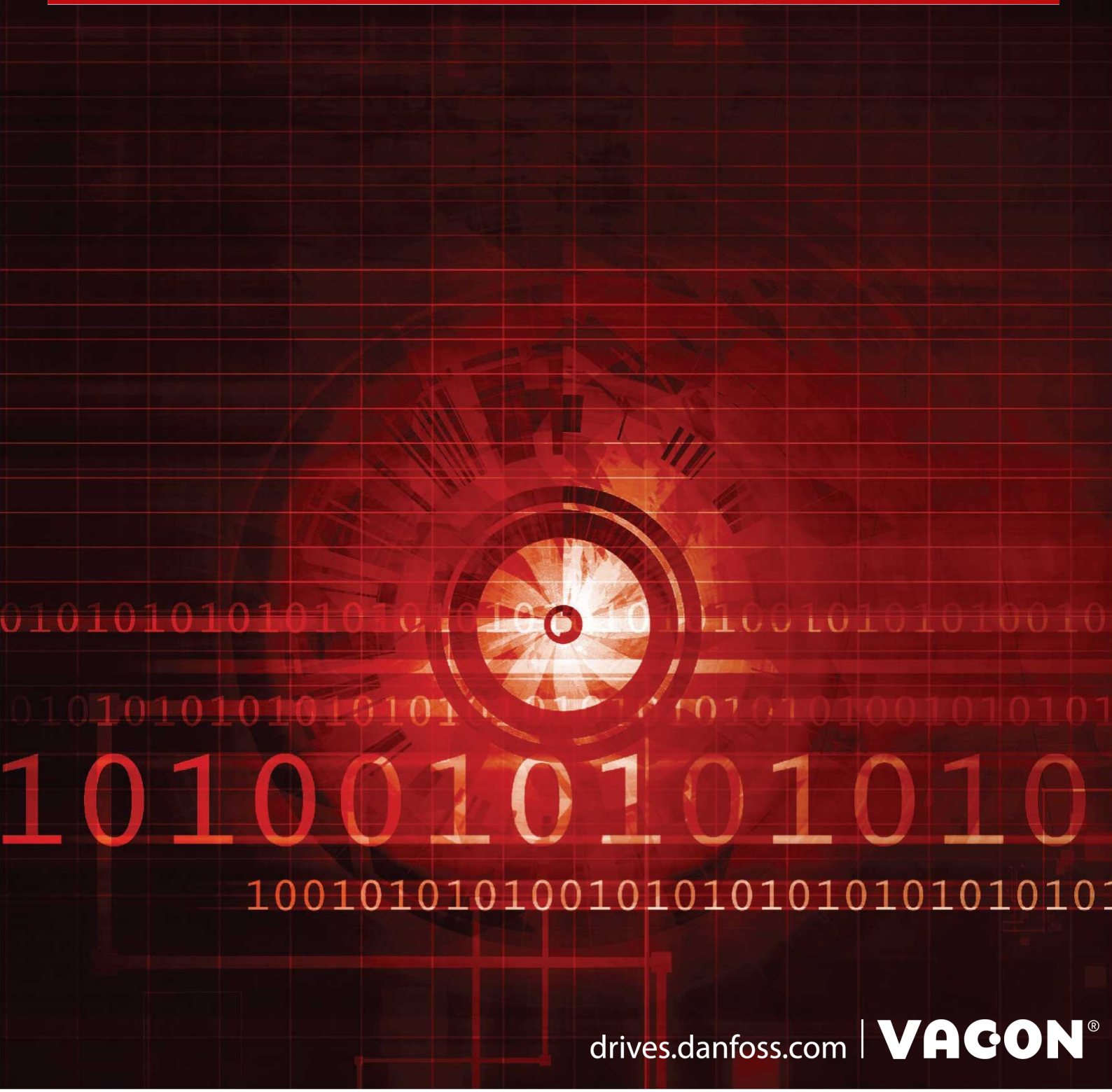
ENGINEERING TOMORROW

User Guide

VACON® OPTE3/E5 PROFIBUS DP



drives.danfoss.com | VACON®

Contents

1 Introduction

1.1 Purpose of the Manual

The PROFIBUS DP programming guide provides information about configuring the system, controlling the drive, accessing parameters, programming, troubleshooting, and some typical application examples.

The programming guide is intended for use by qualified personnel, who are familiar with the VACON® drives, PROFIBUS technology, and with the PC or PLC that is used as a master in the system.

Read the instructions before programming and follow the procedures in this manual.

1.2 Additional Resources

Resources available for the drive and optional equipment are:

- VACON® RS485 CAN bus Installation Guide provides the necessary information to install the option board to the AC drive.
- The Operating Guide of the AC drive provides the necessary information to get the drive up and running.
- The Application Guide of the AC drive provides more details on working with parameters and many application examples.
- VACON® OPTEA/OPTE9 Ethernet Board Programming Guide provides information on Ethernet settings.

Supplementary publications and manuals are available from drives.danfoss.com/knowledge-center/technical-documentation/.

For US and Canadian markets:

NOTE! Download the English and French product manuals with applicable safety, warning and caution information from https://www.danfoss.com/en/service-and-support/.
REMARQUE Vous pouvez télécharger les versions anglaise et française des manuels produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site https://www.danfoss.com/en/service-and-support/.

1.3 Manual and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this manual is English.

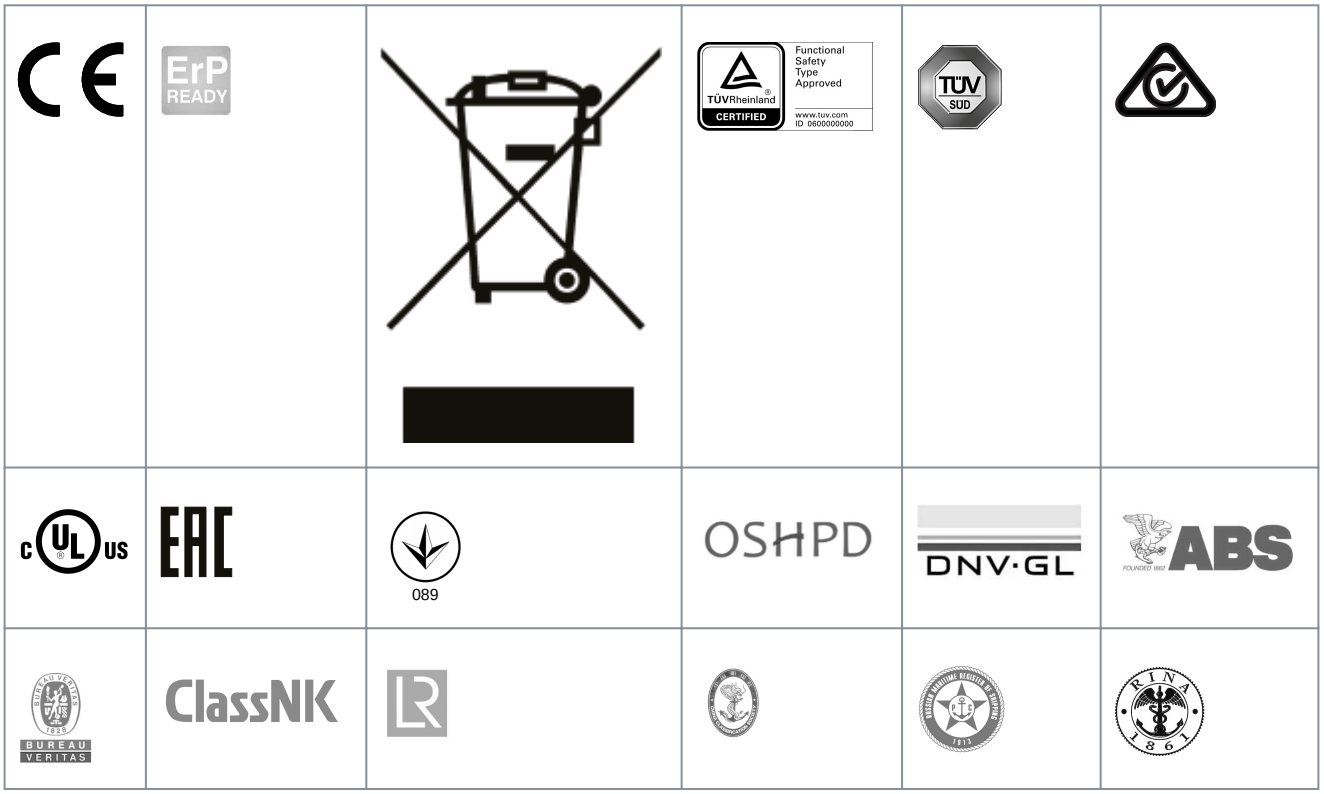
Table 1: Manual and Software Version

Manual version	New features	Firmware version
DPD00997B	Support for VACON® 100 INDUSTRIAL, VACON® 100 FLOW, VACON® 100 X, VACON® 20 X/CP, and VACON® 20 drives.	V004
DPD00997C	• Support for new B version hardware. Firmware can also be used with older A version hardware. • Improved functionality of Control-By-PLC bit. This bit does not any more force control and reference place to fieldbus. This bit is still required so that control from the fieldbus is possible.	V005
	• Support for VACON® NXP drive. • Support for PROFIsafe when OPTE3/E5 board is used together with Advanced safety option board. See details in 4.4 PROFIsafe. • Support for Fast Communication and 16 process data when installed to VACON® NXP drive. See details in 4.2 Fieldbus Option Board Communication Modes. • Support for "C3 C5 Mode" compatibility mode when OPTE3/E5 is installed to VACON® NXP drive. See details in 6.1 PROFIBUS DP Board Parameters. • Support for "NX Mode" compatibility mode when OPTE3/E5 is installed to VACON® 100 family and VACON® 20 drives. See details in 6.1 PROFIBUS DP Board Parameters.	V006

Manual version	New features	Firmware version
DPD00997D	• Support for PPO_PROFIdrive mode which enables usage of PROFIdrive 4.1 together with PPO types. See details in 6.1 PROFIBUS DP Board Parameters. • Support for drive fault history with time stamps. See details in 5.1.5 Supported Parameters. • Support for Drive CW and Drive SW monitor values. See details in 7.1 PROFIBUS DP Board Monitoring Values.	V007
DPD00997E	• PROFIsafe over PROFIBUS for VACON® NXP extended for advanced safety option boards OPTBL, OPTBM and OPTBN in slots C and E in addition to slot D. • Maintance improvements and fixes. • Configuration file updated. • The structure of the manual updated. Installation information removed (see VACON® RS485 CAN bus Installation Guide).	V008
	• Telegram 140 • PNU 10129	V009

1.4 Type Approvals and Certifications

The following list is a selection of possible type approvals and certifications for Danfoss drives:



NOTICE

The specific approvals and certification for the drive are on the nameplate of the drive. For more information, contact the local Danfoss office or partner.

