D0h	0	n-point control deviation [55]	n-point	INT32			Yes
22D1h	0	n-point cm type [56]	n-point	INT8	-2	2	No
22D2h	1	n-point cm delay time [56]	n-point	UINT16	0	100	No
22D3h	1	n-point cm threshold [56]	n-point	INT32	0	2147483647	No
2320h 2A20h	0	demand value signal type [56]		UINT8	0	4	No
2321h 2A21h	0	used analogue input for demand value [57]		INT8	-1	3	No
2322h 2A22h	0	used digital input for demand value [57]		INT8	-1	1	No
2324h 2A24h	0	demand value cablebreak detection [57]		UINT8	0	1	No
2325h 2A25h	0	demand value cablebreak detection lower limit [57]		INT32	0	2147483647	No
2326h	0	demand value cablebreak detection upper limit		INT32	0	2147483647	No

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2A26h		☐ 57					
2327h 2A27h	0	demand value min interface ☐ 57		INT32	-2147483648	2147483647	No
2328h 2A28h	0	demand value max interface ☐ 58		INT32	-2147483648	2147483647	No
2329h 2A29h	0	demand value min bus interface ☐ 58		INT32	-32768	32767	No
232Ah 2A2Ah	0	demand value max bus interface ☐ 58		INT32	-32768	32767	No
232Bh	0	demand value min reference ☐ 58	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
232Ch	0	demand value max reference ☐ 59	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
232Dh 2A2Dh	0	demand value deadband enable ☐ 59	vprc (open-loop) dcol vpoc	UINT8	0	1	No
232Eh 2A2Eh	0	demand value deadband ☐ 59	vprc (open-loop) dcol vpoc	INT16	0	16384	No
2380h 2A80h	0	fixed command values enable ☐ 59		INT8	0	1	No
2381h 2A81h	0	Dig. input count for fixed command values ☐ 60		INT8			No
	1	fixed command values used digin 1 ☐ 60		INT8	-1	1	No
	2	fixed command values used digin 2 ☐ 61		INT8	-1	1	No
	3	fixed command values used digin 3 ☐ 61		INT8	-1	1	No
2382h 2A82h	0	fixed command values count ☐ 62		INT8			No
	1	fixed command value 1 ☐ 62		INT32	-2147483648	2147483647	No
	2	fixed command value 2 ☐ 63		INT32	-2147483648	2147483647	No
	3	fixed command value 3 ☐ 63		INT32	-2147483648	2147483647	No
	4	fixed command value 4 ☐ 64		INT32	-2147483648	2147483647	No
	5	fixed command value 5 ☐ 64		INT32	-2147483648	2147483647	No
	6	fixed command value 6 ☐ 65		INT32	-2147483648	2147483647	No
	7	fixed command value 7 ☐ 65		INT32	-2147483648	2147483647	No
2400h	0	demand value positive velocity ☐ 66	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
2401h	0	demand value negative velocity ☐ 66	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
2402h	0	target window enable ☐ 66	n-point vprc (closed-loop) dpc dsc	INT8	0	2	No
2403h	0	target window delay time ☐ 66	n-point vprc (closed-loop) dpc dsc	INT16	0	100	No
2404h	0	target window threshold ☐ 67	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
2405h	0	solenoid-off window enable ☐ 67	n-point vprc (closed-loop) dpc dsc	INT8	0	2	No

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2406h	0	solenoid-off window delay time [67]	n-point vprc (closed-loop) dpc dsc	INT8	0	100	No
2407h	0	solenoid-off threshold [67]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
2420h	0	Displayed unit [68]	n-point vprc (closed-loop) dpc dsc	INT8	0	12	No
2422h	0	command feed forward [68]	n-point vprc (closed-loop) dpc dsc	INT16	0	10000	No
2423h	0	velocity feed forward [68]	n-point vprc (closed-loop) dpc dsc	INT16	0	10000	No
2424h	0	Integrator enable [68]	n-point vprc (closed-loop) dpc dsc	INT8	0	1	No
2425h	0	reduction of I-part if outside I-windows [68]	n-point vprc (closed-loop) dpc dsc	INT8	0	2	No
2426h	0	Kp positive [69]	n-point vprc (closed-loop) dpc dsc	INT16	0	25000	No
2427h	0	Kp negative [69]	n-point vprc (closed-loop) dpc dsc	INT16	0	25000	No
2428h	0	Ti positive [69]	n-point vprc (closed-loop) dpc dsc	INT16	0	10000	No
2429h	0	Ti negative [69]	n-point vprc (closed-loop) dpc dsc	INT16	0	10000	No
242Ah	0	I window positive [69]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
242Bh	0	I window negative [70]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
242Ch	0	I inner window positive [70]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
242Dh	0	I inner window negative [70]	n-point vprc (closed-loop) dpc dsc	INT32	0	2147483647	No
242Eh	0	D time positive [71]	n-point vprc (closed-loop) dpc dsc	INT16	0	10000	No
242Fh	0	D time negative [71]	n-point vprc (closed-loop)	INT16	0	10000	No

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			dpc dsc				
2430h	0	D value positive [71]	n-point vprc (closed-loop) dpc dsc	INT16	0	10000	No
2431h	0	D value negativ [71]	n-point vprc (closed-loop) dpc dsc	INT16	0	10000	No
2500h 2C00h	0	used solenoid driver 1 [71]		INT8	-1	1	No
2501h 2C01h	0	solenoid 1 enable [72]		UINT8	0	2	No
2502h 2C02h	0	solenoid 1 enable used digin [72]		UINT8	0	1	No
2503h 2C03h	0	solenoid 1 inversion [72]		UINT8	0	1	No
2504h 2C04h	0	Imin always active solenoid 1 [72]		UINT8	0	1	No
2505h 2C05h	0	solenoid 1 cablebreak detection [72]		UINT8	0	1	No
2506h 2C06h	0	solenoid 1 Imin [72]		INT16	0	16384	No
2507h 2C07h	0	solenoid 1 Imax [73]		INT16	0	16384	No
2508h 2C08h	0	solenoid 1 dither function [73]		UINT8	0	1	No
2509h 2C09h	0	solenoid 1 dither period [73]		INT16	2	250	No
250Ah 2C0Ah	0	solenoid 1 dither amplitude [73]		INT16	0	16384	No
250Bh 2C0Bh	0	solenoid 1 switch on threshold [73]		INT16	0	16384	No
250Ch 2C0Ch	0	solenoid 1 switch off threshold [74]		INT16	0	16384	No
250Dh 2C0Dh	0	solenoid 1 switch reduction time [74]		UINT16	0	10000	No
250Eh 2C0Eh	0	solenoid 1 switch reduction value [74]		INT16	0	16384	No
250Fh 2C0Fh	0	solenoid 1 lower I-min (S1578) [74]		INT16	0	16384	No
2510h 2C10h	0	solenoid 1 lower I-max (S1578) [74]		INT16	0	16384	No
2520h 2C20h	0	solenoid 1 characteristic optimisation enable [75]		INT8	0	1	No
2521h 2C21h	0	solenoid 1 characteristic optimisation point count [75]		INT8			No
	1	solenoid 1 characteristic optimisation point 1 [75]		INT32	-2147483648	2147483647	No
	2	solenoid 1 characteristic optimisation point 2 [75]		INT32	-2147483648	2147483647	No
	3	solenoid 1 characteristic optimisation point 3 [76]		INT32	-2147483648	2147483647	No
	4	solenoid 1 characteristic optimisation point 4 [76]		INT32	-2147483648	2147483647	No
	5	solenoid 1 characteristic optimisation point 5 [77]		INT32	-2147483648	2147483647	No
	6	solenoid 1 characteristic optimisation point 6 [78]		INT32	-2147483648	2147483647	No
	7	solenoid 1 characteristic optimisation point 7 [78]		INT32	-2147483648	2147483647	No

