Profibus-DP - connection VCI-PROF

for static frequency inverters VCB 400

S9

Installation /
Machine designation: ....
Frequency inverter Type: ....
Serial-No.: ....

**Supplement to the operating instructions
of the VCB 400 frequency inverter**

Supplement S9 to the operating instructions for frequency inverter VCB 400 with Profibus-DP - connection VCI-PROF

VCB 400-010	—	**4**	**kW**
VCB 400-014	—	**5.5**	**kW**
VCB 400-018	—	**7.5**	**kW**
VCB 400-025	—	**11**	**kW**
VCB 400-034	—	**15**	**kW**
VCB 400-045	—	**22**	**kW**
VCB 400-060	—	**30**	**kW**
VCB 400-075	—	**37**	**kW**
VCB 400-090	—	**45**	**kW**
VCB 400-115	—	**55**	**kW**
VCB 400-135	—	**65**	**kW**
VCB 400-150	—	**75**	**kW**
VCB 400-180	—	**90**	**kW**
VCB 400-210	—	**110**	**kW**
VCB 400-250	—	**132**	**kW**
VCB 400-300	—	**160**	**kW**
VCB 400-370	—	**200**	**kW**
VCB 400-460	—	**250**	**kW**
VCB 400-570	—	**315**	**kW**

A   IMPORTANT INFORMATION ON THIS SUPPLEMENT

These operating instructions are valid for the frequency inverter range **VCB 400** with Profibus-DP - connection VCI-PROF.

A **list of contents** is provided for you at the beginning of this supplement to the operating instructions.

The **Operating Instructions Part 1 General information and power section** contains general information, the construction and layout drawings, technical data, the dimensional drawings and the description of the cable connections..

The **Operating Instructions Part 2 Control section and parameterisation** describes certain configurations with the relevant control connections and provides information about the handling of the control unit **KP 100**, the individual equipment parameters and their parameterisation.

The **Instructions for the Profibus-DP – connection VCI-PROF** supplements the documentation for the frequency inverter. The information required to use the communication interface is described in the following chapters.

For more clarity the following pictograms are used in the operating instructions for warnings and notes.:

⇒ Caution! Lethal risk from high direct contact voltage..
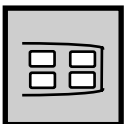
⇒ Caution! Instruction must be observed..

⇒ Caution! Disconnect the unit from the mains before performing any operation and wait at least 5 minutes until the intermediate circuits capacitors have discharged to a safe residual voltage.

⇒ Prohibited! Incorrect handling may damage the equipment..

⇒ Useful information, tip.

⇒ Setting can be changed using the control unit KP 100.

⇒ This parameter can be adjusted in each of the four data records.

CONTENTS

A.1   FURTHER INFORMATION

These operating instructions have been drafted with the greatest care and have been extensively checked several times. For reasons of clarity, not all detailed information on all product models and also not every conceivable case of installation, operation or maintenance could be taken into account. Should you require further information or if particular problems should occur which are not treated in enough detail in the operating instructions you may request the necessary information from the local agent of VECTRON Elektronik.
We also like to remind you that the contents of these operating instructions are not part of any previous or current agreement, confirmation or legal relationship nor should they amend this. All the manufacturer's obligations ensue from the relevant sales contract which also includes the complete and solely valid terms of warranty. These contractual terms of warranty are neither extended nor restricted by the implementation of these operating instructions.

The manufacturer retains the right to correct or alter the contents and product details as well as omissions without previous notice and accepts no liability for damage, injuries or expenses due to the aforementioned reasons.

1 GENERAL INFORMATION

1.1 SAFETY INSTRUCTIONS

The appropriate instructions for a safe handling and operation of the frequency inverter can be found in our **Operating instructions Part 1 and Part 2**.

2 PROFIBUS-DP - CONNECTION VCI-PROF

The control hardware and software for the frequency inverter models VCB is virtually freely configurable. This means that theoretically certain functions can be assigned to the control connections and one has virtually a free choice of the software modules used and their internal connection.
This modular concept allows you to adapt the frequency inverter to a number of different drive tasks.
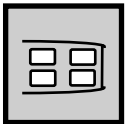
The demands on the control hardware and software are common for known drive tasks. Thus, certain functional assignments for the control connections and the internal connection of the software modules can be determined. These fixed assignments can be selected with the parameter *Configuration* **30 (CONF)**.

The frequency inverter can be parameterised with either the control unit KP100 or via the Profibus-DP interface. The number of DP-Slaves which can be defined is limited to a max. of 125 stations by the standardised interface assignment.

All control connections and the communication interfaces for the frequency inverter are located under the cover, which may have to be removed. (Operating instructions Part 1, Construction and layout drawing).

The extension card Profibus-DP - connection VCI-PROF is connected to the 2-wire bus via the 9-pin Sub-D socked marked X316.
The station address within the network, which is clearly assigned to a frequency inverter, can be set with a length of 8 bits via the Hex code switches S5 and S6. The LED's H301, H302 and H303 show the current operating status of the extension card.
The service interface provided at the 9-pin Sub-D socket marked X317 should not be used for current applications.

Front view of extension card Profibus-DP – connection VCI-PROF
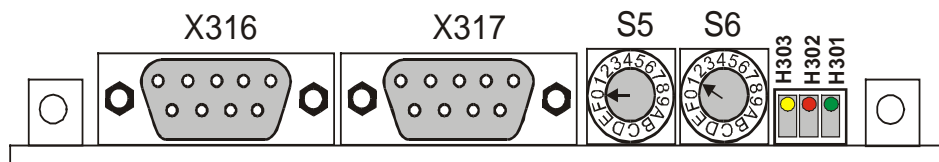
Note: The extension card **Profibus-DP - connection VCI-PROF** is **not** standard equipment for the frequency inverter and must be listed separately in your order.

2.1 SPECIFICATIONS FOR THE PROFIBUS-DP - INTERFACES

The Profibus-DP – interface complies with the European field bus standard EN50170 and German Standard DIN 19245. The ID number 0x7530 in the device master data file has been issued by the Profibus – Nutzer - Organisation e.V..

This Profibus model, which has been optimised for speed and low connection costs, has been specially designed for communication between automation systems and decentralised peripheral equipment. Transmission in a real-time system on the bus side and inverter-internal processing of the data calls for observance of maximum reaction times, guaranteed in normal operation through telegrams of a fixed length.