1.5 Product Overview

1.5.1 PROFIBUS

PROFIBUS is an international standard for fieldbus communication in automation technology (IEC 61158 and IEC 61784). The member companies of the PROFIBUS International User Community support the standard.

For information about PROFIBUS and downloads for PROFIBUS DP and the PROFIdrive profile, refer to www.profibus.com.

1.5.2 PROFIBUS DP

The PROFIBUS DP protocol enables communication between PROFIBUS masters and slaves.

The master devices control the communication. The master can send data without a separate command when a token is given to the Master. The slave devices are peripheral devices. Typical slave devices include input/output devices, valves, drives, and measuring transmitters. They do not have bus access rights and they can only acknowledge received messages or send messages to the master when requested to do so.

VACON® AC drives can be connected to the PROFIBUS DP network using a fieldbus board. The drive can then be controlled, monitored, and programmed from the Host system.

OPTE5/E3 option board also supports connection from DP Master (class 2) when DP-V1 is enabled. In this case, the master class 2 can initiate a connection, read and write parameters using the PROFIdrive Parameter Access service, and close the connection.

1.5.3 Features of PROFIBUS DP–VACON® Interface

Features of the PROFIBUS DP–VACON® interface:

- Direct control of VACON® AC drives (for example, Run, Stop, Direction, Speed reference, Fault reset)
- Full access to all VACON® AC drive parameters
- Monitor VACON® AC drive status (for example, output frequency, output current, fault code)

1.5.4 Technical Data

Table 2: PROFIBUS DP Option Board Technical Data

Technical item or function		Technical data
Connections	Interface	OPTE3: Pluggable connector (5.08 mm) OPTE5: 9-pin D-SUB connector (female)
	Data transfer method	RS485, half duplex
	Transfer cable	Shielded Twisted Pair
	Electrical isolation	500 V DC
Communications	Drive profile	PROFIdrive
	Standard Telegrams	1, 20
	Vendor Telegrams	100, 101, 138, 139
	Standard (Safety) Telegrams	30, 31(1)
	Vendor (Safety) Telegrams	58000(1)
	PPO types	1, 2, 3, 4, 5, 6
	Baud rate	9.6 kBd to 12 MBd. Autobaud detect is always on.
	Addresses	2–126
Environment	Ambient operating temperature	-10°C…50°C (For further information, see the installation manual of the AC drive)
	Storing temperature	-40°C…60°C
	Humidity	<95%, no condensation, or frost allowed, non-corrosive

Technical item or function		Technical data
	Altitude	Maximum 1000 m
	Vibration	0.5 G at 9…200 Hz
Safety	Fulfills EN 50178 standard	

[1] Select only when Advanced safety option board with PROFIsafe is connected.

1.5.5 VACON® PC Tools

With VACON® PC tools, it is possible to do following operations for OPTE3/E5 PROFIBUS DP:

- Update firmware into OPTE3/E5 PROFIBUS DP option board (with VACON® Loader), see 3.2.1 Updating Fieldbus Firmware with VACON® Loader
- Set parameters for OPTE3/E5 PROFIBUS DP (with VACON® NCDrive or VACON® Live), see 3.2.3.1 Setting Drive and PROFIBUS DP Parameters with VACON® NCDrive and 3.2.3.2 Setting Drive and PROFIBUS DP Parameters with VACON® Live
- Read monitor values of OPTE3/E5 PROFIBUS DP (with VACON® NCDrive or VACON® Live)

For instructions on downloading and installing the tools, see 3.1.1 Installing VACON® PC Tools.
The following table describes what PC tools are supported in each AC drive type.

Table 3: The Supported PC Tools with Different AC Drives

Tool	VACON® 100 family	VACON® NXS/NXP	VACON® 20 family
VACON® Loader	Serial(1)	Serial(1)	Serial(1)
VACON® Live	Serial(1), Ethernet(2)		Serial(1)
VACON® NCIPConfig	Not used with OPTE3/E5 PROFIBUS DP		
VACON® NCDrive		Serial(1), Ethernet(2)	
VACON® NCLoad	Not used with OPTE3/E5 PROFIBUS DP		

[1] The connection type "serial" is a direct serial connection to the AC drive.

[2] The connection type "Ethernet" is an Ethernet connection, for example, VACON® 100 family built-in Ethernet interface, or a connection via OPTEA/OPTE9 Dual Port Ethernet option board.

1.6 Symbols and Abbreviations

Table 4: Symbols and Abbreviations

Abbreviation	Definition
CW	Control word
DP	Distributed periphery
DU	Data unit
EEPROM	Electrical erasable programmable read-only memory
EMC	Electromagnetic compatibility
FB	Fieldbus
FDT	Field device tool
GSD	Generic Station Description
HMI	Human machine interface

Abbreviation	Definition
IND	Sub index
LED	Light emitting diode
PC	Personal computer
PDI	Process Data In
PDO	Process Data Out
PLC	Programmable logic controller
PNU	Parameter number
PPO	Process parameter object
SW	Status word

2 Safety

2.1 Safety Symbols

The following symbols are used in this manual:

⚠ D A N G E R ⚠

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ W A R N I N G ⚠

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ C A U T I O N ⚠

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

N O T I C E

Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

2.2 Danger and Warnings

⚠ D A N G E R ⚠

SHOCK HAZARD FROM POWER UNIT COMPONENTS

The power unit components are live when the drive is connected to mains. A contact with this voltage can lead to death or serious injury.

- Do not touch the components of the power unit when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

⚠ D A N G E R ⚠

SHOCK HAZARD FROM TERMINALS

The motor terminals U, V, W, the brake resistor terminals, or the DC terminals are live when the drive is connected to mains, also when the motor does not operate. A contact with this voltage can lead to death or serious injury.

- Do not touch the motor terminals U, V, W, the brake resistor terminals, or the DC terminals when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

⚠ D A N G E R ⚠

SHOCK HAZARD FROM DC LINK OR EXTERNAL SOURCE

The terminal connections and the components of the drive can be live 5 minutes after the drive is disconnected from the mains and the motor has stopped. Also the load side of the drive can generate voltage. A contact with this voltage can lead to death or serious injury.

- Before doing electrical work on the drive:
  Disconnect the drive from the mains and make sure that the motor has stopped.
  Lock out and tag out the power source to the drive.
  Make sure that no external source generates unintended voltage during work.
  Wait 5 minutes before opening the cabinet door or the cover of the AC drive.
  Use a measuring device to make sure that there is no voltage.

⚠ WARNING ⚠

SHOCK HAZARD FROM CONTROL TERMINALS

The control terminals can have a dangerous voltage also when the drive is disconnected from mains. A contact with this voltage can lead to injury.

- Make sure that there is no voltage in the control terminals before touching the control terminals.

⚠ WARNING ⚠

ACCIDENTAL MOTOR START

When there is a power-up, a power break, or a fault reset, the motor starts immediately if the start signal is active, unless the pulse control for Start/Stop logic is selected. If the parameters, the applications or the software change, the I/O functions (including the start inputs) can change. If you activate the auto reset function, the motor starts automatically after an automatic fault reset. See the Application Guide. Failure to ensure that the motor, system, and any attached equipment are ready for start can result in personal injury or equipment damage.

- Disconnect the motor from the drive if an accidental start can be dangerous. Make sure that the equipment is safe to operate under any condition.

⚠ WARNING ⚠

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the drive properly can result in death or serious injury.

- Ensure the correct grounding of the equipment by a certified electrical installer.

⚠ WARNING ⚠

SHOCK HAZARD FROM PE CONDUCTOR

The drive can cause a DC current in the PE conductor. Failure to use a residual current-operated protective (RCD) device Type B or a residual current-operated monitoring (RCM) device can lead to the RCD not providing the intended protection and therefore can result in death or serious injury.

- Use a type B RCD or RCM device on the mains side of the drive.

2.3 Cautions and Notices

⚠ CAUTION ⚠

DAMAGE TO THE AC DRIVE FROM INCORRECT MEASUREMENTS

Doing measurements on the AC drive when it is connected to mains can damage the drive.

- Do not do measurements when the AC drive is connected to mains.

⚠ CAUTION ⚠

DAMAGE TO THE AC DRIVE FROM INCORRECT SPARE PARTS

Using spare parts that are not from the manufacturer can damage the drive.

- Do not use spare parts that are not from the manufacturer.

⚠ CAUTION ⚠

DAMAGE TO THE AC DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

- Make sure that the AC drive is always grounded with a grounding conductor that is connected to the grounding terminal that is identified with the PE symbol.

⚠ C A U T I O N ⚠

CUT HAZARD FROM SHARP EDGES

There can be sharp edges in the AC drive that can cause cuts.

- Wear protective gloves when mounting, cabling, or doing maintenance operations.

⚠ C A U T I O N ⚠

BURN HAZARD FROM HOT SURFACES

Touching surfaces, which are marked with the 'hot surface' sticker, can result in injury.

- Do not touch surfaces which are marked with the 'hot surface' sticker.

N O T I C E

DAMAGE TO THE AC DRIVE FROM STATIC VOLTAGE

Some of the electronic components inside the AC drive are sensitive to ESD. Static voltage can damage the components.

- Remember to use ESD protection always when working with electronic components of the AC drive. Do not touch the components on the circuit boards without proper ESD protection.

N O T I C E

DAMAGE TO THE AC DRIVE FROM MOVEMENT

Movement after installation can damage the drive.

- Do not move the AC drive during operation. Use a fixed installation to prevent damage to the drive.

N O T I C E

DAMAGE TO THE AC DRIVE FROM INCORRECT EMC LEVEL

The EMC level requirements for the AC drive depend on the installation environment. An incorrect EMC level can damage the drive.

- Before connecting the AC drive to the mains, make sure that the EMC level of the AC drive is correct for the mains.

N O T I C E

RADIO INTERFERENCE

In a residential environment, this product can cause radio interference.

- Take supplementary mitigation measures.

N O T I C E

MAINS DISCONNECTION DEVICE

If the AC drive is used as a part of a machine, the machine manufacturer must supply a mains disconnection device (refer to EN 60204-1).

N O T I C E

MALFUNCTION OF FAULT CURRENT PROTECTIVE SWITCHES

Because there are high capacitive currents in the AC drive, it is possible that the fault current protective switches do not operate correctly.

N O T I C E

VOLTAGE WITHSTAND TESTS

Doing voltage withstand tests can damage the drive.

- Do not do voltage withstand tests on the AC drive. The manufacturer has already done the tests.

2.4 Grounding

Ground the AC drive in accordance with applicable standards and directives.