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	8	solenoid 1 characteristic optimisation point 8 [79]		INT32	-2147483648	2147483647	No
	9	solenoid 1 characteristic optimisation point 9 [79]		INT32	-2147483648	2147483647	No
2580h 2C80h	0	used solenoid driver 2 [80]		INT8	-1	1	No
2581h 2C81h	0	solenoid 2 enable [80]		UINT8	0	2	No
2582h 2C82h	0	solenoid 2 enable used digin [80]		UINT8	0	1	No
2583h 2C83h	0	solenoid 2 inversion [80]		UINT8	0	1	No
2584h 2C84h	0	Imin always active solenoid 2 [80]		UINT8	0	1	No
2585h 2C85h	0	solenoid 2 cablebreak detection [81]		UINT8	0	1	No
2586h 2C86h	0	solenoid 2 Imin [81]		INT16	0	16384	No
2587h 2C87h	0	solenoid 2 Imax [81]		INT16	0	16384	No
2588h 2C88h	0	solenoid 2 dither function [81]		UINT8	0	1	No
2589h 2C89h	0	solenoid 2 dither period [81]		INT16	2	250	No
258Ah 2C8Ah	0	solenoid 2 dither amplitude [81]		INT16	0	16384	No
258Bh 2C8Bh	0	solenoid 2 switch on threshold [82]		INT16	0	16384	No
258Ch 2C8Ch	0	solenoid 2 switch off threshold [82]		INT16	0	16384	No
258Dh 2C8Dh	0	solenoid 2 switch reduction time [82]		UINT16	0	10000	No
258Eh 2C8Eh	0	solenoid 2 switch reduction value [82]		INT16	0	16384	No
258Fh 2C8Fh	0	solenoid 2 lower I-min (S1578) [82]		INT16	0	16384	No
2590h 2C90h	0	solenoid 2 lower I-max (S1578) [82]		INT16	0	16384	No
25A0h 2CA0h	0	solenoid 2 characteristic optimisation enable [83]		INT8	0	1	No
25A1h 2CA1h	0	solenoid 2 characteristic optimisation point count [83]		INT8			No
	1	solenoid 2 characteristic optimisation point 1 [83]		INT32	-2147483648	2147483647	No
	2	solenoid 2 characteristic optimisation point 2 [84]		INT32	-2147483648	2147483647	No
	3	solenoid 2 characteristic optimisation point 3 [84]		INT32	-2147483648	2147483647	No
	4	solenoid 2 characteristic optimisation point 4 [85]		INT32	-2147483648	2147483647	No
	5	solenoid 2 characteristic optimisation point 5 [85]		INT32	-2147483648	2147483647	No
	6	solenoid 2 characteristic optimisation point 6 [86]		INT32	-2147483648	2147483647	No
	7	solenoid 2 characteristic optimisation point 7 [86]		INT32	-2147483648	2147483647	No
	8	solenoid 2 characteristic optimisation point 8 [87]		INT32	-2147483648	2147483647	No
	9	solenoid 2 characteristic optimisation point 9 [87]		INT32	-2147483648	2147483647	No

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4.4.2.1 Device node address

Index	Sub-Index	Datatype	Range
2000h	0	UINT8	1 .. 127

4.4.2.2 Device node baudrate

Index	Sub-Index	Datatype	Range
2001h	0	UINT16	10 : 10kBaud 20 : 20kBaud 50 : 50kBaud 100 : 100kBaud 125 : 125kBaud 250 : 250kBaud 500 : 500kBaud 1000 : 1000kBaud

4.4.2.3 Device temperature

Actual, internal temperature if the WANDFLUH-Elektronic in Â°C.

Index	Sub-Index	Datatype	Range
2002h	0	INT16	-55 .. +150

4.4.2.4 actual value mode

TODO!

Index	Sub-Index	Datatype	Range
2200h	0	UINT8	1: actual value via fieldbus 2: actual value local

4.4.2.5 actual value input 16 bits

Index	Sub-Index	Datatype	Range
2201h	0	INT16	Min .. Max Bus Interface

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4.4.2.6 actual value input 32 bits

Index	Sub-Index	Datatype	Range
2202h	0	INT32	Min .. Max Bus Interface

4.4.2.7 actual value signal type

Index	Sub-Index	Datatype	Range
2220h	0	UINT8	0: Voltage 1: Current 2: Digital 3: Frequency 4: PWM

4.4.2.8 used analogue input for actual value

Index	Sub-Index	Datatype	Range
2221h	0	INT8	-1: not used 0 .. [Analogue input count - 1]

4.4.2.9 used digital input for actual value

Index	Sub-Index	Datatype	Range
2222h	0	INT8	-1: not used 0 .. [digital input count - 1]

4.4.2.10 Actual value cablebreak detection

Index	Sub-Index	Datatype	Range
2224h	0	UINT8	0: Off 1: On

4.4.2.11 Actual value cablebreak detection lower limit

Signal type	Range
Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)

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Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.12 Actual value cablebreak detection upper limit

Signal type	Range
Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)
Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.13 actual value min interface

Signal type	Range
Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)
Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.14 actual value max interface

Signal type	Range
Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)
Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.15 actual value min bus interface

Index	Sub-Index	Datatype	Range
2229h	0	INT32	-32768 .. 32767

4.4.2.16 actual value max bus interface

Index	Sub-Index	Datatype	Range
222Ah	0	INT32	-32768 .. 32767

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4.4.2.17 actual value min reference

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.18 actual value max reference

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.19 Channel enablement

Index	Sub-Index	Datatype	Range
2240h	0	UINT8	0: Disabled 1: Enabled 2: External (dig. input)

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4.4.2.20 used digin for channel enablement

Specifies the used dig. input for the channel - enablement, if parameter 'Channel enablement' is set to 'external'.

Index	Sub-Index	Datatype	Range
2241h	0	INT8	-1: not used 0 .. [dig. input count - 1]

4.4.2.21 Mode of operation

Index	Sub-Index	Datatype	Range
2242h	0	UINT8	0: Command unipolar (1-sol) 1: Command unipolar (2-sol) 2: Command bipolar (2-sol) 3: Command unipolar (2-sol with DigInp)

4.4.2.22 Used digin for solenoid B

Active digital input for the solenoid B selection if the parameter "Mode of operation = Command unipolar (2-sol with DigInp)".

Index	Sub-Index	Datatype	Range
2243h	0	INT8	-1: not used 0 .. [dig. input count - 1]

4.4.2.23 Solenoid type

Index	Sub-Index	Datatype	Range
2244h	0	UINT8	0: Proportional solenoid without current measurement 1: Proportional solenoid with current measurement 2: Switching solenoid without current measurement

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4.4.2.24 Error handling mask

The errors can be selected, which lead to activate the selected digital output in the active state.

Index	Sub-Index	Datatype	Range
2245h	0	UINT16	1: Cablebreak command signal 2: Short circuit solenoid driver 1 4: Short circuit solenoid driver 2 8: Cablebreak solenoid driver 1 16: Cable break solenoid driver 2 32: Cablebreak actual value signal 64: Trailing window error 128 J1939-bus error (J1939 only) 256: LVDT trailing window error (LVDT only)

4.4.2.25 Error handling reaction

Index	Sub-Index	Datatype	Range
2246h	0	UINT8	0: Solenoid 1+2 off 1: Solenoid 1 on 2: Solenoid 2 on 3: Solenoid 1+2 on

4.4.2.26 Error handling used digout

If a selected error is active, this digital output will be activated. In choosing "not used", no digital output will be assigned to the error.