Unlike the FMS variant, PROFIBUS-DP does not have an object-oriented approach, i.e., the user, represented by the application on the master side and the inverter coupled to the slave, has to decode the raw data himself. Agreements thus have to be reached on the structure of the data records to be transmitted. These definitions must be known on both user sides. Within the course of a standardisation of data transmissions in the drive technology field it is sensible to only allow certain telegrams. This ensures that various devices which have a PROFIBUS - interface and only use the standardised telegrams can communicate with each other. The profile "Variable speed drives" (PROFIDRIVE) for electrical drive technology specifies five standardised data telegrams, the Parameter-Process data Objects (PPO). PPO Type 2 is used in the software here.

Profibus-DP – INTERFACE X316		
Pin No.	**Signal**	**Description**
X316-1	Shield	Lead shield / Protective earth
X316-2	-	free
X316-3	RxD/TxD-P	Receive / Send data Plus (RS485 B)
X316-4	CNTR-P	Control signal for repeater (direction control)
X316-5	DGND	Data transmission potential (earth to 5V)
X316-6	VP	Distribution voltage for terminating impedances-P (5V)
X316-7	-	free
X316-8	RxD/TxD-N	Receive / Send data Plus (RS485 A)
X316-9	CNTR-N	Control signal for repeater (direction control)

The station address must be set with the Hex code switch. There must be a clear assignment of the station address within the network using the code switch.

HEX CODE SWITCH	
S6	High Nibble for 8 Bit hexadecimal identifier
S5	Low Nibble for 8 Bit hexadecimal identifier

Note: The serial RS232-interface marked X317 may not be used at present. The RS232-interface can only be used with an optional interface adapter.

The three LED's H301 (green), H302 (red) and H303 (yellow) provide information on the operating status of the communication interface.

LED status display			
H301 (green)	H302 (red)	H303 (yellow)	Status
on	on	-	Reset
on	-	-	Reset complete without error
flashing	-	-	Ready for communication
-	short on	-	Waiting for data during Data_Exchange
-	on	-	Component defective
-	-	on	Component sending

Note: It is normal for the red LED to flash on occasionally. This indicates that the controller has not reacted quickly enough to a request from the Profibus component on account of the run times. No information is lost.

3   TRANSMISSION TECHNIQUE

3.1   HARDWARE

Data is transferred in Profibus-DP applications according to the RS-485 standard. This transmission method is used in applications with a high data transfer rate and uncomplicated installation technology. The twisted data line pair should be laid in a sheathed copper cable. The standard data transfer rate set during commissioning of 9.60 kBaud to 1.50 Mbaud should be taken into account when planning the bus structure. The maximum line length should be dimensioned according to the data transfer rate and number of repeaters in the network topology.
The specifications of the line length with various data transfer rates relate to line type A with the following technical data:

Surge impedance:	135 ... 165 Ω
Capacitance per unit length:	< 30 pF/m
Loop resistance:	110 Ω/km
Lead diameter:	0.64 mm
Lead cross-section:	> 0.34 mm^2
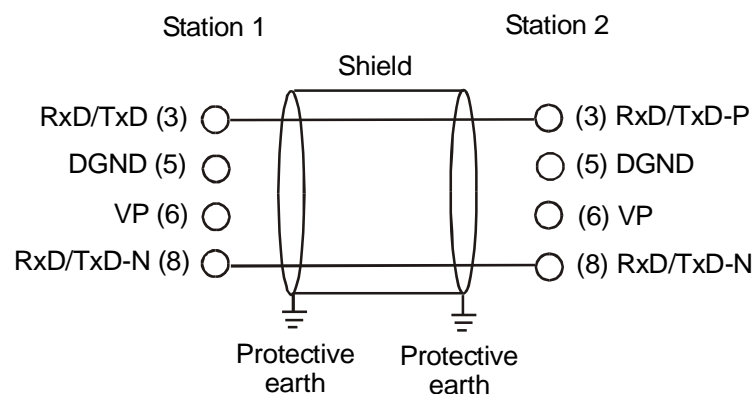
Note: The connection, designed as a shielded data line acc. to EMC guidelines, should be laid separate from power and HT lines. The braided shield and film shield below this should be connected to protective earth at both ends.

Termination of the Profibus-DP should be at the physical ends of the linear bus structure. The active bus termination should be connected to the ends of a segment containing a max. of 32 subscribers. A faultless operation of the network requires a permanent supply to both active bus terminations via the respective connection.

```
                            ○  VP (Pin 6)
                           ▮
                           ▮   390 Ω
                           ▮
              Data line    ○  RxD/TxD-P (Pin 3)
              ──────────── ▮
                           ▮   220 Ω
                           ▮
              Data line    ○  RxD/TxD-N (Pin 8)
              ──────────── ▮
                           ▮   390 Ω
                           ▮
                            ○  DGND (Pin 5)
```
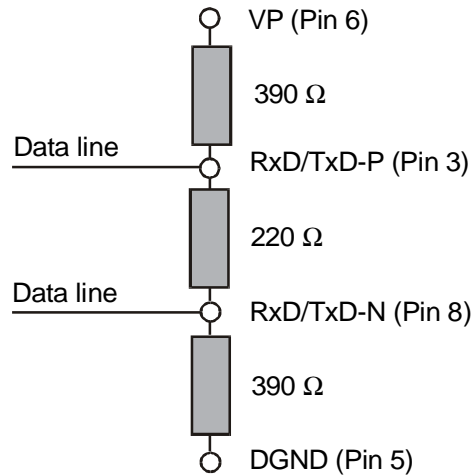
3.2   STATION ADDRESSES

Each frequency inverter with a Profibus-DP – connection is assigned a clear station address in the bus system. A maximum of 125 devices (master and slaves) can be connected to a bus. The number of subscribers which can be connected to a segment is limited to 32. Repeaters are used for extension. The station address consists of a maximum of 8 bits where the four lower bits are assigned to switch S2 and the four upper bits to switch S1.

Note: The subscriber address is set with the Hex switch and is issued during planning. The ID number for the Profibus DP – slave used by the master is taken from the device master data and is independent of the station address set with the Hex switch.

3.3   BAUD RATE

The Profibus-DP – connection has been standardised according to the field bus standard EN 50170 and supports the following baud rates if the data line specified as line type A is used:

Profibus-DP - connection	
Baud rate [kBaud]	**Line length [m]**
9.60	1200
19.20	1200
93.75	1200
187.50	1000
500.00	400
1500.00	200

Note: The baud rates quoted are automatically detected by the connection assembly and do not have to be set. The start value for an automatic baud rate detection is 500.00 kBaud.