⚠ C A U T I O N ⚠

DAMAGE TO THE AC DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

- Make sure that the AC drive is always grounded with a grounding conductor that is connected to the grounding terminal that is identified with the PE symbol.

⚠ W A R N I N G ⚠

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the drive properly can result in death or serious injury.

- Ensure the correct grounding of the equipment by a certified electrical installer.

The standard EN 61800-5-1 tells that 1 or more of these conditions for the protective circuit must be true.

The connection must be fixed.

- The protective earthing conductor must have a cross-sectional area of minimum 10 mm^2 Cu or 16 mm^2 Al. OR
- There must be an automatic disconnection of the mains, if the protective earthing conductor breaks. OR
- There must be a terminal for a second protective earthing conductor in the same cross-sectional area as the first protective earthing conductor.

Cross-sectional area of the phase conductors (S) [mm^2]	The minimum cross-sectional area of the protective earthing conductor in question [mm^2]
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S$	S/2

The values of the table are valid only if the protective earthing conductor is made of the same metal as the phase conductors. If this is not so, the cross-sectional area of the protective earthing conductor must be determined in a manner that produces a conductance equivalent to that which results from the application of this table.

The cross-sectional area of each protective earthing conductor that is not a part of the mains cable or the cable enclosure, must be a minimum of:

- 2.5 mm^2 if there is mechanical protection, and
- 4 mm^2 if there is not mechanical protection. With cord-connected equipment, make sure that the protective earthing conductor in the cord is the last conductor to be interrupted, if the strain-relief mechanism breaks.

Obey the local regulations on the minimum size of the protective earthing conductor.

N O T I C E

MALFUNCTION OF FAULT CURRENT PROTECTIVE SWITCHES

Because there are high capacitive currents in the AC drive, it is possible that the fault current protective switches do not operate correctly.

N O T I C E

VOLTAGE WITHSTAND TESTS

Doing voltage withstand tests can damage the drive.

- Do not do voltage withstand tests on the AC drive. The manufacturer has already done the tests.

⚠ W A R N I N G ⚠

SHOCK HAZARD FROM PE CONDUCTOR

The drive can cause a DC current in the PE conductor. Failure to use a residual current-operated protective (RCD) device Type B or a residual current-operated monitoring (RCM) device can lead to the RCD not providing the intended protection and therefore can result in death or serious injury.

- Use a type B RCD or RCM device on the mains side of the drive.

3 Commissioning

3.1 Before Commissioning

VACON® OPTE3/E5 PROFIBUS DP can be commissioned through the control panel of the AC drive or by using the VACON® PC tools.

Before starting the commissioning, check the following:

- When using the control panel of the AC drive for commissioning: for instructions on how to use the control panel, see the Operating Guide for VACON® NXP products or the Application Guide for the VACON® 100 family.
- When using VACON® PC tool for commissioning: the correct tool installed.
  - For a list of supported PC tools, see 1.5.5 VACON® PC Tools.
  - For instructions on installing the tools, see 3.1.1 Installing VACON® PC Tools.
- VACON® AC drive in which OPTE3/E5 PROFIBUS DP option board installed. See VACON® RS485 CAN bus Installation Guide for instructions.
- When using serial connection:
  - VACON® NXP is connected to PC with RS232 serial cable. The cable is connected from PC to the 9-pin D-SUB connector (female) of the VACON® NXP control unit. If PC does not contain RS232 serial port, then USB - RS232 converter device is needed between PC and VACON® NXP control unit.
  - VACON® 100 family and VACON® 20 are connected to PC with VACON® Serial Cable.
- When using Ethernet connection:
  - Ethernet cable which is connected to the Ethernet interface of the option board, or, in VACON® 100 family drives, of the control board.
  - VACON® NXP requires option board supporting Ethernet communication. For example, OPTEA/OPTE9 Dual Port Ethernet option board.

3.1.1 Installing VACON® PC Tools

Prepare for commissioning by installing the needed VACON® PC Tools.

Procedure

1. Go to www.danfoss.com/.
2. Select *Downloads* from *Service and Support* drop-down menu.
3. Select Drives as business unit.
4. Download the VACON® PC tool depending on the used AC drive.

   - VACON® 100 family AC drive: VACON® Loader and VACON® Live
   - VACON® 20 AC drive: VACON® Loader and VACON® Live
   - VACON® NXP AC drive: VACON® NCDrive and VACON® Loader
5. Start the installation program and follow the on-screen instructions.
6. After installation, launch VACON® PC tool from Windows Start menu.
7. For more information about software features, go to *Help* drop-down menu and select *Contents*.

3.1.2 Downloading Fieldbus Option Firmware

Prepare for commissioning by downloading the Fieldbus Option Firmware.

Procedure

1. Go to www.danfoss.com/.
2. Select Downloads from Service and Support drop-down menu.
3. Select Drives as business unit.
4. Download file Fieldbus firmware.

3.2 Commissioning with VACON® PC Tools

3.2.1 Updating Fieldbus Firmware with VACON® Loader

Use these instructions to upload the fieldbus firmware with VACON® Loader.

NOTE! Screenshots in these instructions are examples only. The product information shown in them is different depending on which option board is used.

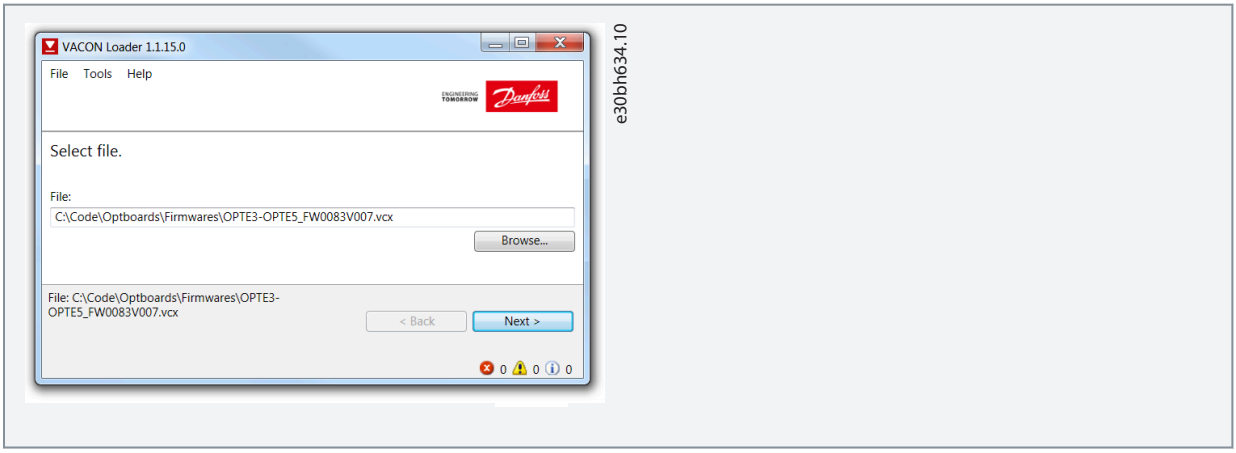
Check the list in Before commissioning.

Adjust the baud rate if needed:

- With VACON® 20, use the baud rate 9600.
- With VACON® 20 X and VACON® 20 CP, the following baud rates are supported: 9600, 19200, 38400 or 57600.
- With VACON® 100 family and VACON® NXP drives, VACON® Loader selects a correct baud rate automatically.

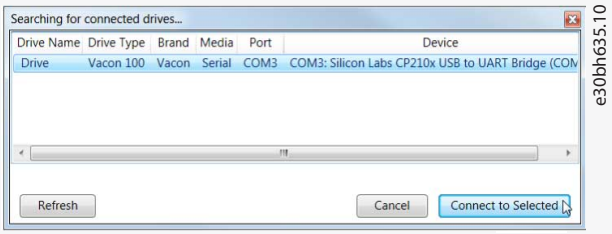
Procedure

1. Connect your PC to the controller by using the serial cable.
2. Open the **File Explorer** and select the firmware file to be updated to the option board and double-click it.



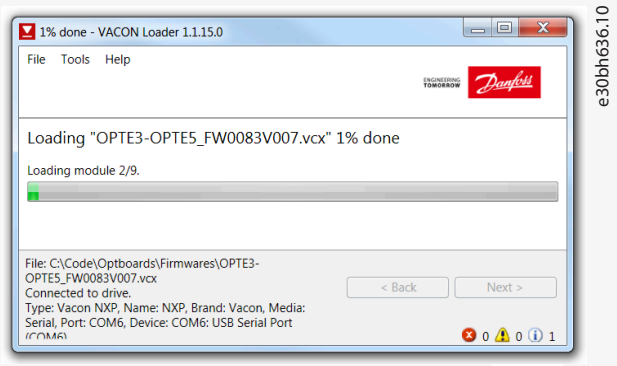
VACON® Loader software opens.

3. Press *Next* and wait for the loader to find the network drives.
4. Select a drive from the list and press *Connect to Selected*.

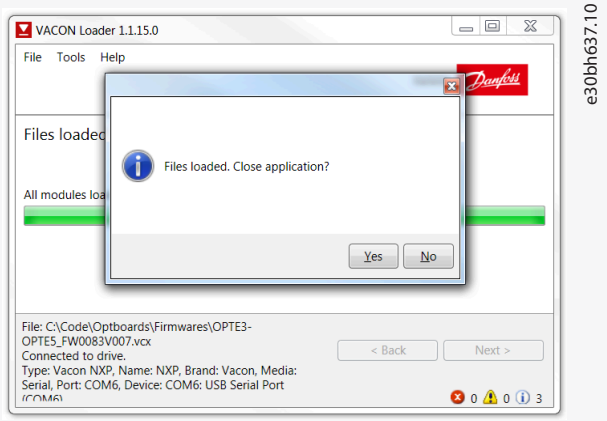


5. Select the modules to be updated, and press *Next*.

Firmware starts to load:



Loading is finished:



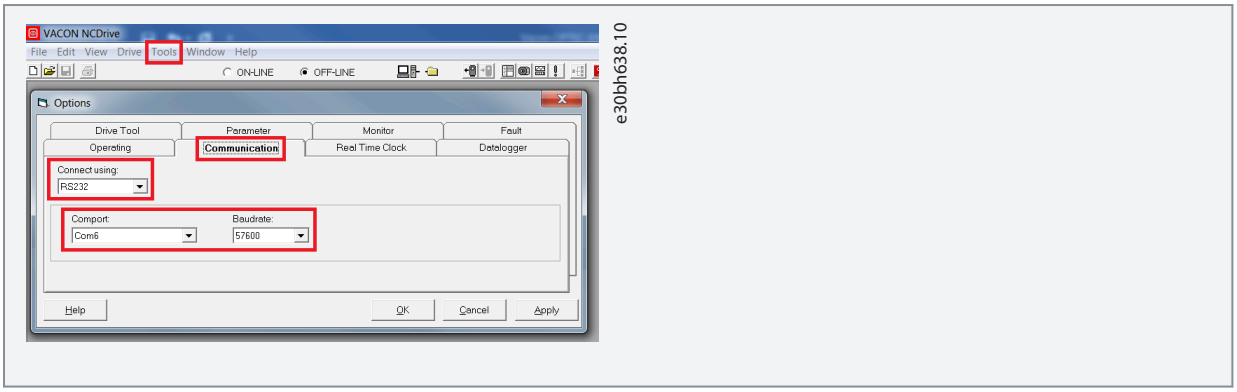
3.2.2 Adjusting Communication Settings

3.2.2.1 Adjusting Serial Communication Settings in VACON® NCDrive

Use these instructions to adjust the serial communication settings in VACON® NCDrive.