Index	Sub-Index	Datatype	Range
2247h	0	UINT8	-1: not used 0 .. [dig. output count - 1]

4.4.2.27 Function handling mask

Digital output can be activated, when a certain function is running. Several functions can be set at the same time.

Index	Sub-Index	Datatype	Range
2248h	0	UINT8	1: Solenoid 1 active 2: Solenoid 2 active 4: Channel is ready (no error) 8: Temperature Derating active 16: LVDT outside trailing window (LVDT-only)

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4.4.2.28 Function handling used digout

Active digital output for the function. In choosing "not used", no digital output will be assigned to the function.

Index	Sub-Index	Datatype	Range
2249h	0	UINT8	-1: not used 0 .. [dig. output count - 1]

4.4.2.29 Valve type

Index	Sub-Index	Datatype	Range
224Ah	0	UINT8	0: Standard 2-Solenoid 1: 4/3-way 1-solenoid

4.4.2.30 Used digin for ramp enable

Index	Sub-Index	Datatype	Range
2250h	0	UINT8	-1: not used 0 .. [dig. input count - 1]

4.4.2.31 n-point controller set point

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.2.32 n-point controller actual value

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-	6381h	0	UINT8	0 .. 255: element count [RO]

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loop)		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6501h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6601h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	2281h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.2.33 n-point controller threshold value 1

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.34 n-point controller threshold value 2

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.35 n-point controller threshold value 3

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	1 / 1000

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Unit	Range	Resolution
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.36 n-point controller threshold value 4

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	
Mpa	0 .. 50000	1 / 1000
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.37 n-point control deviation

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	63D0h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6550h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6650h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	22D0h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

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4.4.2.38 n-point cm type

Index	Sub-Index	Datatype	Range
22D1h	0	INT8	0: off 2: Trailing window monitoring on -2: Trailing window monitoring on (raises error)

4.4.2.39 n-point cm delay time

Index	Sub-Index	Datatype	Range
22D2h	1	UINT16	0 .. 100: 0 .. 100ms

4.4.2.40 n-point cm threshold

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	1 / 1000
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.41 demand value signal type

Index	Sub-Index	Datatype	Range
2320h	0	UINT8	0: Voltage 1: Current 2: Digital 3: Frequency 4: PWM

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4.4.2.42 used analogue input for demand value

Index	Sub-Index	Datatype	Range
2321h	0	INT8	-1: not used 0 .. [Analogue input count - 1]

4.4.2.43 used digital input for demand value

Index	Sub-Index	Datatype	Range
2322h	0	INT8	-1: not used 0 .. [digital input count - 1]

4.4.2.44 demand value cablebreak detection

Index	Sub-Index	Datatype	Range
2324h	0	UINT8	0: Off 1: On

4.4.2.45 demand value cablebreak detection lower limit

Signal type	Range
Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)
Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.46 demand value cablebreak detection upper limit

Signal type	Range
Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)
Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.47 demand value min interface

Signal type	Range

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Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)
Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.48 demand value max interface

Signal type	Range
Voltage	-10000 .. 10000: -10 .. +10V, resolution 0.001 Volts
Current	0 .. 20000: 0 .. +20V, resolution 0.001 Amperes
Digital	0 .. 1: 0 (off), 1 (on)
Frequency	0 .. 5000000: 0 .. 5000 Hz, resolution 0.001 Hz
PWM	0 .. 100000: 0 .. 100%, resolution 0.001 %

4.4.2.49 demand value min bus interface

Index	Sub-Index	Datatype	Range
2329h	0	INT32	-32768 .. 32767

4.4.2.50 demand value max bus interface

Index	Sub-Index	Datatype	Range
232Ah	0	INT32	-32768 .. 32767

4.4.2.51 demand value min reference

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	1 / 1000
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

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4.4.2.52 demand value max reference

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.53 demand value deadband enable

Index	Sub-Index	Datatype	Range
232Dh	0	UINT8	0: off 1: on

4.4.2.54 demand value deadband

Index	Sub-Index	Datatype	Range
232Eh	0	INT16	0 .. 16384: 0 .. 100%

4.4.2.55 fixed command values enable

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

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Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

4.4.2.56 Dig. input count for fixed command values

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

4.4.2.57 fixed command values used digin 1

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values

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| | 1 .. x | INT32 | | Open-Loop: -16384 .. 16384: -100 .. 100%
Closed-Loop: refer to "Scaled parameter" |

4.4.2.58 fixed command values used digin 2

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

4.4.2.59 fixed command values used digin 3

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

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4.4.2.60 fixed command values count

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

4.4.2.61 fixed command value 1

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

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4.4.2.62 fixed command value 2

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

4.4.2.63 fixed command value 3

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

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4.4.2.64 fixed command value 4

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

4.4.2.65 fixed command value 5

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

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4.4.2.66 fixed command value 6

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

4.4.2.67 fixed command value 7

Fixed command values function on/off

Index	Sub-Index	Datatype	Value	Description
2380h	0	UINT8	0	Fixed command values not active
			1	Fixed command values active

Fixed command values digital input x

Index	Sub-Index	Datatype	Value	Description
2381h	0	UINT8	x [RO]	Count of dig. inputs used for fixed command values
	1 .. x	UINT8	-1	Not used
			0 .. 3*	Number of the dig. input (* count is device specific)

Fixed command values 1 .. x

Index	Sub-Index	Datatype	Value	Description
2382h	0	UINT8	x [RO]	Count of Fixed command values
	1 .. x	INT32		Open-Loop: -16384 .. 16384: -100 .. 100% Closed-Loop: refer to "Scaled parameter"

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4.4.2.68 demand value positive velocity

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.69 demand value negative velocity

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	
Mpa	0 .. 50000	1 / 1000
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.70 target window enable

Index	Sub-Index	Datatype	Range
2402h	0	INT8	0: off 2: on

4.4.2.71 target window delay time

Index	Sub-Index	Datatype	Range
2403h	0	INT16	0 .. 100: 0 .. 100ms

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4.4.2.72 target window threshold

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.73 solenoid-off window enable

Index	Sub-Index	Datatype	Range
2405h	0	INT8	0: off 2: on

4.4.2.74 solenoid-off window delay time

Index	Sub-Index	Datatype	Range
2406h	0	INT8	0 .. 100: 0 .. 100ms

4.4.2.75 solenoid-off threshold

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

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4.4.2.76 Displayed unit

Index	Sub-Index	Datatype	Range
2420h	0	INT8	0: Free unit 1: mm 2: Deg 3: Inch 4: bar 5: psi 6: kN 7: MPa 8: l/min 9: m/s 10: Inch/s 11: 1/Min 12: Deg/s

4.4.2.77 command feed forward

Index	Sub-Index	Datatype	Range
2422h	0	INT16	0 .. 10000: 0 .. 10, resolution 0.001

4.4.2.78 velocity feed forward

Index	Sub-Index	Datatype	Range
2423h	0	INT16	0 .. 10000: 0 .. 10, resolution 0.001