4   ESTABLISHING COMMUNICATION AND AVAILABLE SERVICES

The protocol architecture of the Profibus-DP is based on accepted international standards. The protocol architecture is based on the Open-System-Interconnection reference model in accordance with the international standard ISO 7498. The user data is not evaluated by the communications protocol but are saved according to the PROFIDRIVE profile for variable speed drives. The profile contains the definition for the speed control and the possibility of an application-specific extension.

Communication is established with the services:

- *Slave-Diag*   Test whether a slave exists in the network

- *Set_Prm*   Transfer protocol parameter to the slave

- *Chk_Cfg*   Transfer the setpoint configuration to the slave

- *Slave_Diag*   Test whether Set_Prm and Chk_Cfg have been successful

Communication between master and slave is monitored for safety reasons with protective functions against failure and faulty data transfer. The monitoring functions are implemented in the DP-master and DP-slaves in the form of timeout features. The monitoring interval is set during planning of the Profibus-DP network.
The timeout feature expects a data exchange between the DP-master and frequency inverter during the pre-set interval. If Slave_Diag reports that the protocol parameter and configuration have been successfully transferred, the connection set-up is terminated. The DP-master can address the frequency inverter again on expiry of the monitoring interval and perform a reset. Following confirmation of data exchange further communication is with the service *Data_Exchange*.

Note: The user cannot see when communication is established. This is handled by the DP-master. A subscriber on the bus can only be addressed if it has been set up beforehand with the planning tool used (e.g. Siemens WinDrive, Kuhnke VEBES).

The service *Data_Exchange* effects a data exchange with the Parameter process data object type 2. One output data record is written from the Master to the Slave and one input data record from the Slave to the Master in **one** cycle.

Apart from the subscriber-related user data traffic, which is automatically handled by the DP-Master, communication can also be established with a group of bus subscribers. The event-controlled synchronisation of the inputs and outputs is carried out by the services *SYNC/UNSYNC* and *FREEZE/UNFREEZE*.

4.1 SYNC/UNSYNC

On receipt of the SYNC-command the connecting assembly retains its **Output status** (control word, setpoint), i.e. the content of the output to the inverter initially remains unchanged. Although output data records transferred from the Master after SYNC are received in the buffer on the connecting assembly, they are not transferred further. Thus they cannot be accessed by the inverter. They are only forwarded from the buffer to the inverter following receipt of the UNSYNC-command. This ensures that all addressed salves receive the new output data record simultaneously.
An UNSYNC-command terminates the SYNC status, communication is once again purely sequential.

4.2 FREEZE/UNFREEZE

If the connecting assembly receives a FREEZE-command, it "freezes" its buffered **input data record** (status word, actual value). The output data record to the inverter is still updated. The Master can thus access all input data records of the addressed slaves and generate a process image for a defined time. The FREEZE-status is terminated with an UNFREEZE-command.

4.3 PARAMETER-PROCESS DATA OBJECT TYPE 2

The object PPO Type 2 used in the service Data_Exchange consists of 20 bytes. The data block to be transferred is split into two areas, one of which (PKW) is to transmit and receive data for parameter processing and the other (PZD) to transfer process data.

Parameter process data object Type 2										
Parameter flag/value PKW-area				Process data PZD-area						Comment
PKE	IND	PWE	PWE	PZD 1	PZD 2	PZD 3	PZD 4	PZD 5	PZD 6	Transmission direction
		PWEh PWEh	PWEI PWEI	STW ZSW	HSW1 HIW1	HSW2 HIW2	-	-	-	M->S (OUT) S->M (IN)
0/1	2/3	4/5	6/7	8/9	10/11	12/13	14/15	16/17	18/19	Byte number
8 bytes				6 bytes			6 bytes			Data consistency

PKE: Parameter flag
IND: Subindex
PWE: Parameter value

STW: Control word
ZSW: Status word
HSW: Main setpoint
HIW: Main actual value

Note: The even-numbered byte numbers contain the low-byte and the high byte of the respective 16-bit data word should be saved in the subsequent byte.

Communication between the DP-master and DP-slave is shown in the following diagram. The master (active subscriber) which has the transmit authorisation can address the assigned DP-slaves. A message is sent to or a response requested from the slave depending on the order flag.

Parameter-code (PKW)		Process data (PZD)			
Order Par.-No. Data rec. No. Par.value	**Response** Par.-No. Data rec. No. Par.value	Control → Control word	Setpoint K_s → X → Setpoint	Status → Status word	Act. Value K_i → X → Act.value
M -> S	S -> M	Master -> Slave		Slave -> Master	
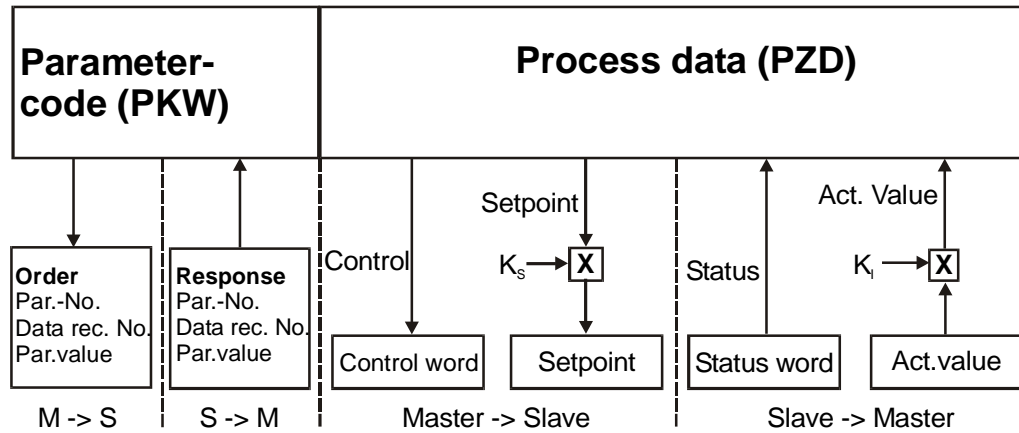
The parameter characteristic values can be processed unchanged following decoding / coding of the order or response; value types Int, Unsigned Int and Long can be transferred. Process data, on the other hand, has to be converted on account of the format specified in the profile. Scaling has been determined according to the PROFIDRIVE specification with $\pm 100\% = \pm 2^{14}$.