Procedure

1. Connect your PC to the control unit by using the USB/RS232 cable.
2. Select *Tools*.
3. Select *Options*….
4. Select *Communication* tab.
5. Define settings for the USB - RS232 adapter and press *OK*.



3.2.2.2 Adjusting Serial Communication Settings in VACON® Live

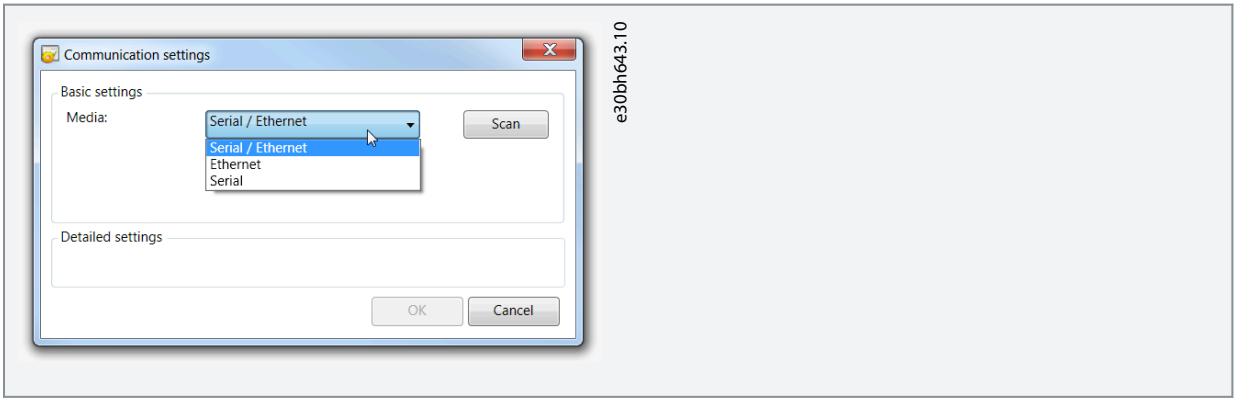
Use these instructions to adjust the serial communication settings in VACON® Live.

Procedure

1. Connect the PC to VACON® AC drive with VACON® Serial Cable.
2. Start VACON® Live.
3. When the program starts, select *Online* for start-up mode.

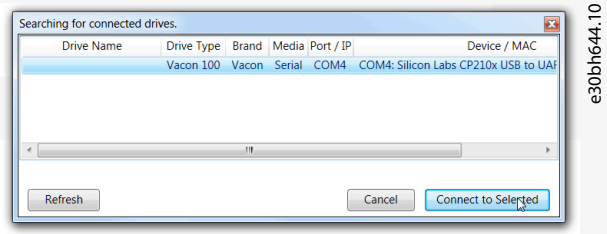
The program scans compatible drives. After successful scanning, VACON® Live shows the drive in connected drives window.

4. If VACON® Live cannot find your AC drive, ensure that *Serial / Ethernet* or *Serial* is selected.



5. Press *Scan*.
6. Select the drive and press *Connected to Selected*.

VACON® Live reads parameter and monitor value tree from the drive.



3.2.3 Setting Drive and PROFIBUS DP Parameters

3.2.3.1 Setting Drive and PROFIBUS DP Parameters with VACON® NCDrive

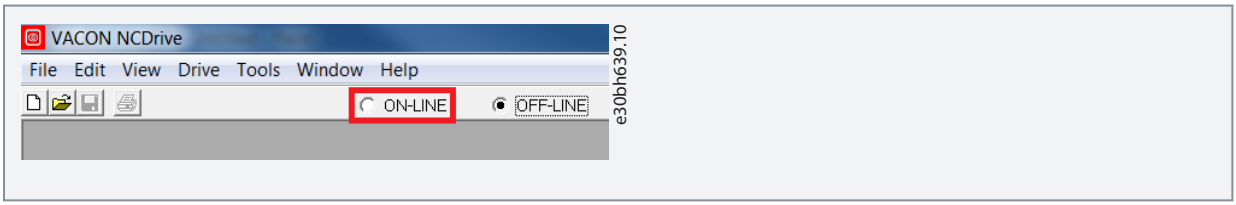
Use these instructions to set the Drive and PROFIBUS DP Parameters with VACON® NCDrive.

Make sure that the communications have been adjusted. More information:

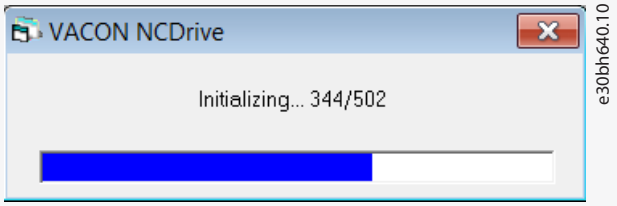
- Serial communication:
  - VACON® NCDrive, see 3.2.2.1 Adjusting Serial Communication Settings in VACON® NCDrive
- When using Ethernet communication, see VACON OPTEA/OPTE9 Programming Guide for instructions.

Procedure

1. Press the *ON-LINE* button.

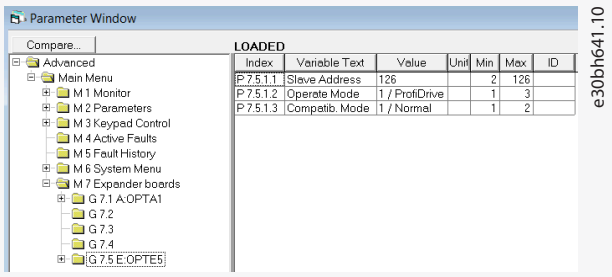


The NCDrive connects to the drive and starts loading parameter information.



2. To change the option board settings, navigate to the *M7 Expander boards* menu, and select the slot to which OPTE3/E5 PROFIBUS DP is connected.

It is possible to change parameters defined in 6.1 PROFIBUS DP Board Parameters. Add at least the PROFIBUS slave address.



3.2.3.2 Setting Drive and PROFIBUS DP Parameters with VACON® Live

Use these instructions to find the Drive and PROFIBUS DP Parameters with VACON® Live.

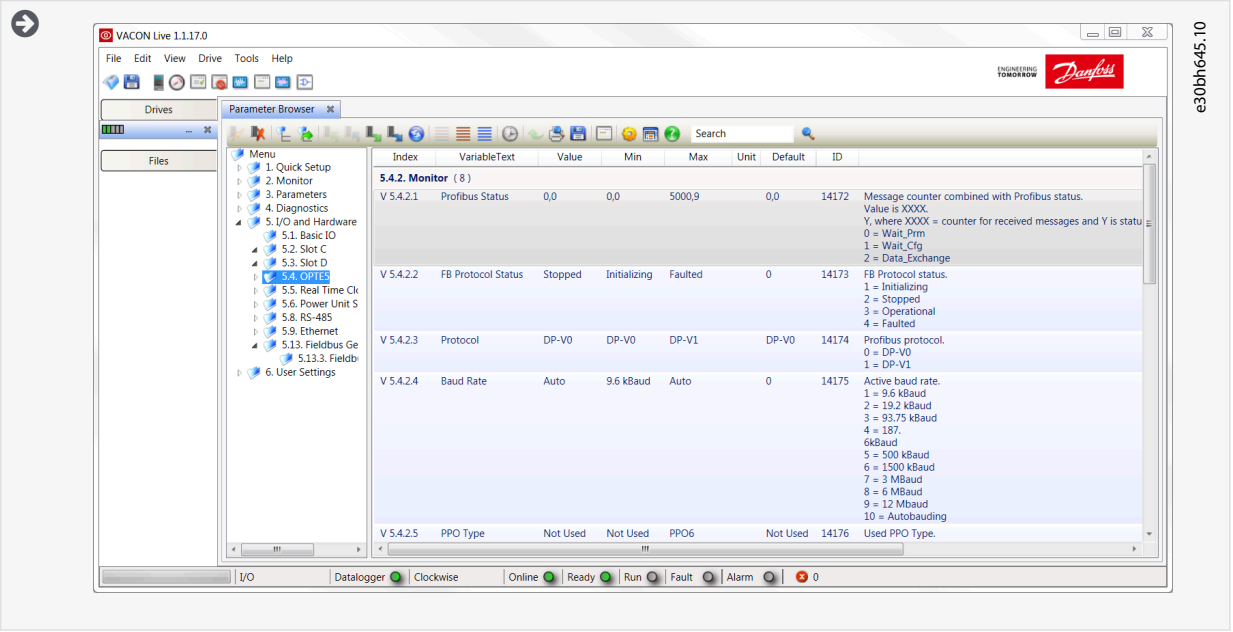
With VACON® Live, it is possible to modify OPTE3/E5 PROFIBUS DP parameters and view monitor values.

Make sure that the communications have been adjusted. More information:

- Serial communication:
  - VACON® Live, see 3.2.2.2 Adjusting Serial Communication Settings in VACON® Live
- When using Ethernet communication, see VACON OPTEA/OPTE9 Programming Guide for instructions.

Procedure

1. Open VACON® Live.
2. Navigate to *5. I/O and Hardware* menu. Add at least the PROFIBUS slave address.



3.3 Replacing VACON® NXS or NXL AC Drive with VACON® 100 Family AC Drive

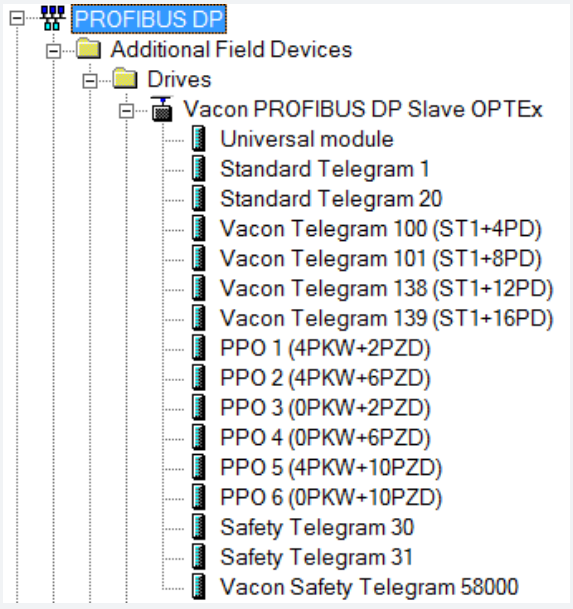
Make these adjustments when replacing VACON® NXS or VACON® NXL AC Drive with VACON® 100 Family AC Drive.