4.4.2.79 Integrator enable

Index	Sub-Index	Datatype	Range
2424h	0	INT8	0: off 1: on

4.4.2.80 reduction of I-part if outside I-windows

Index	Sub-Index	Datatype	Range
2425h	0	INT8	0: reset to 0 1: unchanged 2: reduction over time

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4.4.2.81 Kp positive

Index	Sub-Index	Datatype	Range
2426h	0	INT16	0 .. 25000: 0 .. 25, resolution 0.001

4.4.2.82 Kp negative

Index	Sub-Index	Datatype	Range
2427h	0	INT16	0 .. 25000: 0 .. 25, resolution 0.001

4.4.2.83 Ti positive

Index	Sub-Index	Datatype	Range
2428h	0	INT16	0 .. 10000: 0 .. 10s, resolution 0.001s

4.4.2.84 Ti negative

Index	Sub-Index	Datatype	Range
2429h	0	INT16	0 .. 10000: 0 .. 10s, resolution 0.001s

4.4.2.85 I window positive

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

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4.4.2.86 I window negative

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.87 I inner window positive

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	1 / 1000
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.88 I inner window negative

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	1 / 1000
kN	0 .. 1000000	
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	

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Unit	Range	Resolution
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

4.4.2.89 D time positive

Index	Sub-Index	Datatype	Range
242Eh	0	INT16	0 .. 10000: 0 .. 10s, resolution 0.001s

4.4.2.90 D time negative

Index	Sub-Index	Datatype	Range
242Fh	0	INT16	0 .. 10000: 0 .. 10s, resolution 0.001s

4.4.2.91 D value positive

Index	Sub-Index	Datatype	Range
2430h	0	INT16	0 .. 10000: 0 .. 10, resolution 0.001

4.4.2.92 D value negativ

Index	Sub-Index	Datatype	Range
2431h	0	INT16	0 .. 10000: 0 .. 10, resolution 0.001

4.4.2.93 used solenoid driver 1

Index	Sub-Index	Datatype	Range
2500h	0	INT8	-1: not used 0 .. [solenoid driver count - 1]

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4.4.2.94 solenoid 1 enable

Index	Sub-Index	Datatype	Range
2501h	0	UINT8	0: off 1: on 2: external (dig. input)

4.4.2.95 solenoid 1 enable used digin

Index	Sub-Index	Datatype	Range
2502h	0	UINT8	-1: not used 0 .. [dig. input count - 1]

4.4.2.96 solenoid 1 inversion

Index	Sub-Index	Datatype	Range
2503h	0	UINT8	0: no inversion 1: inversion of solenoid current

4.4.2.97 Imin always active solenoid 1

Index	Sub-Index	Datatype	Range
2504h	0	UINT8	0: normal 1: Imin always active

4.4.2.98 solenoid 1 cablebreak detection

Index	Sub-Index	Datatype	Range
2505h	0	UINT8	0: off 1: on

4.4.2.99 solenoid 1 Imin

Solenoid-type	Range		
	DSV	MD2	SD6

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	current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
	current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.100 solenoid 1 Imax

Solenoid-type	Range		
	DSV	**MD2**	**SD6**
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.101 solenoid 1 dither function

Index	Sub-Index	Datatype	Range
2508h	0	UINT8	0: off 1: on

4.4.2.102 solenoid 1 dither period

Index	Sub-Index	Datatype	Range
2509h	0	INT16	2 .. 250: 500 .. 4Hz

4.4.2.103 solenoid 1 dither amplitude

Solenoid-type	Range		
	DSV	**MD2**	**SD6**
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.104 solenoid 1 switch on threshold

Index	Sub-Index	Datatype	Range
250Bh	0	INT16	0 .. 16384: 0 .. 100%

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4.4.2.105 solenoid 1 switch off threshold

Index	Sub-Index	Datatype	Range
250Ch	0	INT16	0 .. 16384: 0 .. 100%

4.4.2.106 solenoid 1 switch reduction time

Index	Sub-Index	Datatype	Range
250Dh	0	UINT16	0 .. 10000: 0 .. 10s, resolution 0.001s

4.4.2.107 solenoid 1 switch reduction value

Index	Sub-Index	Datatype	Range
250Eh	0	INT16	0 .. 16384: 0 .. 100%

4.4.2.108 solenoid 1 lower I-min (S1578)

Solenoid-type	Range		
	DSV	MD2	SD6
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.109 solenoid 1 lower I-max (S1578)

Solenoid-type	Range		
	DSV	MD2	SD6
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

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4.4.2.110 solenoid 1 characteristic optimisation enable

Index	Sub-Index	Datatype	Range
2520h	0	INT8	0: off 1: on

4.4.2.111 solenoid 1 characteristic optimisation point count

Index	Sub-Index	Datatype	Range
2521h	0	INT8	9 [RO]

4.4.2.112 solenoid 1 characteristic optimisation point 1

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.113 solenoid 1 characteristic optimisation point 2

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off

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			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.114 solenoid 1 characteristic optimisation point 3

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.115 solenoid 1 characteristic optimisation point 4

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description

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2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.116 solenoid 1 characteristic optimisation point 5

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

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4.4.2.117 solenoid 1 characteristic optimisation point 6

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.118 solenoid 1 characteristic optimisation point 7

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description

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0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.119 solenoid 1 characteristic optimisation point 8

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.120 solenoid 1 characteristic optimisation point 9

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

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Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	**Description**	**Value**	**Description**
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.121 used solenoid driver 2

Index	Sub-Index	Datatype	Range
2580h	0	INT8	-1: not used 0 .. [solenoid driver count - 1]

4.4.2.122 solenoid 2 enable

Index	Sub-Index	Datatype	Range
2581h	0	UINT8	0: off 1: on 2: external (dig. input)

4.4.2.123 solenoid 2 enable used digin

Index	Sub-Index	Datatype	Range
2582h	0	UINT8	-1: not used 0 .. [dig. input count - 1]

4.4.2.124 solenoid 2 inversion

Index	Sub-Index	Datatype	Range
2583h	0	UINT8	0: no inversion 1: inversion of solenoid current

4.4.2.125 Imin always active solenoid 2

Index	Sub-Index	Datatype	Range
2584h	0	UINT8	0: normal 1: Imin always active

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4.4.2.126 solenoid 2 cablebreak detection

Index	Sub-Index	Datatype	Range
2585h	0	UINT8	0: off 1: on

4.4.2.127 solenoid 2 Imin

Solenoid-type	Range		
	DSV	MD2	SD6
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.128 solenoid 2 Imax

Solenoid-type	Range		
	DSV	MD2	SD6
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.129 solenoid 2 dither function

Index	Sub-Index	Datatype	Range
2588h	0	UINT8	0: off 1: on

4.4.2.130 solenoid 2 dither period

Index	Sub-Index	Datatype	Range
2589h	0	INT16	2 .. 250: 500 .. 4Hz

4.4.2.131 solenoid 2 dither amplitude

Solenoid-type	Range

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	DSV	MD2	SD6
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.132 solenoid 2 switch on threshold

Index	Sub-Index	Datatype	Range
258Bh	0	INT16	0 .. 16384: 0 .. 100%

4.4.2.133 solenoid 2 switch off threshold

Index	Sub-Index	Datatype	Range
258Ch	0	INT16	0 .. 16384: 0 .. 100%

4.4.2.134 solenoid 2 switch reduction time

Index	Sub-Index	Datatype	Range
258Dh	0	UINT16	0 .. 10000: 0 .. 10s, resolution 0.001s

4.4.2.135 solenoid 2 switch reduction value

Index	Sub-Index	Datatype	Range
258Eh	0	INT16	0 .. 16384: 0 .. 100%

4.4.2.136 solenoid 2 lower I-min (S1578)