4.3.1   COMMUNICATION CHANNEL, PKW-AREA

The 8-byte long parameter-flag-value-area refers to the handling of the interface for parameter exchange between the DP-Master and DP-Slave. The sequence and structure of the 2 bytes in the PKW-area is identical for both transmission directions.

Structure of the parameter flag (PKE)			
AK	SPM	PNU	
15 14 13 12	11	10 9 8 7 6 5 4 3 2 1 0	

AK: Order or response flag (value range 0 ..15)
SPM: Toggle-Bit for asynchronous response processing (0=OFF, 1=ON),
       0: SPM-processing is not supported
PNU: Parameter number (value range 1..1999)

The PNU area transmits the number of the parameter to be processed. The parameter number corresponds to the information in Part 2 of the operating instructions. Bit 11 (SPM) can be used to activate/deactivate asynchronous response processing (0 = OFF, 1 = ON, in the current application asynchronous response processing is not supported, i.e. SPM = 0). The order or response flags are saved in area AK. If no parameter processing is required for the present, set the functional mode "no order".

Structure of the order flag (AK)					
Order flag (AK)					**Function**
15	14	13	12	dec.	
0	0	0	0	**0**	no order
0	0	0	1	**1**	Request parameter value (WORD / LONG)
0	0	1	0	**2**	Change parameter value (WORD)
0	0	1	1	**3**	Change parameter value (LONG)
0	1	1	0	**6**	Request parameter value (ARRAY) WORD / LONG)
0	1	1	1	**7**	Change parameter value (ARRAY WORD)
1	0	0	0	**8**	Change parameter value (ARRAY LONG)

The data record changeover described in the operating instructions Part 2 is defined as an array in the structure of the order and response flag. The parameters saved in the four data records can be parameterised separately or together with byte 2/3 (IND).

Note: The order flag is sent by the DP-Master to the DP-Slave. The DP-Slave responds with the corresponding response flag if the order is processed correctly. If the order has not been executed correctly the DP-slave sends the corresponding response and flags the error message as a parameter value.

Structure of the response flag (AK)					
Response flag (AK)					**Function**
15	14	13	12	dec	
0	0	0	0	**0**	no order
0	0	0	1	**1**	Transfer parameter value (WORD)
0	0	1	0	**2**	Transfer parameter value (LONG)
0	1	0	0	**4**	Transfer parameter value (ARRAY WORD)
0	1	0	1	**5**	Transfer parameter value (ARRAY LONG)
0	1	1	1	**7**	Order inexecutable (with error no.)
1	0	0	0	**8**	No operating sovereignty for PKW – interface

If the inverter detects an error during processing of the parameter order this is entered in the response flag and returns an error number in PWEI (byte 6/7). This error number is interpreted on the master side as INTEGER16 .

Error message codes in response data record (Slave -> Master)	
Error no. (dec.)	**Meaning**
0	Unauthorised PNU
1	Parameter value cannot be changed
2	Lower or upper parameter value limit exceeded
3	Faulty subindex
4	No array
5	Wrong data type
18	Other error

The word IND transfers a subindex and is used to index the parameter. In the present application existing parameters are assigned the data record number 0; you can select from a number of (data record switchover) existing parameters by entering a number between 1 ... 4.
The actual parameter value is transferred in the area PWE; as a 16-bit value (WORD) it occupies PWEI, as a 32-bit value (LONG) PWEh and PWEI, whereby the high word is in PWEh.
Parameters are read or written in normal operation with the defined service Data_Exchange. The entries in the PKW-area must be made according to the type of transmission and the specification of parameters and parameter values set in the user program on the master side and on the side of the inverter.
Parameters which have to be set can be found in the parameter list as well as the standard operating instructions. Specify in the parameter list whether a parameter can be switched between data records (data record = 1 ... 4) or is only present once in a data record = 0. You can also write parameters without having taken over the value in the EEPROM. This is particularly interesting for defining setpoint defaults. In this case the setting for the addressed data record is increased by "5".

Example: Data record = 5 means data record = 0, only RAM etc.

Pay attention to the display format of a parameter and the data type (WORD, LONG). String parameters **cannot** be transferred on account of the possible number of bytes.
The transferred values are always integer values. In the event of values with decimals the decimal point is not transferred.
A slave **always** responds to an order from the Master when using PPO. Each PPO can always only contain an order or a response so that a maximum of 4 bytes of parameter values can be transferred for each object. Thus, collective orders or collective responses are not possible. If a slave cannot provide the output data record before the next order is received the Master sends the same order again until it receives the corresponding response. If, on the other hand, the Master has not sent a new order before the next poll cycle, the slave reacts by transferring the current parameter value until a new order is received. Subsequent identical write orders are detected and ignored by the driver programs by the slave.

Note: The sequence of individual steps to transfer a data frame is defined by the Profibus-DP - protocol. Data entries in the corresponding registers are terminated by setting the order flag.

4.3.1.1   WRITE / READ PARAMETERS

The various parameters are transferred by the area Parameter-Flag-Value (PKW). This 8-bytes long area contains the number and the value up to 4 bytes in length. Individual data telegrams are shown in the following as examples.

Write examples:

- The parameter *Fixed frequency 1* **480 (FF1)** specifies the output frequency of the frequency inverter which is to be selected via data record changeover and contact input. In data record 4 the set fixed frequency is to be changed to – 300.00 Hz. (PNU = 480 / AK=8 / SPM = 0 / IND = 4 / PWEh = 65535 / PWEI = 35536)

Parameter-Flag-Value (PKW)							
PKE		**IND**		**PWE high**		**PWE low**	
low	high	low	high	low	high	low	high
11100000	1000 0 001	00000100	00000000	11111111	11111111	11010000	10001010

- The parameter *Start voltage* **600 (FF1)** defines the starting point for the U/f-characteristic curve. The value can be switched between data records and should be increased to 10.3 V in all four data records.
  (PNU = 600 / AK= 7 / SPM = 0 / IND = 0 / PWEh = 0 / PWEI = 103)