With VACON® 100 Family AC drive and OPTE3/E5, the baud rate is always automatically selected.

Procedure

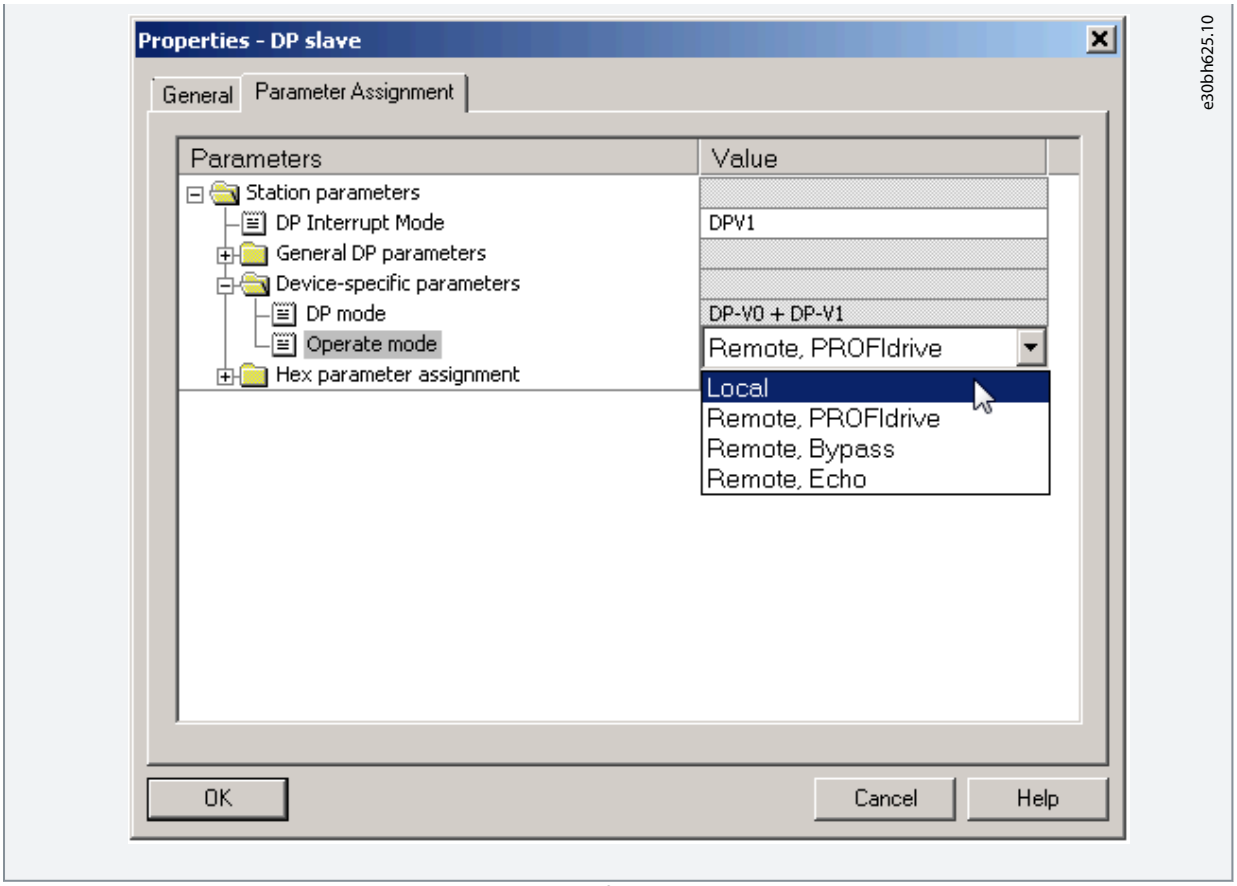
1. Take the newer GSD file into use in the PLC.
   a. Download the GSD files from http://drives.danfoss.com.
   b. If the Mode parameter is set to NX mode or C3/C5 mode (see 6.1 PROFIBUS DP Board Parameters), use the GSD file for OPTC3/C5. This option can be used to support old installations.

By default, the OPTE3/E5 uses a different GSD file containing more modules than OPTC3/C5. The PPO types supported in OPTC3/C5 (1–5) are still supported and are compatible with OPTE3/E5.



2. To select operate mode with panel parameter, use **Local**.

In OPTC3/C5, the PPO type and operate mode are selected using panel parameters. In OPTE3/E5, when Local is not selected, it is possible to do it with the PLC. See 6.1.2 Operate Mode for more information.



3. If needed, remove FBDIN bits used in PROFIdrive 2.0. VACON® 100 family AC drives do not support them.

4 Control Interface and Communication

4.1 PROFIBUS DP Communication Overview

The data transfer between the PROFIBUS DP master and the slave takes place via the input/output data field. The Master writes to the output data of the Slave and the Slave answers by sending the contents of its input data to the Master. The contents of the input/output data is defined in the device profile. The device profile for AC drives is PROFIdrive.

When fieldbus has been selected as the active control place on the AC drive, the operation of the AC drive can be controlled from the PROFIBUS DP Master. Regardless if the active control place is fieldbus, the AC drive can be monitored and its parameters set by the PROFIBUS DP Master.

The communication between the PROFIBUS DP board and the AC drive can be split into two types:

- Process Data
  - Process Data In (PDI): For controlling AC drive, maximum of 18 words
  - Process Data Out (PDO): Is used for fast monitoring of the AC drive, maximum of 18 words
- Service Data: Used for Write/Read parameters and variables. Available only when the device is configured to use PPO1, PPO2, or PPO5. In this case, PROFIdrive 2.0 is used by the default. PROFIdrive 4.1 can be used together with PPO types by enabling "PPO_PROFIdrive Mode" setting. See details in chapter 5.1 PROFIBUS DP board parameters.

NOTE! If Standard Telegrams are used in data exchange, Service Data is communicated using the acyclic data exchange as specified in DP-V1 and the PROFIdrive 4.1 specification.

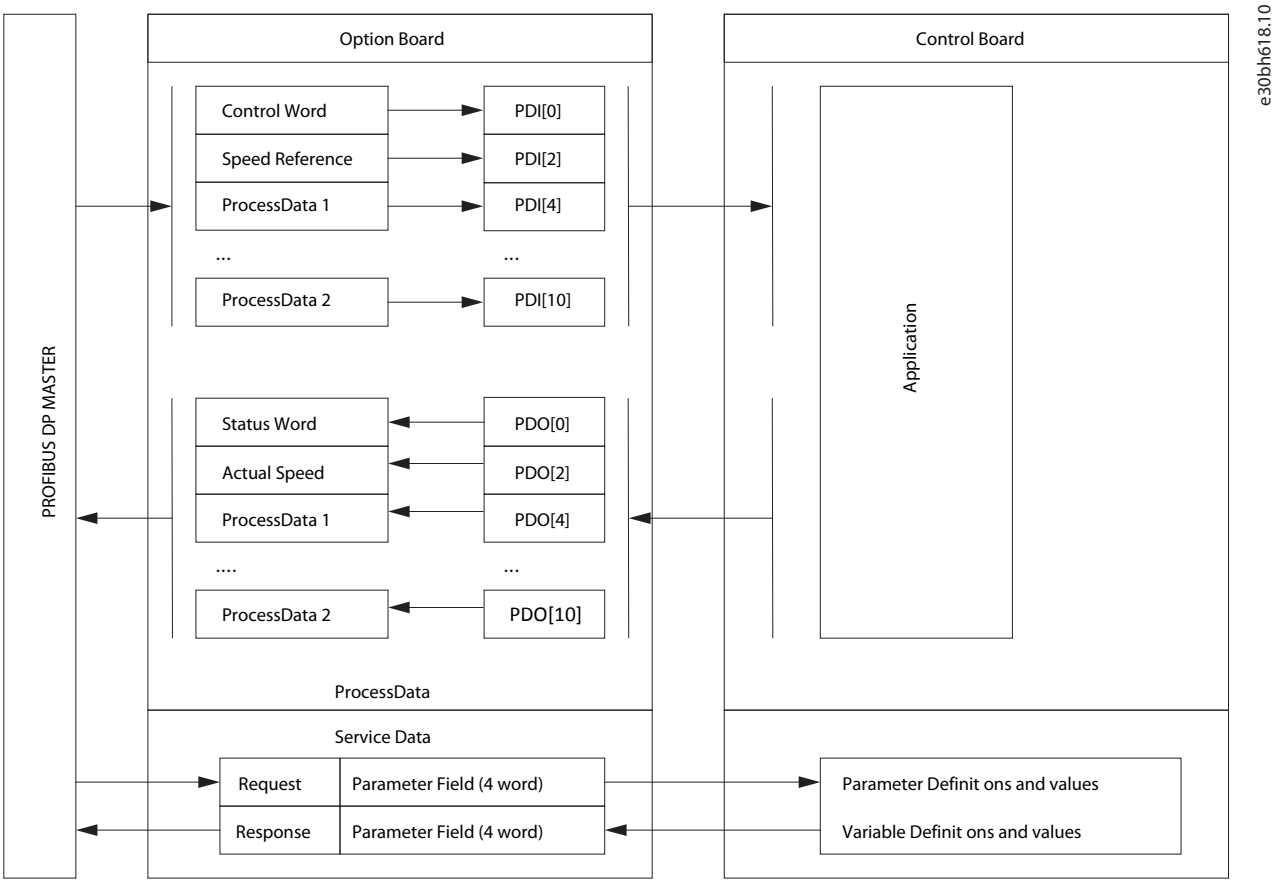


Illustration 1: Data Transfer between PROFIBUS DP Master and VACON® AC drive

4.1.1 Determining the PROFIBUS DP Cycle Time

The PROFIBUS DP cycle time must be determined, for example, when using PROFIsafe over PROFIBUS DP, as it must be considered for the safety watchdog time.

The PROFIBUS DP master calculates the cycle time based on these variables:

- Number of slaves
- Transmission rate
- Data volume (input and output data)

Use the PLC program to check the value.
Instructions use this setup:

- PLC with 4 VACON® AC drives
- configured with 16 bytes of Process Data
- on a transmission rate of 1.5 Mbps.