Solenoid-type	Range		
	DSV	MD2	SD6
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle		

4.4.2.137 solenoid 2 lower I-max (S1578)

Solenoid-type	Range

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	DSV	MD2	SD6
current measured	0 .. 16384: 0 .. 1534mA at 24V 0 .. 16384: 0 .. 2557mA at 12V	0 .. 16384: 0 .. 2112mA	0 .. 16384: 0 .. 1877mA at 24V 0 .. 16384: 0 .. 2346mA at 12V
current not measured	0 .. 16384: 0 .. 100% Duty-Cycle			

4.4.2.138 solenoid 2 characteristic optimisation enable

Index	Sub-Index	Datatype	Range
25A0h	0	INT8	0: off 1: on

4.4.2.139 solenoid 2 characteristic optimisation point count

Index	Sub-Index	Datatype	Range
25A1h	0	INT8	9 [RO]

4.4.2.140 solenoid 2 characteristic optimisation point 1

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	**Description**	**Value**	**Description**
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

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4.4.2.141 solenoid 2 characteristic optimisation point 2

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.142 solenoid 2 characteristic optimisation point 3

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description

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| 0 .. 16384 | 0 .. 100% solenoid current | 0 .. 16384 | 0 .. 100% command - solenoid current |

4.4.2.143 solenoid 2 characteristic optimisation point 4

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.144 solenoid 2 characteristic optimisation point 5

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

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Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.145 solenoid 2 characteristic optimisation point 6

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.146 solenoid 2 characteristic optimisation point 7

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

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Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.147 solenoid 2 characteristic optimisation point 8

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1
	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	Description	Value	Description
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.2.148 solenoid 2 characteristic optimisation point 9

Characteristic optimisation on/off

Index	Sub-Index	Datatype	Value	Description
2520h	0	UINT8	0	Characteristic optimisation sol-1 off
			1	Characteristic optimisation sol-1 on
25A0h	0	UINT8	0	Characteristic optimisation sol-2 off
			1	Characteristic optimisation sol-1 on

Characteristic optimisation values

Index	Sub-Index	Datatype	Value	Description
2521h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-1

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	1 .. 9	UINT32		Characteristic optimisation points (see below
25A1h	0	UINT8	9 [RO]	Characteristic optimisation point count sol-2
	1 .. 9	UINT32		Characteristic optimisation points (see below).

Coding of one characteristic optimisation point as 32-bit integer value:

Solenoid-current output Y-axis (High - Word)		Solenoid-current input X-axis (Low - Word)	
Value	**Description**	**Value**	**Description**
0 .. 16384	0 .. 100% solenoid current	0 .. 16384	0 .. 100% command - solenoid current

4.4.3 Standardised Device Profile Area

Index	Sub-Index	Description	Controlmode	Datatype	min. Value	max. Value	PDO-Mapping
6040h 6840h	0	Device control word [90]		UINT16	-32768	32767	Yes
6041h 6841h	0	Device Statusword [90]		UINT16			Yes
6042h 6842h	0	device mode [91]		UINT8	1	2	Yes
6043h 6843h	0	device control mode [91]		INT8	-128	127	Yes
604Fh 684Fh	0	device local [91]		UINT8	0	1	Yes
6050h 6850h	0	device version [92]		VSTRING			No
6052h 6852h	0	device serial number [92]		VSTRING			No
6054h 6854h	0	device model description [92]		VSTRING			No
6057h 6857h	0	device vendor name [92]		VSTRING			No
605Fh 685Fh	0	device capability [92]		UINT32			No
6300h 6B00h	0	vpoc set point - element count [93]	vpoc	UINT8			No
	1	vpoc set point [93]	vpoc	INT16	-32768	32767	Yes
6330h 6B30h	0	vpoc ramp type [93]	vpoc	INT8	-128	127	No
6332h 6B32h	0	vpoc dvg ramp acceleration time positive - element count [93]	vpoc	UINT8			No
	1	vpoc dvg ramp acceleration time positive [93]	vpoc	UINT16	0	51000	No
6333h 6B33h	0	vpoc dvg ramp acceleration time negative - element count [94]	vpoc	UINT8			No
	1	vpoc dvg ramp acceleration time negative [94]	vpoc	UINT16	0	51000	No
6335h 6B35h	0	vpoc dvg ramp deceleration time positive - element count [94]	vpoc	UINT8			No
	1	vpoc dvg ramp deceleration time positive [94]	vpoc	UINT16	0	51000	No
6336h 6B36h	0	vpoc dvg ramp deceleration time negative - element count [94]	vpoc	UINT8			No
	1	vpoc dvg ramp deceleration time negative [94]	vpoc	UINT16	0	51000	No
6380h 6B80h	0	vprc set point - element count [94]	vprc (open-loop) vprc (closed-loop)	UINT8			No
	1	vprc set point [95]	vprc (open-loop) vprc (closed-loop)	INT16	-32768	32767	Yes
6381h	0	vprc actual value - element count [95]	vprc (closed-loop)	UINT8			No

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Index	Sub-Index	Description	Controlmode	Datatype	min. Value	max. Value	PDO-Mapping
	1	vprc actual value [95]	vprc (closed-loop)	INT16			Yes
63B0h 6BB0h	0	vprc ramp type [96]	vprc (open-loop)	INT8	-128	127	No
63B2h 6BB2h	0	vprc dvg ramp acceleration time positive - element count [96]	vprc (open-loop)	UINT8			No
	1	vprc dvg ramp acceleration time positive [96]	vprc (open-loop)	UINT16	0	51000	No
63B3h 6BB3h	0	vprc dvg ramp acceleration time negative - element count [96]	vprc (open-loop)	UINT8			No
	1	vprc dvg ramp acceleration time negative [96]	vprc (open-loop)	UINT16	0	51000	No
63B5h 6BB5h	0	vprc dvg ramp deceleration time positive - element count [97]	vprc (open-loop)	UINT8			No
	1	vprc dvg ramp deceleration time positive [97]	vprc (open-loop)	UINT16	0	51000	No
63B6h 6BB6h	0	vprc dvg ramp deceleration time negative - element count [97]	vprc (open-loop)	UINT8			No
	1	vprc dvg ramp deceleration time negative [97]	vprc (open-loop)	UINT16	0	51000	No
63D0h	0	vprc control deviation - element count [97]	vprc (closed-loop)	UINT8			No
	1	vprc control deviation [97]	vprc (closed-loop)	INT16			Yes
63D1h	0	vprc cm type [98]	vprc (closed-loop)	INT8	-2	2	No
63D2h	0	vprc cm delay time - element count [98]	vprc (closed-loop)	UINT8			No
	1	vprc cm delay time [98]	vprc (closed-loop)	INT16	0	100	No
63D3h	0	vprc cm threshold - element count [98]	vprc (closed-loop)	UINT8			No
	1	vprc cm threshold [98]	vprc (closed-loop)	INT16	0	16384	No
6480h 6C80h	0	dcol set point - element count [98]	dcol	UINT8			No
	1	dcol set point [99]	dcol	INT32	-2147483648	2147483647	Yes
64B0h 6CB0h	0	dcol ramp type [99]	dcol	INT8	-128	127	No
64B2h 6CB2h	0	dcol dvg ramp acceleration time positive - element count [99]	dcol	UINT8			No
	1	dcol dvg ramp acceleration time positive [100]	dcol	UINT16	0	51000	No
64B3h 6CB3h	0	dcol dvg ramp acceleration time negative - element count [100]	dcol	UINT8			No
	1	dcol dvg ramp acceleration time negative [100]	dcol	UINT16	0	51000	No
64B5h 6CB5h	0	dcol dvg ramp deceleration time positive - element count [100]	dcol	UINT8			No
	1	dcol dvg ramp deceleration time positive [100]	dcol	UINT16	0	51000	No
64B6h 6CB6h	0	dcol dvg ramp deceleration time negative - element count [100]	dcol	UINT8			No
	1	dcol dvg ramp deceleration time negative [100]	dcol	UINT16	0	51000	No
6500h	0	dsc set point - element count [101]	dsc	UINT8			No
	1	dsc set point [101]	dsc	INT32	-2147483648	2147483647	Yes
6501h	0	dsc actual value - element count [101]	dsc	UINT8			No
	1	dsc actual value [102]	dsc	INT32			Yes
6550h	0	dsc control deviation - element count [102]	dsc	UINT8			No
	1	dsc control deviation [102]	dsc	INT32			Yes
6551h	0	dsc cm type [103]	dsc	INT8	-2	2	No
6552h	0	dsc cm delay time - element count [103]	dsc	UINT8			No
	1	dsc cm delay time [103]	dsc	INT16	0	100	No
6553h	0	dsc cm threshold - element count [103]	dsc	UINT8			No
	1	dsc cm threshold [103]	dsc	INT32	0	2147483647	No
6600h	0	dpc set point - element count [104]	dpc	UINT8			No
	1	dpc set point [104]	dpc	INT32	-2147483648	2147483647	Yes
6601h	0	dpc actual value - element count [104]	dpc	UINT8			No
	1	dpc actual value [105]	dpc	INT32			Yes