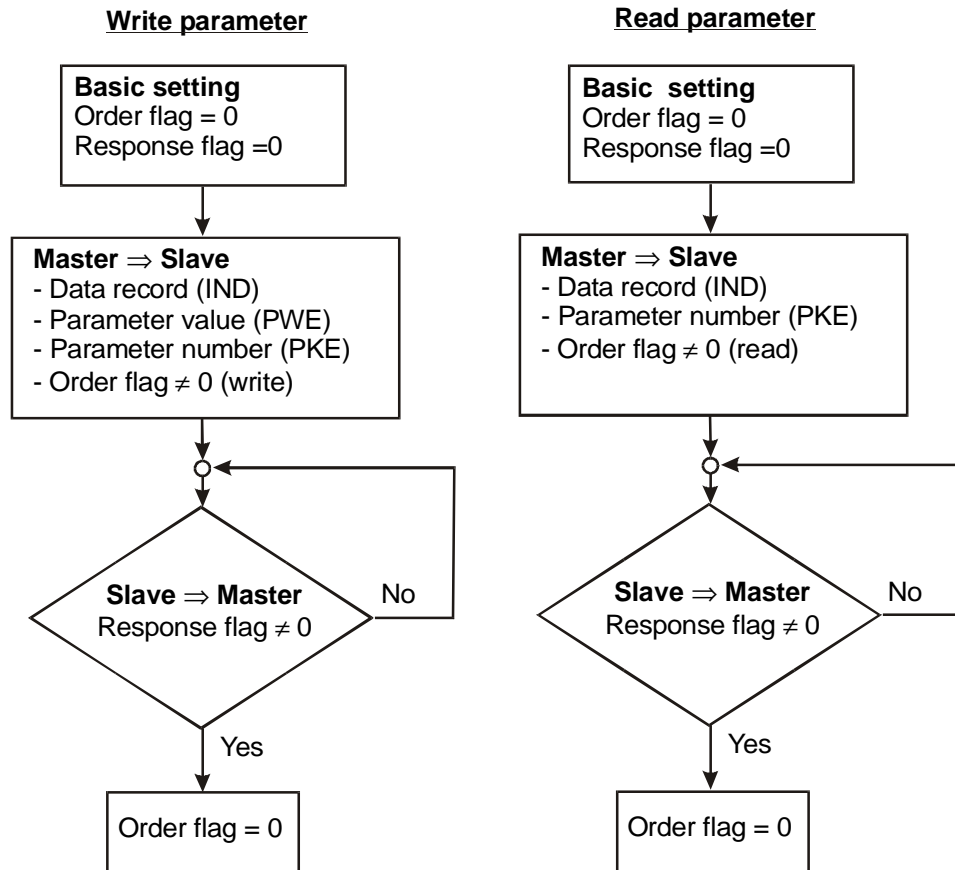| Parameter-Flag-Value (PKW)							
PKE		**IND**		**PWE high**		**PWE low**	
low	high	low	high	low	high	low	high
01011000	0111 0 010	00000000	00000000	00000000	00000000	01100111	00000000

Read examples:

- The parameter *Machine voltage* **212 (U RMS)** is a readout actual value for the machine. (PNU = 212 / AK = 1 / SPM = 0 / IND = 0)

Parameter-Flag-Value (PKW)							
PKE		**IND**		**PWE high**		**PWE low**	
low	high	low	high	low	high	low	high
11010100	0001 0 000	00000000	00000000	00000000	00000000	00000000	00000000

- The parameter *Stator frequency* **210 (FS)** shows the output frequency currently modulated by the frequency inverter. In terms of a motor this is the stator frequency and thus a readout actual value for the machine.
  (PNU = 210 / AK = 1 / SPM = 0 / IND = 0)

Parameter-Flag-Value (PKW)							
PKE		**IND**		**PWE high**		**PWE low**	
low	high	low	high	low	high	low	high
11010010	0001 0 000	00000000	00000000	00000000	00000000	00000000	00000000

The following structograms show the write and read process for random frequency inverter parameters. This data exchange permits the use of the varied control and regulating functions of the inverter software via the Profibus-DP – protocol. In accordance with the operating instructions Part 2, parameterisation can also be carried out via the DP-Master alternatively to operation with the control unit KP100.

<div align="center">

Write parameter   **Read parameter**

</div>

Basic setting	**Basic setting**
Order flag = 0	Order flag = 0
Response flag =0	Response flag =0

Master ⇒ Slave	**Master ⇒ Slave**
- Data record (IND)	- Data record (IND)
- Parameter value (PWE)	- Parameter number (PKE)
- Parameter number (PKE)	- Order flag ≠ 0 (read)
- Order flag ≠ 0 (write)	

Slave ⇒ Master Response flag ≠ 0 — No / Yes — Order flag = 0

Slave ⇒ Master Response flag ≠ 0 — No / Yes — Order flag = 0

The use of the Parameter-Flag-Value area (PKW) is independent of the process data area (PZD). The setpoints and actual values transferred as process data are to be selected depending on the application.

Note: The process data is defined via the parameter *Select setpoint/actual value* **391 (PRPZD)**. In configurations without measurement of the actual speed via a shaft encoder you should select the frequency. Control methods such as a field-oriented control can be used more precisely with the speed.

4.3.2 PROCESS DATA CHANNEL, PZD-AREA

The process data area, comprising 12 bytes, is used for a cyclic update of the process data. In the direction Master to Slave the control word is transferred in the bytes PZD1 followed by the 4 setpoint bytes.
In the opposite direction the 16-bit status word occupies PZD1. PZD2 and PZD3 are provided for frequency inverter actual values.

4.3.2.1 SETPOINTS / ACTUAL VALUES

The use of the setpoint/actual value channel has a fixed definition for the Profibus-DP interface. Bytes 10/11 (PZD2) contain the speed of the drive and bytes 12/13 (PZD3) the output frequency of the frequency inverter.
The setpoint source is defined by the parameter *Select setpoint/actual value* **391 (PRPZD)** on control level 3. The necessary conversion of the setpoint to be evaluated on the inverter side and the reported actual value is carried out from the pre-set nominal frequency for the drive. Standardisation according to PROFIDRIVE specification requires conversion into a percentage setpoint.