NOTE! These examples do not include the effect of acyclic data exchange, alarms, or retransmissions.

Using Siemens TIA Portal V13

1. Open *Network view*.
2. Select the *PROFIBUS* network.
3. Select *General*.
4. Select *PROFIBUS*.
5. Select *Bus parameters*.
6. Select *Ttr typical*.

The following value is shown: 3.3 ms.

Using Beckhoff TwinCAT System Manager V2

1. Open *I/O - Configuration*.
2. Select *PROFIBUS master*.
3. Select *EL6731* (in this example).
4. Select *Estimated DPCycle*.

The following value is shown: 3.1 ms.

4.2 Fieldbus Option Board Communication Modes

The VACON® fieldbus option boards support the following fieldbus board communication modes:

- Normal mode, for most commonly used setups (see 4.2.3 Normal Fieldbus Communication)
- Normal extended mode, for setups that requires 16 process data items
- Fast mode, with low latency process data (see 4.2.4 Fast Fieldbus Communication)
- Fast safety mode with safety "black channel" (see 4.2.5 Fast Safety Fieldbus Communication)
- Fast PROFIBUS mode. Use other modes with new installations.

NOTE! Not all boards support all modes. For details, see 4.2.1 Requirements for Communication Modes.
The fast communication modes can be enabled to get minimum communication delay between the fieldbus and application.

4.2.1 Requirements for Communication Modes

Table 5: Requirements for Different Fieldbus Communication Modes for VACON® NXP

Software or hardware	Fast/Normal Extended	Fast safe
Control Board	NXP (serial number 761 or later)	NXP (serial number 761 or later)
System Software	NXP00002V196.vcn	NXP00002V196.vcn
Applications(1)	Multipurpose V236 or later (Normal Extended Mode)	Any(2)
Fieldbus option firmware version	OPTE3/E5 V006 or later	OPTE3-E5_FW0083V006.vcx or later
	OPTE9 V007 or later	-
	OPTEA V001 or later	OPTEA V001 or later(3)

Software or hardware	Fast/Normal Extended	Fast safe
	OPTEC V003 or later	-
	OPTE6 V010 or later	-
	OPTE7 V006 or later	-
Advanced safety option	-	OPTBL_FW0227V001 or later

[1] For latest information about application support for fieldbus communication modes, refer to application-specific manuals.

[2] If safety option is configured to use a safety fieldbus, the fast safe mode is automatically enabled regardless of used application. However, the availability of 16 process items is limited by the application in use. Also the process data application cycle is normally set to 10 ms, instead of 1 ms for fast application.

[3] Only with Advanced Safety Option

Table 6: Requirements for Normal Extended Communication Mode for VACON® 100 Family

Software	Normal Extended
System Software	• INDUSTRIAL FW0072V030 • FLOW FW0159V022
Fieldbus option firmware version	OPTE9: V010
	OPTEA: V003
	OPTE7: V006
	OPTE3/OPTE5: V008

4.2.2 Fieldbus Communication Mode Features and Limitations

Fast mode

- 1 ms process data interval
- Available in VACON® NXP slots D and E
  - Possible to run both slots simultaneously
  - Have similar process data latency in both slots
- Service data latency is also reduced
  - Running multiple service data queries at high interval can cause high CPU load in VACON® NXP AC drive.

Fast safe mode

- 1 ms process data interval
- Includes safety "black channel"
- Activated/deactivated automatically, not available for setting
- Safety fieldbus must be activated in safety configuration
  - Advanced safety option board must be installed into slot D
  - Safety fieldbus must be activated in safety configuration

16 process data items

- 16 process data items always require support from application
- Available in Fast, Fast safe, and Normal extended mode
- If no support is available in the application, the process data out is always '0', while incoming process data items 9–16 are discarded

4.2.3 Normal Fieldbus Communication

The normal fieldbus communication between option board and the AC drive application is shown in Illustration 2. In normal communication, both process data, and service data are transferred in succession at 5 ms interval.

Communication delay for process data can be calculated by summing all delays together:

$$t = t_{\text{IO data cycle}} + t_{\text{update interval}} + 2 \cdot t_{\text{communication delay}} + t_{\text{application cycle}}$$

Example: With fieldbus cycle time of 4 ms and application cycle of 10 ms, the delay is:

$$t = 4\ \text{ms} + 10\ \text{ms} + (2 \cdot 5)\ \text{ms} + 10\ \text{ms} = 34\ \text{ms}$$

NOTE!: This value does not include delays of the fieldbus master, jitter in the process data cycle of the communication protocol or resending due to electronic interference.

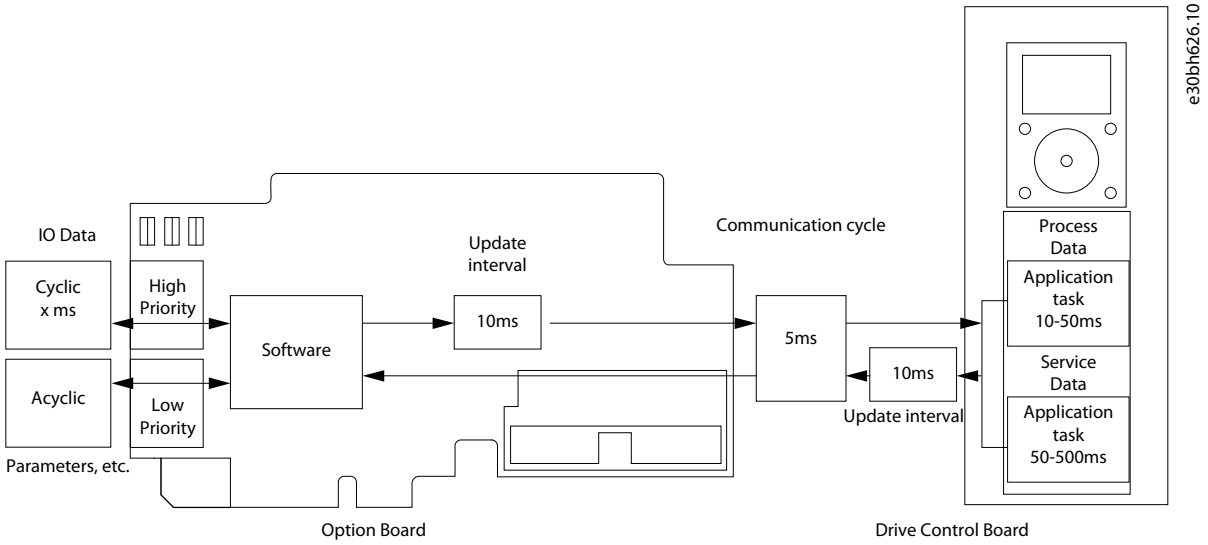


Illustration 2: Normal Fieldbus Communication

4.2.4 Fast Fieldbus Communication

The fast mode decreases the communication delay between the PLC and the AC drive application significantly by using two communication channels separately for process and service data. The process data interval is set to 1 ms, while other data is sent acyclically. When the fast mode is activated, the application can be synchronized to run with the communication cycle. The Fast communication mode is shown in Illustration 3. This mode also includes the ability to transfer 16 process data items.

The communication delay for process data in fast communication mode is (when application task is synchronized with communication):

$$t = t_{\text{IO data cycle}} + t_{\text{update interval}} + t_{\text{application cycle}}$$

Example: With fieldbus cycle time of 1 ms, an application cycle of 1 ms the delay is:

$$t = 1\ \text{ms} + 1{+}1\ \text{ms} = 3\ \text{ms}$$

NOTE: This value does not include delays of the fieldbus master, jitter in the process data cycle of the communication protocol or resending due to electronic interference.

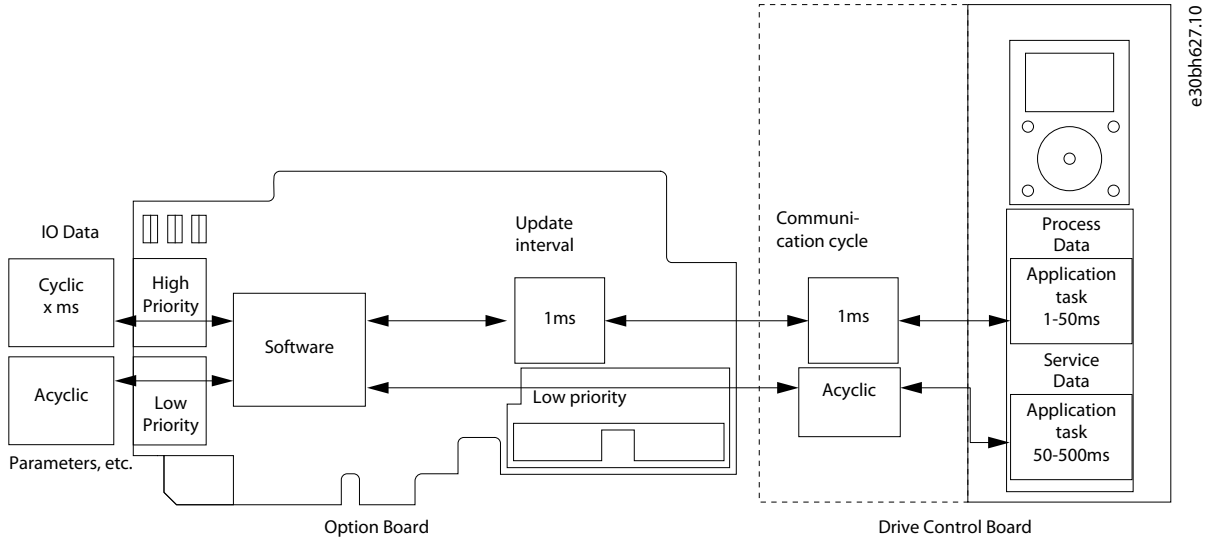


Illustration 3: Fast Fieldbus Communication

4.2.5 Fast Safety Fieldbus Communication

The fast safety mode uses the same communication methods as in "Fast mode" (Illustration 3), but also transfers safety "black channel" data used to the advanced safety option board.

NOTE: This mode is automatically enabled, if an advanced safety option board is connected to slot D and the safety fieldbus is activated and is not available for setting. This mode is also automatically turned off when the advanced safety option board is removed.

4.2.6 Normal Extended Mode

The normal extended mode uses the same communication method as in "Fast mode", but reduces the communication cycle to 10 ms. This mode can be used in applications where 16 process data items are required but the lowest possible communication delay is not needed. It can also be used in these applications when the increased CPU load of Fast mode to VACON® NXP drives is undesirable.