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Index	Sub-Index	Description	Controlmode	Datatype	min. Value	max. Value	PDO-Mapping
6650h	0	dpc control deviation - element count [105]	dpc	UINT8			No
	1	dpc control deviation [105]	dpc	INT32			Yes
6651h	0	dpc cm type [106]	dpc	INT8	-2	2	No
6652h	0	dpc cm delay time - element count [106]	dpc	UINT8			No
	1	dpc cm delay time [106]	dpc	INT16	0	100	No
6653h	0	dpc cm threshold - element count [106]	dpc	UINT8			No
	1	dpc cm threshold [106]	dpc	INT32	0	2147483647	No

4.4.3.1 Device control word

The control word is bit coded, i.e., each individual bit has a certain control function. The table below lists the individual functions with the bit belonging to it.

MSB								LSB							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
High - Byte								Low - Byte							

Bit	Name	Description
0	Disable (D)	These bits form the device control commands. Refer to the description of the device state machine.
1	Hold enable (H)	
2	Device mode active (M)	
3	Reset fault (R)	Resets an error/fault
4	Reserved	
5	Reserved	
6	Reserved	
7	Reserved	
8	Reserved	
9	Reserved	
10	Reserved	
11	Reserved	
12	Reserved	
13	Reserved	
14	Reserved	
15	Manufacturer-specific	

4.4.3.2 Device Statusword

The status word is bit coded, i.e., each individual bit has a status display function. The table below lists the individual functions with the bit belonging to it.

MSB								LSB							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
High - Byte								Low - Byte							

Bit	Name	Description
0	Disable (D)	These bits determine the device condition. Refer to the description of the device state machine.
1	Hold enable (H)	

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2	Device mode active (M)	
3	Ready (R)	
4	Reserved	
5	Reserved	
6	Reserved	
7	Reserved	
8	Reserved	
9	Ramp running	The preset value ramp is active (open-loop modes only)
10	Reserved	
11	Trailing window error	The trailing window error is active (closed-loop modes only)
12	Target window reached	The target window is reached (closed-loop modes only)
13	Reserved	
14	Reserved	
15	Manufacturer-specific	

4.4.3.3   device mode

Index	Sub-Index	Datatype	Range
6042h	0	UINT8	1: Command value from fieldbus 2: Command value local

4.4.3.4   device control mode

Index	Sub-Index	Datatype	Range
6043h	0	INT8	1: Schieberventil ohne Kolbenlage-Regelung (vpoc) 3: Pressure/flow valve open loop (vprc) 4: Pressure/flow valve closed loop (vprc) 6: Position open loop (dcol) 7: Speed control closed loop (dsc) 9: Position closed loop (dpc) -5: Pressure control closed loop 2-sol (vprc) -6: 2-point controller 1-sol (n-point) -7: 2-point controller 2-sol (n-point) -8: 3-point controller 2-sol (n-point)

4.4.3.5   device local

Index	Sub-Index	Datatype	Range
604Fh	0	UINT8	0: Control-word via fieldbus 1: Control-word local

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4.4.3.6   device version

Contains the device software version (= software version)

Index	Sub-Index	Datatype	Range
6050h	0	VSTRING	Visible String (09h) [RO]

4.4.3.7   device serial number

Contains the device serial number.

Index	Sub-Index	Datatype	Range
6052h	0	VSTRING	Visible String (09h) [RO]

4.4.3.8   device model description

It contains the device model description.

Index	Sub-Index	Datatype	Range
6054h	0	VSTRING	Visible String (09h) [RO]

4.4.3.9   device vendor name

It contains the device vendor name.

Index	Sub-Index	Datatype	Range
6057h	0	VSTRING	Wandfluh AG [RO]

4.4.3.10   device capability

Index	Sub-Index	Datatype	Range
605Fh	0	UINT32	Bit 0..13 = reserved Bit 14 = n-point controller (WANDFLUH specific) Bit 15 = Vendor specific Bit 16 = Hydraulic drive Bit 17 = Position open loop Bit 18 = Speed controller Bit 19 = P/Q controller Bit 20 = Position controller Bit 21-23 = reserved Bit 24 = Hydraulic proportional valve Bit 25 = Spool position control open loop (without LVDT) Bit 26 = Spool position control closed loop (with LVDT) Bit 27 = Pressure control valve open loop (without feedback sensor) Bit 28 = Pressure control valve closed loop (with feedback sensor) Bit 29 = P/Q Valve Bit 30 = reserved Bit 31 = Modular device (can have various functions)

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4.4.3.11 vpoc set point - element count

Index	Sub-Index	Datatype	Range
6300h	0	UINT8	1 [RO]

4.4.3.12 vpoc set point

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.13 vpoc ramp type

Index	Sub-Index	Datatype	Range
6330h	0	INT8	0: Ramp off 3: Ramp on -1: enable ramp via dig. Input

4.4.3.14 vpoc dvg ramp acceleration time positive - element count

Index	Sub-Index	Datatype	Range
6332h	0	UINT8	1 [RO]

4.4.3.15 vpoc dvg ramp acceleration time positive

Index	Sub-Index	Datatype	Range
6332h	1	UINT16	0 .. 51000: 0 .. 51000ms

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4.4.3.16 vpoc dvg ramp acceleration time negative - element count

Index	Sub-Index	Datatype	Range
6333h	0	UINT8	1 [RO]

4.4.3.17 vpoc dvg ramp acceleration time negative

Index	Sub-Index	Datatype	Range
6333h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.18 vpoc dvg ramp deceleration time positive - element count

Index	Sub-Index	Datatype	Range
6335h	0	UINT8	1 [RO]

4.4.3.19 vpoc dvg ramp deceleration time positive

Index	Sub-Index	Datatype	Range
6335h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.20 vpoc dvg ramp deceleration time negative - element count