Setting setpoints/actual values	
Mode 391 (PRPZD)	**Setpoint/Actual value**
1	Speed
2 **(default)**	Frequency

- The frequency setpoint is suitable for control methods for variable speed drives. The value set by the DP-Master is placed at the drive's disposal depending on the control method
- The default speed setpoint should be used, for example, for a field-oriented control. The speed list value called from the frequency inverter is measured by the connected shaft encoder and is compared directly with the speed setpoint by the DP-Master.
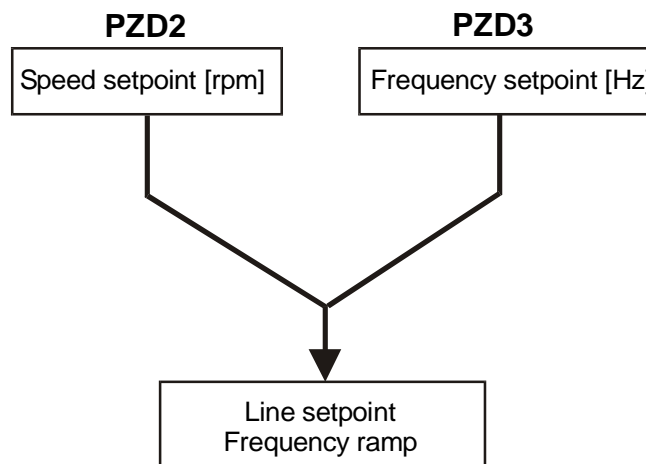

Standardisation of the speed and frequency setpoint is independent of the physical value. Standardisation according to PROFIDRIVE defines $\pm\,100\,\% = \pm\,2^{14}$.

Note: The setpoint transmitted by the DP-Master is processed internally by the frequency inverter and leads to the desired operating point for the drive. The actual value to be called can vary from the setpoint in one stationary operating point. The 16-bit values are subject to fluctuations depending on the measuring and calculation accuracy.

The setpoint default via the Profibus-DP is to be used directly in those configurations with speed control. These configurations, described in Part 2 of the operating instructions, contain the frequency setpoint channel for the setpoint.

The speed or frequency line setpoint is transferred via bytes 10 to 13 of the process data and added to the internal setpoint.

Line setpoint
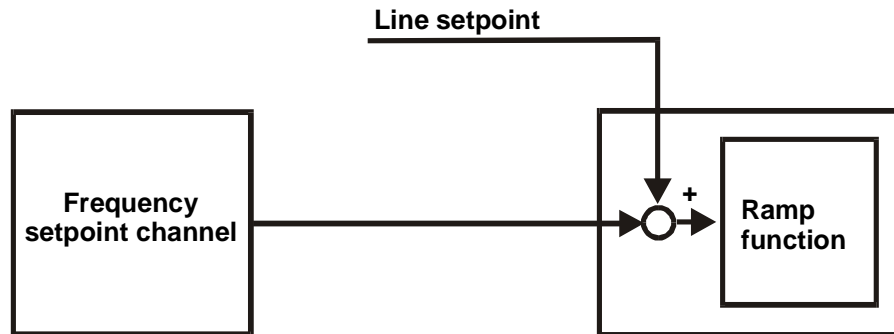
Example:

In configuration 110 the internal frequency setpoint channel is to be operated with fixed frequencies. The frequency setpoint is also transferred via the Profibus-DP – interface in the process data object.

The operating instructions Part 2 describe the setting for the parameter *Frequency setpoint source* **475 (RPSEL)**. In operating mode 10 the internal setpoint default setting is via the pre-set fixed frequencies. The four fixed frequencies of a data record, having been added, are linked to the line set point and can be freely parameterised. The contact inputs permit a changeover between the pre-set fixed frequencies. The line setpoint which is transmitted via the bus system is transmitted according to PROFIDRIVE specifications and added to the current internal setpoint. The sum total of the transmitted line setpoint and internal setpoint is limited by the pre-set range for the limit frequencies. The pre-set line setpoint, parameter *Setpoint frequency Bus* **282 (F-BUS)**, and the value after addition, parameter *Setpoint frequency Ramp* **283 (FRAMP)**, are read out as actual values in the menu VAL.

Note: The addition of the internal setpoint to the line setpoint can lead to a change in the direction of rotation, depending on the selected sign. The result of this addition depends on direction of rotation which is set via the digital contact inputs.

The standardisation of speed and frequency setpoint is determined according to PROFIDRIVE. The reference quantity is determined from the input nominal values for the machine.

			PZDx
+ 100% =	2^{14} =	0x4000	01000000 00000000
- 100% =	-2^{14} =	0xC000	11000000 00000000

Setpoints: (Setpoint/Motor nom. value) · 2^{14} Dynamic range $\pm$ 200 %

Actual values: (Actual value/ Motor nom. value) · 2^{14} Dynamic range $\pm$ 200 %

Note: The operating limits are to be extended to 200 % for variable speed drives which are operated above the rating values.
+ 200% = 2^{15} = 0x7FFF = 01111111 11111111
- 200% = -2^{15} = 0x8000 = 10000000 00000000

4.4 CONTROL IN THE BUS MODE

The dialogue between the DP-Master and frequency inverter includes not only the exchange of setpoints and actual values but also the control of individual functions. A device command is executed and reported back to the DP-Master by the frequency inverter via the status word according to the transmitted control word. The status or control word is saved in bytes 8 and 9 of the parameter-process data object depending on the transmission direction.

Control and status words are structured according to DRIVECOM.
Reference is made to the DRIVECOM specifications for the meaning of the individual statuses. The inverter is only controlled via the bus in case the inverter has been switched to the remote mode. The mode selected with the parameter *LocalRemote-Flag* **412 (REMOT)** deactivates the sole release via contact input S1IND.

If the parameter *LocalRemote-Flag* **412 (REMOT)** is set, the remote mode is activated and the parameter control word or status word is used. The actual value *Profibus-values* **281 (PWERT)** permits a control of the transmitted values via the optional control unit KP100 or control software. The parameter, transmitted as a character string, is structured according to the abbreviations for the parameter process data object Type 2.

Note: If the remote mode is activated, release can only be via the communication channel, and this only if the hardware release (S1IND) and Start right (S2IND) have been switched on !

The inverter is started and stopped in the remote mode via the control word and the internal status is read via the status word. The sequence is defined in the status machine.

Status machine:
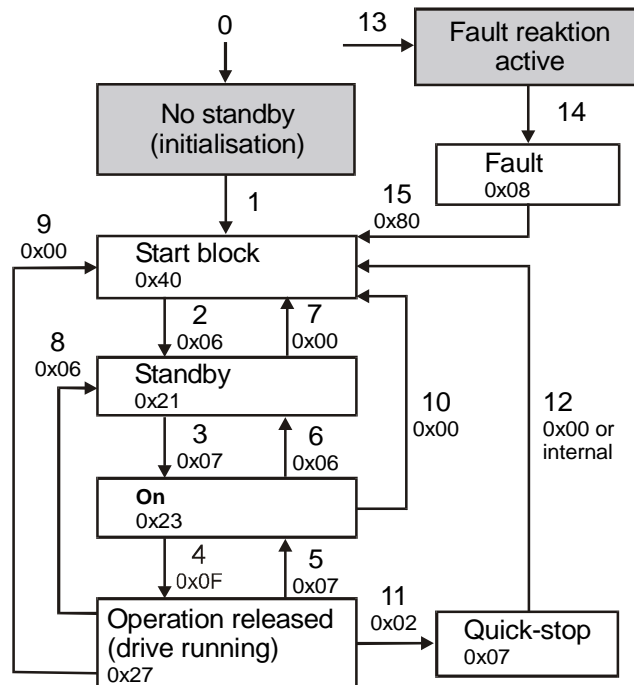
Note: We are preparing an extension of the status machine with the function "quick-stop.