NOTE! This mode can be automatically enabled in VACON® applications supporting 16 process data items.

4.3 Drive Control

4.3.1 PROFIBUS DP Modules

The OPTE3/E5 option board implements the following PROFIBUS DP modules:

Table 7: OPTE3/E5 Modules

Module name	Number	Abbreviation	Type	Description
Standard Telegram 1	7	ST1	Drive(1)	See 4.3.5.3 Standard Telegrams.
VACON® Telegram 100	8	ST1+4PD		See 4.3.5.4 Vendor-Specific Telegrams.
VACON® Telegram 101	9	ST1+8PD		
VACON® Telegram 138	11	ST1+12PD		
VACON® Telegram 139	12	ST1+16PD		
VACON® Telegram 140	16	GCW+16PD		
Standard Telegram 20	10	ST20		See 4.3.5.3 Standard Telegrams.
Parameter-Process Data Type 1…6	1...6	PPO1…PPO6		See 4.3.6.4 PPO Types.
Standard Telegram 30	13	ST30	Safety(2)	See 4.4.2 PROFIdrive on PROFIsafe.

Module name	Number	Abbreviation	Type	Description
Standard Telegram 31	14	ST31		
VACON® Telegram 58000	15	ST58000		

[1] Drive module rules:

- Only 1 drive module is allowed.
- Always configure 1 drive module.

[2] Safety module rules:

- If a safety module is configured, it must always be in slot 1.
- Only 1 safety module is allowed.
- ST20 and PPO1...6 is not allowed with safety modules.
- In the Advanced Safety option board, select the same safety module as configured.

The supported module combinations are described in Table 8.

Table 8: Supported Module Combinations

Slot 1	Slot 2: Empty	Slot 2: ST1(+PD)	Slot 2: ST20	Slot 2:PPO1...6
Empty	-	allowed	allowed	allowed
ST1(+PD)	allowed	-	-	-
ST20	allowed	-	-	-
ST30, 31	-	allowed	-	-
ST58000	-	allowed	-	-
PPO1...6	allowed	-	-	-

An invalid module configuration causes a diagnostic configuration fault. As a result, the device returns to parameterization state and does not start the data exchange with PROFIBUS DP master.

If there is a safety module fault, a channel-related diagnosis (see 8.2.2 Channel-Related Diagnosis) is activated to notify the master of a problem with the safety module. The data exchange is started with PROFIBUS DP master.

4.3.2 Fieldbus Process Data

The process data items are directly sent unmodified from fieldbus to the application. Therefore the process data mapping and usage must be configured in application. For the latest information, see the application-specific manual.

Fieldbus process data items can be used to write and read variables quickly and periodically to/from VACON® AC drives. Incoming process data can be used for multiple different purposes (for example, torque reference), and outgoing process data can be used for information about the state of the AC drive.

For fast access to any VACON® AC drive application ID over any fieldbus, generic Process Data Out parameters are defined. The content of the process data items is selected with the FB DataOut Selection parameters. Writing any application ID number to these parameters then maps the data value of that application ID to be sent in the corresponding Process Data Out variable.

The fieldbus data-mapping (FB DataOut x Sel) affects the data of the corresponding Process Data Out variable (see Illustration 4). By writing ID value 1 to FB DataOut1 Selection (ID 852), the value of ID 1 (Output Frequency) is sent in Process Data Out 1. The value is always raw value in process data out, so for example, 16.43 Hz has value 1643. The scaling of the parameters can be checked from application manuals.

The status word and actual speed values cannot be changed. However, if a profile is used, the values sent by the fieldbus protocol can differ. In Bypass mode, these values are given as is.

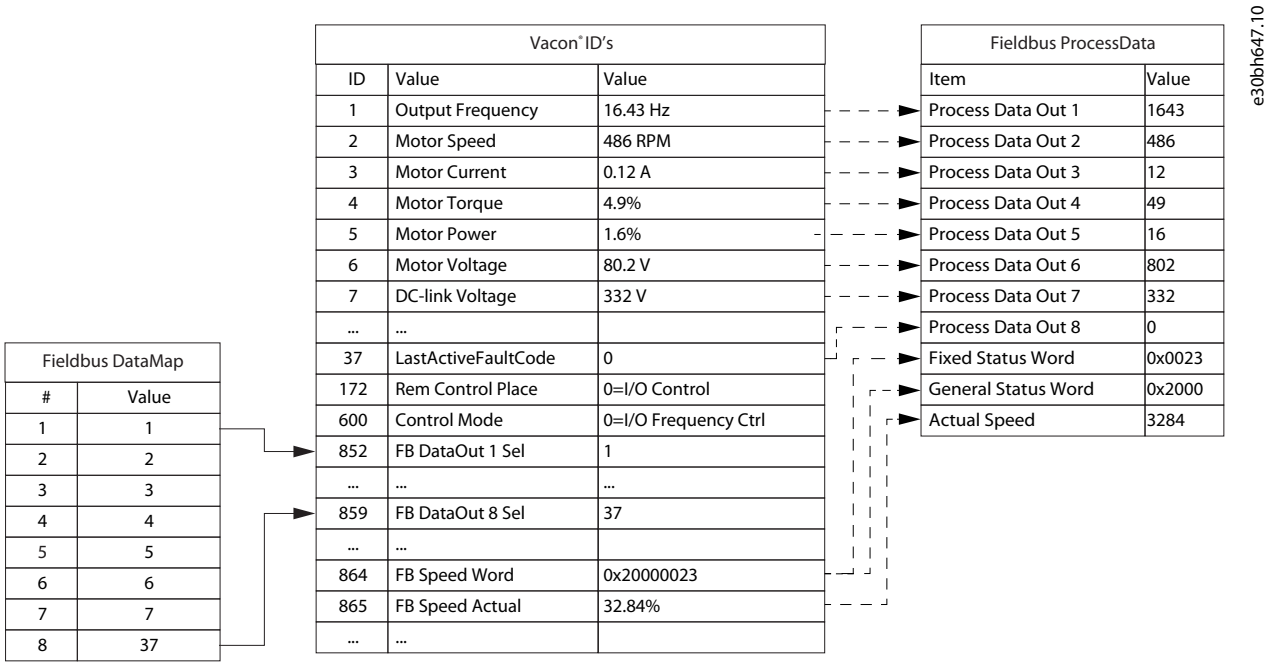


Illustration 4: Fieldbus Data Mapping

Table 9: Fieldbus Process Data Selection Indexes in Panel Tree for VACON® AC drives

Parameter name	ID	Index in panel tree for VACON® 100 family	Index in panel tree for VACON® NXP Multipurpose application[1]	Index in panel tree for VACON® 20	Index in panel tree for VACON® 20 X/CP
FB DataOut 1 Selection	852	P3.6.1	P2.13.3	P10.1	P11.1
FB DataOut 2 Selection	853	P3.6.2	P2.13.4	P10.2	P11.2
...	...	...	...	...	...
FB DataOut 8 Selection	859	P3.6.8	P2.13.10	P10.8	P11.8
FB DataOut 9 Selection[2]	[2]	-	[2]	-	-
FB DataOut 10 Selection[2]	[2]	-	[2]	-	-
...	...	-	...	-	-
FB DataOut 16 Selection[2]	[2]	-	[2]	-	-

[1] For other applications, see the application manuals.

[2] Supported in VACON® NXP when Fast mode or Normal extended mode is enabled. See details in 4.2 Fieldbus Option Board Communication Modes and 6.6 VACON® NXP System Software Parameters for Application Developers.

Table 10: Default Process Data Mapping for VACON® 100 Family

PD	Mapped Application Data	ID	Unit	Scale
1	Output Frequency	1	Hz	0.01 Hz
2	Motor Speed	2	RPM	1 RPM
3	Motor Current	3	A	Varies[1]
4	Motor Torque	4	%	0.1%

PD	Mapped Application Data	ID	Unit	Scale
5	Motor Power	5	%	0.1%
6	Motor Voltage	6	V	0.1 V
7	DC-link voltage	7	V	1 V
8	Last Active Fault Code	37	-	-

[1] Scaling is based on drive nominal power, see Table 14.

Table 11: Default Process Data Mapping for VACON® NXP Multipurpose Application

PD	Mapped Application Data	ID	Unit	Scale
1	Output Frequency	1	Hz	0.01 Hz
2	Motor Speed	2	RPM	1 RPM
3	Motor Current	45	A	0.1 A
4	Motor Torque	4	%	0.1%
5	Motor Power	5	%	0.1%
6	Motor Voltage	6	V	0.1 V
7	DC-link voltage	7	V	1 V
8	Last Active Fault Code	37	-	-

Table 12: Default Process Data Mapping for VACON® 20 X/CP

PD	Mapped Application Data	ID	Unit	Scale
1	Output Frequency	1	Hz	0.01 Hz
2	Motor Speed	2	RPM	1 RPM
3	Motor Current	3	A	Varies[1]
4	Motor Torque	4	%	0.1%
5	Motor Power	5	%	0.1%
6	Motor Voltage	6	V	0.1 V
7	DC-link voltage	7	V	1 V
8	Last Active Fault Code	37	-	-

[1] Scaling is based on drive nominal power, see Table 14.

Table 13: Default Process Data Mapping for VACON® 20

PD	Mapped Application Data	ID	Unit	Scale
1	Frequency Reference	25	Hz	0.01 Hz
2	Output Reference	1	Hz	0.01 Hz
3	Motor Speed	2	RPM	1 RPM
4	Motor Voltage	6	V	0.1 V

PD	Mapped Application Data	ID	Unit	Scale
5	Motor Torque	4	%	0.1%
6	Motor Current	3	A	Varies[1]
7	Motor Power	5	%	0.1%
8	DC-link voltage	7	V	1 V

[1] Scaling is based on drive nominal power, see Table 14.

Table 14: Current Scaling Based on Nominal Power

Nominal power	Current scale
< 5 kW	0.01 A
5–100 kW	0.1 A
> 100 kW	1 A

4.3.3 Bypass Operating Mode

In the Bypass operating mode, the control word, and status word fields in Process Data do not use the PROFIdrive bit definitions. Instead, the internal control and status word bit definitions are used. These definitions can differ depending on the used application.

Operate mode can be set either on the control panel (see 6.1.2 Operate Mode) or in the PLC (see 6.2.1 Operate Mode).

For the control and status word definitions in the standard applications, see the following topics:

- 4.3.3.1 Control Word Overview
- 4.3.3.2 Status Word Overview

For latest information and special applications, see the application-specific manual.

Bypass Setpoint and Actual Value

In the Bypass operating mode, the valid ranges for setpoint and actual values is 0…10000d, which corresponds to 0.00% to 100.00%. The scale of the setpoint value is 0.01%. In this case, the value 0% corresponds to the parameterized Minimum Frequency in the drive, while 100% corresponds to Maximum Frequency.