Index	Sub-Index	Datatype	Range
6336h	0	UINT8	1 [RO]

4.4.3.21 vpoc dvg ramp deceleration time negative

Index	Sub-Index	Datatype	Range
6336h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.22 vprc set point - element count

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface

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Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)				
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.23 vprc set point

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.24 vprc actual value - element count

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	6381h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6501h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6601h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	2281h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.25 vprc actual value

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-	6381h	0	UINT8	0 .. 255: element count [RO]

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loop)		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6501h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6601h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	2281h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.26 vprc ramp type

Index	Sub-Index	Datatype	Range
63B0h	0	INT8	0: Ramp off 3: Ramp on -1: enable ramp via dig. Input

4.4.3.27 vprc dvg ramp acceleration time positive - element count

Index	Sub-Index	Datatype	Range
63B2h	0	UINT8	1 [RO]

4.4.3.28 vprc dvg ramp acceleration time positive

Index	Sub-Index	Datatype	Range
63B2h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.29 vprc dvg ramp acceleration time negative - element count

Index	Sub-Index	Datatype	Range
63B3h	0	UINT8	1 [RO]

4.4.3.30 vprc dvg ramp acceleration time negative

Index	Sub-Index	Datatype	Range
63B3h	1	UINT16	0 .. 51000: 0 .. 51000ms

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4.4.3.31 vprc dvg ramp deceleration time positive - element count

Index	Sub-Index	Datatype	Range
63B5h	0	UINT8	1 [RO]

4.4.3.32 vprc dvg ramp deceleration time positive

Index	Sub-Index	Datatype	Range
63B5h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.33 vprc dvg ramp deceleration time negative - element count

Index	Sub-Index	Datatype	Range
63B6h	0	UINT8	1 [RO]

4.4.3.34 vprc dvg ramp deceleration time negative

Index	Sub-Index	Datatype	Range
63B6h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.35 vprc control deviation - element count

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	63D0h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6550h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6650h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	22D0h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.36 vprc control deviation

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	63D0h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6550h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter

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dpc	6650h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	22D0h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.37 vprc cm type

Index	Sub-Index	Datatype	Range
63D1h	0	INT8	0: off 2: Trailing window monitoring on -2: Trailing window monitoring on (raises error)

4.4.3.38 vprc cm delay time - element count

Index	Sub-Index	Datatype	Range
63D2h	0	UINT8	1 [RO]

4.4.3.39 vprc cm delay time

Index	Sub-Index	Datatype	Range
63D2h	1	INT16	0 .. 100: 0 .. 100ms

4.4.3.40 vprc cm threshold - element count

Index	Sub-Index	Datatype	Range
63D3h	0	UINT8	1 [RO]

4.4.3.41 vprc cm threshold

Index	Sub-Index	Datatype	Range
63D3h	1	INT16	0 .. 16384: 0 .. 100%

4.4.3.42 dcol set point - element count

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop)	6380h	0	UINT8	0 .. 255: element count [RO]

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vprc (closed-loop)		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.43 dcol set point

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.44 dcol ramp type

Index	Sub-Index	Datatype	Range
64B0h	0	INT8	0: Ramp off 3: Ramp on -1: enable ramp via dig. Input

4.4.3.45 dcol dvg ramp acceleration time positive - element count

Index	Sub-Index	Datatype	Range
64B2h	0	UINT8	1 [RO]

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4.4.3.46 dcol dvg ramp acceleration time positive

Index	Sub-Index	Datatype	Range
64B2h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.47 dcol dvg ramp acceleration time negative - element count

Index	Sub-Index	Datatype	Range
64B3h	0	UINT8	1 [RO]

4.4.3.48 dcol dvg ramp acceleration time negative

Index	Sub-Index	Datatype	Range
64B3h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.49 dcol dvg ramp deceleration time positive - element count

Index	Sub-Index	Datatype	Range
64B5h	0	UINT8	1 [RO]

4.4.3.50 dcol dvg ramp deceleration time positive

Index	Sub-Index	Datatype	Range
64B5h	1	UINT16	0 .. 51000: 0 .. 51000ms

4.4.3.51 dcol dvg ramp deceleration time negative - element count

Index	Sub-Index	Datatype	Range
64B6h	0	UINT8	1 [RO]

4.4.3.52 dcol dvg ramp deceleration time negative

Index	Sub-Index	Datatype	Range
64B6h	1	UINT16	0 .. 51000: 0 .. 51000ms

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4.4.3.53 dsc set point - element count

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.54 dsc set point

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.55 dsc actual value - element count

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	6381h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6501h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6601h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter

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n-point	2281h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.56 dsc actual value

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	6381h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6501h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6601h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	2281h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.57 dsc control deviation - element count

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	63D0h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6550h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6650h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	22D0h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.58 dsc control deviation

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	63D0h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6550h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6650h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	22D0h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

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4.4.3.59 dsc cm type

Index	Sub-Index	Datatype	Range
6551h	0	INT8	0: off 2: Trailing window monitoring on -2: Trailing window monitoring on (raises error)

4.4.3.60 dsc cm delay time - element count

Index	Sub-Index	Datatype	Range
6552h	0	UINT8	1 [RO]

4.4.3.61 dsc cm delay time

Index	Sub-Index	Datatype	Range
6552h	1	INT16	0 .. 100: 0 .. 100ms

4.4.3.62 dsc cm threshold - element count

Index	Sub-Index	Datatype	Range
6553h	0	UINT8	1 [RO]

4.4.3.63 dsc cm threshold

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	1 / 1000
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

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4.4.3.64 dpc set point - element count

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.65 dpc set point

Control-mode	Index	Sub-Index	Datatype	Range
vpoc (open-loop)	6300h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
vprc (open-loop) vprc (closed-loop)	6380h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	Min ..Max Bus Interface
dcol (open-loop)	6480h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dsc	6500h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
dpc	6650h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min .. Max Bus Interface
n-point	22D0h	0	INT32	Min .. Max Bus Interface

4.4.3.66 dpc actual value - element count

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	6381h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6501h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6601h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter

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| | n-point | 2281h | 0 | INT32 | Min- .. Max-Reference: refer to Scaled parameter |

4.4.3.67 dpc actual value

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	6381h	0	UINT8	0 .. 255: element count [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6501h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6601h	0	UINT8	0 .. 255: element count [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	2281h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.68 dpc control deviation - element count

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	63D0h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6550h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6650h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	22D0h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

4.4.3.69 dpc control deviation

Control-mode	Index	Sub-Index	Datatype	Range
vprc (closed-loop)	63D0h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT16	-16384 .. 16383: refer to Internal bus resolution
dsc	6550h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
dpc	6650h	0	UINT8	0 .. 255: Anzahl Elemente [RO]
		1	INT32	Min- .. Max-Reference: refer to Scaled parameter
n-point	22D0h	0	INT32	Min- .. Max-Reference: refer to Scaled parameter

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4.4.3.70 dpc cm type

Index	Sub-Index	Datatype	Range
6651h	0	INT8	0: off 2: Trailing window monitoring on -2: Trailing window monitoring on (raises error)

4.4.3.71 dpc cm delay time - element count

Index	Sub-Index	Datatype	Range
6652h	0	UINT8	1 [RO]

4.4.3.72 dpc cm delay time

Index	Sub-Index	Datatype	Range
6652h	1	INT16	0 .. 100: 0 .. 100ms

4.4.3.73 dpc cm threshold - element count

Index	Sub-Index	Datatype	Range
6653h	0	UINT8	1 [RO]

4.4.3.74 dpc cm threshold

By parameter with an unit (e.g. mm, psi, l/min, etc.), the adjusting range and the resolution depends on the selected unit. The following table shows the connection

Unit	Range	Resolution
Free unit	0 .. 15000000	1 / 1000
mm	0 .. 15000000	
Deg	0 .. 360000	
Zoll	0 .. 100000	
bar	0 .. 500000	
psi	0 .. 8000000	
kN	0 .. 1000000	
Mpa	0 .. 50000	
l/min	0 .. 500000	
m/s	0 .. 2000	
inch/s	0 .. 10000000	
1/Min	0 .. 100000	
Deg/s	0 .. 360000	

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5   Commissioning

To support the *WANDFLUH*-Electronics -CAN commissioning, the parameterisation software PASO can be connected. PASO offers the possibility to show certain process data like command value, valve current, device state (state machine) and so on. The bus-node settings (node address and baudrate) can also be made with PASO, as well as certain CAN-bus diagnostics (refer to section "Fieldbus Diagnostics" page 8);.