The bytes for process data 1 contain the control word in accordance with the PPO Type 2. In accordance with the DRIVECOM specification the desired control command is transmitted as a bit string.
The control word is defined as follows in the bit string:

Control word	
Bit-No.	Name
0	Start
1	Voltage block
2	~~Quick stop~~ (in preparation)
3	Release operation
4	-
5	-
6	-
7	Reset fault
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

A device control command is executed in accordance with the bit combination in the control word. The executed command corresponds to a transition in the shown status machine.

| Command	Control word						Transition
	HEX	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Stop	0x06	x	x	1	1	0	2, 6, 8
Start	0x07	x	x	1	1	1	3
Block voltage	0x00	x	x	x	0	x	7, 9, 10
~~Quick stop~~	~~0x02~~	~~x~~	~~x~~	~~0~~	~~1~~	~~x~~	~~7, 10, 11~~
Block operation	0x07	x	0	1	1	1	5 or FUF = 0
Release operation	0x0F	x	1	1	1	1	4 and FUF = 1
Reset fault	0x80	0 ⇨ 1	x	x	x	x	15

To make operation of the device even easier, a further transition has been implemented in addition to the status machine defined under DRIVECOM. An additional transition from "Start block" to "Release operation" has been provided.
The shaded commands are those which are relevant for the simplified status machine. The other commands are not used there.

Note: An error message must be acknowledged by the user. This may be sent up to 15 seconds after the occurrence of the fault since the inverter has an internal delay. The command "Reset fault" is only activated after the delay for the named reason and is set on the positive flank of bit 7.

Simplified operation of the status machine:
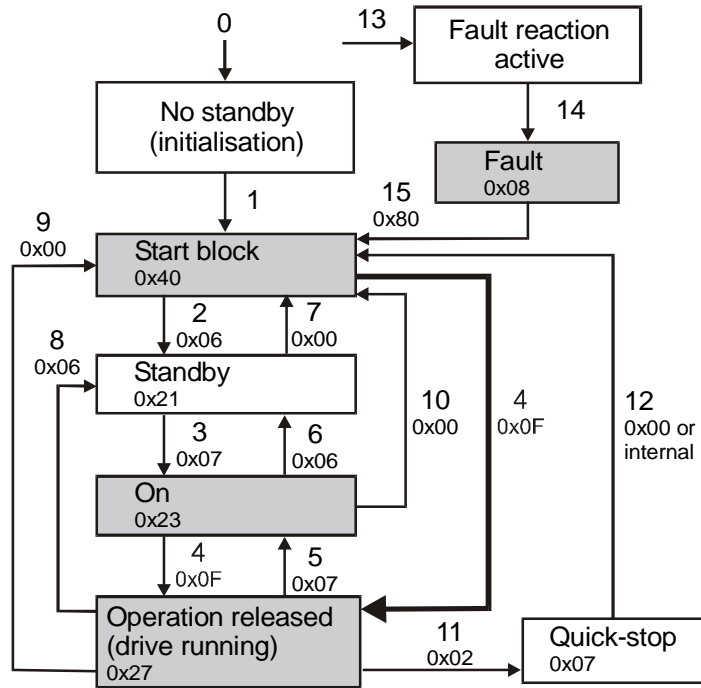
Following initialisation or after a "Reset fault" the status machine is in the "Start block" mode. A start command (= 4 = Release operation) means that the statuses "Standby" and "On" are skipped and the system immediately switches to "Operation released". You can then switch between "On" and "Operation released" with "Block operation" and "Release operation". Any fault which occurs switches the system over to the "Fault" status. The marked statuses for the simplified status machine are then visible. Transitions 1, 4, 5 and 15 exist.

The bytes for process data 1 contain the status word in accordance with the PPO Type 2. In accordance with the DRIVECOM specification the operating status of the frequency inverter is transmitted.
The status word is defined as follows in the bit string:

Status word	
Bit-No.	Name
0	Standby
1	On
2	Operation released
3	Fault
4	Voltage blocked
5	~~Quick-stop~~ (in preparation)
6	Start block
7	Alarm
8	-
9	Remote
10	Setpoint reached
11	Limit value active
12	-
13	-
14	-
15	UdRegDown

The status word reflects the operating status of the frequency inverter. This is independent of the operating mode selected with the parameter *LocalRemote-Flag* **412 (REMOT)**.

Operating status	Status word						
	HEX (*)	Bit 6	~~Bit 5~~	Bit 3	Bit 2	Bit 1	Bit 0
Not on standby	0x00	0	x	0	0	0	0
Start block	0x40	1	x	0	0	0	0
Standby	0x21	0	1	0	0	0	1
~~Quick-stop~~	~~0x07~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1~~	~~1~~
On	0x23	0	1	0	0	1	1
Operation released	0x27	0	1	0	1	1	1
Fault	0x08	0	x	1	0	0	0
Fault reaction active	0x0F	0	x	1	1	1	1

(*) ignoring bits 7 ... 15

The shaded statuses are those which are relevant for the simplified status machine.

The further bits in the status word are directly related to the hardware and software functions of the frequency inverter.

- The alarm bit "7" can be set at any time by the bus subscribers. It indicates an internal alarm from the frequency inverter. An evaluation of which alarm has been sent can be carried out by reading out the alarm status with the parameter *Alarms* **270 (WARN)**.

- The remote bit "9" is set if the remote mode is set with the parameter *LocalRemote-Flag* **412 (REMOT)** and a hardware release has been received via the digital inputs (S1IND (FUF) = 1 and S2IND (Start right) = 1). The frequency inverter can be only controlled with the status machine shown if the remote bit has been set. The sign for the rotary field is derived from the sum total of the setpoint and line setpoint.