5.1   Step by step instructions for the first commissioning

For the first commissioning, the following steps should be observed:

5.1.1   Test the hydraulic system

1. Switch off the hydraulic system
2. Switch off the fieldbus master
3. Switch on the *WANDFLUH*-Electronics.
4. In the PASO window "Fieldbus_Fieldbus-Info" in the section "Bus State" the following statement will be displayed: Bus-Status = Pre-Operational (refer to section "Fieldbus Diagnostics 6 ")
5. In the PASO status line, the statements "Disabled" or "Init" will be displayed
6. Switch on the hydraulic system
7. With the PASO Menu "Commands_Valve operation", the solenoids can be operated directly.

   IMPORTANT: The hydraulic moves in an open loop system! Be sure, that the hydraulic system can move free.

8. In the PASO window "Parameters_Solenoids", the parameters for the minimum (Imin) and maximum (Imax) current and the dither signal (frequency and level) can be set
9. Disable the device with the PASO Menu "Commands_Disable". In the PASO status line, the statements "Remote PASO" and "Disabled" will be displayed
10. Set the control of the device to Local with the PASO Menu "Commands_Local Control". In the PASO status line, the statements "Remote" and "Init" will be displayed

5.1.2   Adjust the mode of operation

1. In the PASO window "Configuration_Mode of operation", the adjustments for the desired mode of operation can be made

5.1.3   Test the fieldbus

1. Load the EDS-file in the fieldbus master and select the desired baudrate (refer to section "Presupposition and information for the Fieldbus master 108 ")
2. Adjust the node address and the baudrate on the *WANDFLUH*-Electronics (refer to section "Presupposition for the DP-Slave controller card 108 ")
3. Switch on the fieldbus master
4. The *WANDFLUH*-Electronics can be set via the fieldbus master with the NMT-services to the status "Pre-Operational" resp. "Operational" (refer to section "Device Control Services 16 ")
5. In the PASO window "Fieldbus_Fieldbus-Info" in the section "Bus State" the following statement will be displayed: Bus-Status = Pre-Operational resp. Operational (refer to section "Fieldbus Diagnostics 6 ")

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5.1.4 Test the control via the fieldbus

Set the following parameters in the declared order with the SDO-services (refer to section "Service Data Communication (SDO) 13") (only possible in the state "DISABLE"):

1. Set the parameter "Device local (Operating mode)" to "Control Operation via CAN (0)" (refer to section "Device local (Operating mode) 91").

2. Set the parameter "Device mode (Command value mode) to "CAN (1)" (refer to "Device mode (Command value mode) 91").

3. With the parameter "Device control mode (Control mode)" the desired device control mode can be selected (refer to section "Device control mode (Control mode)" page 47).

4. For the release of the *WANDFLUH*-Electronics, the 3 bits "Disable (D)", "Hold enable (H)" and "Device mode active (M)" from the control word (refer to section "Device control word" page 44) must be set to logical 1. The CANopen®-Slave controller is now in the state "ACTIVE".

5. With the SDO-services (refer to section "Service Data Communication (SDO)" page15) resp. the PDO-services (refer to section "Process Data Communication (PDO) " page 12). a command value can now be set via the fieldbus.

5.2 Presupposition for the DP-Slave controller card

For the commissioning of a *WANDFLUH*-Electronics, the following presupposition must be cleared:

- **What is the node address from the *WANDFLUH*-Electronics?**
  The node address can be set via the parameterisation software PASO in the menu item "Fieldbus_Info" (refer to section "Fieldbus Settings 5")

- **What is the Device control mode (Control mode) for the DP-Slave controller card?**
  The Device control mode (Control mode) can be set via the parameter "Device control mode (Control mode) 91". This selection is important for the for the function range of the DP-Slave controller card.

  IMPORTANT: This parameter can only be changed if the *WANDFLUH*-Electronics is in the state "INIT" or "DISABLE" (refer
  to section "Device State Machine 23")

5.3 Presupposition and information for the Fieldbus master

For the commissioning of a Fieldbus master, the following presupposition must be cleared:

- **Node address**
  What is the node address from the *WANDFLUH*-Electronics?

- **EDS-file**
  The EDS-file "WAGxxxC1.eds" must be present on the Master side. If not, this file must be copied into the project tool of the Master.

5.4 Delivery state

The *WANDFLUH*-Electronics is delivered with the following basic configuration:

- Node address 1
- Baudrate 20kBaud

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5.5 Settings

The *WANDFLUH*-Electronics settings can be read or changed trough CAN-bus or PASO.

After the *WANDFLUH*-Electronics power on, all parameter settings can be made through an SDO access. To keep the changed settings after a power cycle, they have to be stored in the nonvolatile memory. Settings can be stored with the "Save parameter" object 1010h (refer to section "<u>Save Parameter</u> 32 ").

5.6 CAN Bus demand value

In the standard version the valve can only be controlled through the CAN-bus or for test reasons through PASO.

The following start up sequence need to be done after each power on:
- The *WANDFLUH*-Electronics is in "pre-operational" state, there is only a communication with SDO- and NMT services available. A PDO or SYNC telegram is not possible, the device does not responds to it.
- Through the NMT service the *WANDFLUH*-Electronics can be set to state "operational (refer to section "<u>Device Control Services</u> 16 "). In this state PDO's and SYNC telegrams can be transmitted and the *WANDFLUH*-Electronics responds accordingly.
- To release the *WANDFLUH*-Electronics the 3 bits "D", "H" and "M" of the statusword have to be set to logical 1 (refer to section "<u>Device control word</u> 90 "). The *WANDFLUH*-Electronics is now in state "active", a command value can now be received from the setpoint object (e.g. 6300h) or an RxPDO transmission.

5.7 Starting after an error

- After an error recognition the device goes immediately into the state disabled by removing the internal release. Because of the error, an emergency object will be sent and the "ready" bit in the statusword (is a part of the transmit PDO) goes to 0.
- To release the device again, the bit "reset fault" (R) has to be changed from 0 → 1 once to reset the error (refer to section "<u>Device State Machine</u> 23 ").

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6 Diagnostic and error detection

A diagositc about the Fieldbus is always possible via the parameterisation software PASO. This will be made via the menu item "Fieldbus_Info". The following values will be displayed:

- Bus Node Adress
- Baudrate
- Bustyp
- ID-Nummer
- Bus-Status

A detailed description of the diagnostic function you will find in the section "Fieldbus Diagnostics 6 ".

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