- The setpoint reached bit "10" is set when the default setpoint is reached. In the special case of a mains failure support, the bit is also set when the mains failure support reaches the frequency 0 Hz. A hysteresis (tolerance range) which can be set with the parameter *max. control deviation* **549 (DEVMX)** applies for "Setpoint reached" (see operating instructions Part 2).

- The limit value active bit "11" indicates that an internal limit is active. This can be, for example, the current limitation, the moment limitation or the overvoltage control. All functions lead to a divergence from the setpoint or to the setpoint not being reached.

- The UdRegDown bit "15" is an application-specific implementation. This bit is set if the frequency of the Ud-controller falls below the parameter *Threshold shutdown* **675 (UDOFF)** in the mains failure mode and the drive has then been forced to run down to zero.
  (see operating instructions Part 2).

5 MONITORING AND TROUBLESHOOTING

Pre-set reactions to errors have to be automatically initiated in the event of an error situation to ensure the safest possible defined system behaviour. The system is switched to a defined status, thus excluding the possibility of any undefined interim statuses and reactions. This is defined through a configuration of the trigger monitoring during planning of the Profibus-DP – network. A triggering of the timeout facility and a restart of the DP-Slave by the DP-Master acknowledges the fault.

The DP-Master monitors data transfer to the slave at the defined interval with a Data_Control_Timer. Each slave has its own timer which permits a detailed fault report and permits the slave outputs to be switched to a safe status.

Communication from the slave is monitored in a similar manner. If data transfer to the DP-Master is disturbed during the trigger monitoring interval, the slave switches the outputs to a safe status. This operating mode corresponds to the Standby mode. Moreover, an access protection is active during operation as a Multi-Master-System. The DP-Slaves are assigned to a DP-Master in the planning phase and this assignment controls the unambiguous access. The further masters receive an image of the inputs and outputs from the DP-Slave.

Caution: The communication interface can be deactivated at any time with an E-stop via the contact input S1IND. If this contact input is opened the inverter is switched off immediately.

5.1 ERROR MESSAGES

The following error messages are displayed in the control unit KP 100 with code and text in moving script after a Profibus-DP – communication error appears.
The respective texts also appear when the fault memory is read out via the optional operating software.

Error messages		
KP 100 display		**Meaning**
Code	**Text**	**Measure / Remedy**
F2001	PROFIBUS Slave	Internal error for DP-Slave. The frequency inverter has to be restarted.
F2002	PROFIBUS Telegram error	Data transfer between DP-Master and DP-Slave has been disturbed. Check the lines and connections. The frequency inverter also has to be restarted.
F2003	PROFIBUS Master	The pre-set time interval for the trigger monitoring has been exceeded. Restart by the DP-Master is necessary.

For a description of the further error messages which can be reported from the frequency inverter, please refer to the operating instructions Part 2.

6   PARAMETER LIST PROFIBUS-DP - CONNECTION VCI-PROF

6.1   DISPLAY PARAMETERS

No.	Abbr.	Control level	Name/Meaning	Unit.	Display range	Chap.
Menu VAL (Actual values)						
281	PWERT	3	Profibus values	-	PPO Type 2	4.4
282	F-BUS	3	Nom. frequency bus	Hz	$0 ... f_{max}$	4.3.2.1
283	FRAMP	3	Nom. frequency ramp	Hz	$0 ... f_{max}$	4.3.2.1

6.2   COMMUNICATION PARAMETERS

The following parameters should be used to configure the communication card Profibus-DP – connection.

No.	Abbr.	Control level	Name/Meaning	Unit	Setting range	Chap.	Default
Communication interface							
391	PRPZD	3	Select setpoint/actual value	-	1: Speed 2: Frequency	4.3.2.1	2
412	REMOT	▦ DS1...DS4 3	LocalRemote flag	-	0: Control via contacts 1: Control via interface	4.4	1

▦ DS1...DS4 ....This parameter can be switched over for each data record

The specific parameters for the communication interface are only partly shown on the optional control unit KP100 and operating software. Full use of the parameter is only possible via the bus. The parameters *Control word* **410 (CMD)** and *Status word* **411 (STAT)** are only shown for troubleshooting depending on the parameter *LocalRemote-Flag* **412 (REMOT)**.

No.	Abbr.	Control level	Name/Meaning	Unit	Setting range	Chap.
Parameter extension						
410	CMD	-	Control word	-	-	8.2
411	STAT	3	Status word	-	-	8.2
484	FFR	-	Frequency setpoint RAM	Hz	0 ... 999.99	8.1
524	FPR	-	% setpoint RAM [*]	%	-300.00 ... +300.00	8.1
529	FPRI	-	% actual value RAM [*]	%	-300.00 ... +300.00	8.1

[*] only in configuration 111

7   DEVICE MASTER DATA FILE

Contents DMD-file   VEC_7530.gsd:
```
;
; Vectron-Elektronik GmbH
; Europark Fichtenhain A6
; 47807 Krefeld
;
; Tel.: 02151/8396-0
;
;
; DMD-file for frequency inverter model VCB 400-xxx  VEC_7530.GSD
;
; Contact person: Ulrich Aretz, Tel. 02151/8396-32
;
#Profibus_DP
Vendor_Name      =  "Vectron-Elektronik GmbH, Krefeld"
Model_Name       =  "IAM PBS01 / PROFANS"
Revision      =  "1.0"
Protocol_Ident   =  0
Station_Type     =  0
Hardware_Release   =  "PROFANS V1.0"
Software_Release   =  "PROFSPEC V1.0"
9.6_supp       =  1
19.2_supp      =  1
93.75_supp      =  1
187.5_supp      =  1
500_supp      =  1
1.5M_supp      =  1
MaxTsdr_9.6    =  60
MaxTsdr_19.2    =  60
MaxTsdr_93.75    =  60
MaxTsdr_187.5    =  60
MaxTsdr_500    =  100
MaxTsdr_1.5M    =  150
Repeater_Ctrl_Sig  =  1
;
Ident_Number     =  0x7530
Freeze_Mode_supp   =  1
Sync_Mode_supp    =  1
Auto_Baud_supp    =  1
Set_Slave_Add_supp =  0
User_Prm_Data_Len  =  0
Min_Slave_Intervall =  20
;
; there folows the description for a compact DP-device called "DP-Kompaktgerät
; WD../AD..", for PPO-Type 2 acc. to VDI/VDE 3689 Sheet 1 a special
; code format has been selected (PPO-Type 2).
Module       =  "DP-Kompaktgerät WD../AD.." 0xB7, 0xB7, 0xB3
EndModule
```