The desired direction of rotation is announced using bit 1 in the control word, whereas bit 2 in the status word indicates the actual direction.

Table 15: Setpoint Value with Operate Mode "Bypass"

Setpoint value	Speed	Direction of rotation	Description of command
0x0000 (0d)	0.00%	N/A	Minimum Frequency
0x2710 (+10000d)	+100.00%	Control word dep.	Full speed

Table 16: Actual Speed Value with Operate Mode "Bypass" or "Echo"

Actual value	Speed	Direction of rotation	Description of value
0x0000 (0d)	0.00%	N/A	At Minimum Frequency
0x2710 (+10000d)	+100.00%	FORWARD	Full speed

4.3.3.1 Control Word Overview

The VACON® Control Word is composed of 32 bits. This control data is split into two words: FBFixedControlWord consist of the first 16 bits and FBGeneralControlWord consist of the remaining 16 bits.

While functionality of the FBFixedControlWord is fixed in VACON® standard applications, functionality of the FBGeneralControlWord is application-specific and can vary even in VACON® standard applications.

FBFixedControlWord bit definitions are described in the tables:

- VACON® 100 Family: Table 17
- VACON® NXP: Table 18
- VACON® 20: Table 19
- VACON® 20 X/CP: Table 20

.

Set all unused bits to zero.

Table 17: Definition of FBFixedControlWord in VACON® 100 Family

Bit	Function	Value	Description
0	Start/Stop	0	Stop request from fieldbus
		1	Run request from fieldbus
1	Direction	0	Requested direction is "FORWARD"
		1	Requested direction is "REVERSE"
2	Fault reset	0	No action
		1	Rising edge (0-->1) resets active faults, alarms, and info
3	Stop mode 1	0	Stop mode is unmodified
		1	Stop mode is overridden to "Ramping"
4	Stop mode 2	0	Normal deceleration ramp time
		1	Deceleration ramp is switched to shorter than normal
5	Quick ramp time	0	Normal deceleration ramp time
		1	Deceleration ramp is switched to shorter than normal
6	Freeze setpoint	0	Changes in the setpoint value from fieldbus (FB Speed Reference) are taken into use by the application
		1	Changes in the setpoint value from fieldbus (FB Speed Reference) are not taken into use by the application
7	Setpoint to Zero	0	The setpoint value from fieldbus is taken from FB Speed Reference
		1	The setpoint value from fieldbus is changed to 0
8	Request Fieldbus Control	0	Control Place is as parameterized in the drive (unchanged)
		1	Control Place is overridden to Fieldbus Control
9	Request Fieldbus Reference	0	Source of the setpoint value is as parameterized in the drive (unchanged)
		1	Source of the setpoint value is overridden to Fieldbus
10	Jogging 1	0	No action
		1	Jogging request with jogging reference 1
11	Jogging 2	0	No action
		1	Jogging request with jogging reference 2
12	Quick stop	0	No action
		1	Drive executes quick stop/emergency stop

Bit	Function	Value	Description
13–15	Reserved	-	-

Table 18: Definition of FBFixedControlWord in VACON® NXP

Bit	Function	Value	Description
0	Start/Stop	0	Stop request from fieldbus
		1	Run request from fieldbus
1	Direction	0	Requested direction is "FORWARD"
		1	Requested direction is "REVERSE"
2	Fault reset	0	No action
		1	Rising edge (0-->1) resets active faults, alarms, and info
3	Fieldbus DIN 1	0	Fieldbus DIN 1 off
		1	Fieldbus DIN 1 on
4	Fieldbus DIN 2	0	Fieldbus DIN 2 off
		1	Fieldbus DIN 2 on
5	Fieldbus DIN 3	0	Fieldbus DIN 3 off
		1	Fieldbus DIN 3 on
6	Fieldbus DIN 4	0	Fieldbus DIN 4 off
		1	Fieldbus DIN 4 on
7	Fieldbus DIN 5	0	Fieldbus DIN 5 off
		1	Fieldbus DIN 5 on
8	Request Fieldbus Control	0	Control Place is as parameterized in the drive (unchanged)
		1	Control Place is overridden to Fieldbus Control
9	Request Fieldbus Reference	0	Source of the setpoint value is as parameterized in the drive (unchanged)
		1	Source of the setpoint value is overridden to Fieldbus
10	Not supported	-	-
11	Not supported	-	-
12	Not supported	-	-
13–15	Reserved	-	-

Table 19: Definition of FBFixedControlWord in VACON® 20

Bit	Function	Value	Description
0	Start/Stop	0	Stop request from fieldbus
		1	Run request from fieldbus
1	Direction	0	Requested direction is "FORWARD"

Bit	Function	Value	Description
		1	Requested direction is "REVERSE"
2	Fault reset	0	No action
		1	Rising edge (0-->1) resets active faults, alarms, and info
3	Not supported	-	-
4	Not supported	-	-
5	Quick ramp time	0	Normal deceleration ramp time
		1	Deceleration ramp is switched to shorter than normal
6	Not supported	-	-
7	Not supported	-	-
8	Not supported	-	-
9	Not supported	-	-
10	Not supported	-	-
11	Not supported	-	-
12	Not supported	-	-
13–15	Reserved	-	-

Table 20: Definition of FBFixedControlWord in VACON® 20 X/CP

Bit	Function	Value	Description
0	Start/Stop	0	Stop request from fieldbus
		1	Run request from fieldbus
1	Direction	0	Requested direction is "FORWARD"
		1	Requested direction is "REVERSE"
2	Fault reset	0	No action
		1	Rising edge (0-->1) resets active faults, alarms, and info
3	Stop mode 1	0	Stop mode is unmodified
		1	Stop mode is overridden to "Ramping"
4	Stop mode 2	0	Normal deceleration ramp time
		1	Deceleration ramp is switched to shorter than normal
5	Quick ramp time	0	Normal deceleration ramp time
		1	Deceleration ramp is switched to shorter than normal
6	Freeze setpoint	0	Changes in the setpoint value from fieldbus (FB Speed Reference) are taken into use by the application
		1	Changes in the setpoint value from fieldbus (FB Speed Reference) are not taken into use by the application

Bit	Function	Value	Description
7	Setpoint to Zero	0	The setpoint value from fieldbus is taken from FB Speed Reference
		1	The setpoint value from fieldbus is changed to 0
8	Request Fieldbus Control	0	Control Place is as parameterized in the drive (unchanged)
		1	Control Place is overridden to Fieldbus Control
9	Request Fieldbus Reference	0	Source of the setpoint value is as parameterized in the drive (unchanged)
		1	Source of the setpoint value is overridden to Fieldbus
10	Not supported	-	-
11	Not supported	-	-
12	Quick stop	0	No action
		1	Drive executes quick stop/emergency stop
13–15	Reserved	-	-

4.3.3.2 Status Word Overview

The VACON® Status Word is composed of 32 bits. This status data is split into two words: FBFixedStatusWord consist of the first 16 bits and FBGeneralStatusWord consist of the remaining 16 bits.

While functionality of the FBFixedStatusWord is fixed in VACON® standard applications, functionality of the FBGeneralStatusWord is application-specific and can vary even in VACON® standard applications.

FBFixedStatusWord bit definitions are described in the tables. Unused bits are set to zero.

- VACON® 100 Family: Table 21
- VACON® NXP: Table 22
- VACON® 20: Table 23
- VACON® 20 X/CP: Table 24

Table 21: Definition of FBFixedStatusWord for VACON® 100 Family

Bit	Function	Value	Description
0	Ready	0	Drive is not ready
		1	Drive is ready to run
1	Run	0	Motor is not running
		1	Motor is running
2	Direction	0	Motor is running clockwise
		1	Motor is running counterclockwise
3	Fault(1)	0	No fault active
		1	Drive has an active fault
4	Alarm(1)	0	No alarm active
		1	Drive has an active alarm
5	At reference	0	Motor is not running at reference speed
		1	Motor is running at reference speed

Bit	Function	Value	Description
6	Zero speed	0	Motor is not at zero speed
		1	Motor is running at zero speed
7	Flux ready	0	Motor is not magnetized
		1	Motor is magnetized
8	Info[1]	0	No info active
		1	Drive has an active info
9–15	Reserved	-	-

[1] Drive faults have three levels: fault, alarm, and info. Bits 3, 4, and 8 are set to 1 when given fault type is activated.

NOTE! In VACON® NXP series AC drives, the FBFixedStatusWord comes from firmware variable "MCStatus".

Table 22: Definition of FBFixedStatusWord for VACON® NXP

Bit	Function	Value	Description
0	Ready	0	Drive is not ready
		1	Drive is ready to run
1	Run	0	Motor is not running
		1	Motor is running
2	Direction	0	Motor is running clockwise
		1	Motor is running counterclockwise
3	Fault[1]	0	No fault active
		1	Drive has an active fault
4	Alarm[1]	0	No alarm active
		1	Drive has an active alarm
5	At reference	0	Motor is not running at reference speed
		1	Motor is running at reference speed
6	Zero speed	0	Motor is not at zero speed
		1	Motor is running at zero speed
7	Flux ready	0	Motor is not magnetized
		1	Motor is magnetized
8	Not supported	-	-
9–15	Reserved	-	-

[1] Drive faults have three levels: fault, alarm, and info. Bits 3 and 4 are set to 1 when given fault type is activated.

Table 23: Definition of FBFixedStatusWord for VACON® 20

Bit	Function	Value	Description
0	Ready	0	Drive is not ready
		1	Drive is ready to run
1	Run	0	Motor is not running
		1	Motor is running
2	Direction	0	Motor is running clockwise
		1	Motor is running counterclockwise
3	Fault[1]	0	No fault active
		1	Drive has an active fault
4	Alarm[1]	0	No alarm active
		1	Drive has an active alarm
5	At reference	0	Motor is not running at reference speed
		1	Motor is running at reference speed
6	Not supported	-	-
7	Not supported	-	-
8	Not supported	-	-
9–15	Reserved	-	-

[1] Drive faults have three levels: fault, alarm, and info. Bits 3 and 4 are set to 1 when given fault type is activated.

Table 24: Definition of FBFixedStatusWord for VACON® 20 X/CP

Bit	Function	Value	Description
0	Ready	0	Drive is not ready
		1	Drive is ready to run
1	Run	0	Motor is not running
		1	Motor is running
2	Direction	0	Motor is running clockwise
		1	Motor is running counterclockwise
3	Fault[1]	0	No fault active
		1	Drive has an active fault
4	Alarm[1]	0	No alarm active
		1	Drive has an active alarm
5	At reference	0	Motor is not running at reference speed
		1	Motor is running at reference speed

Bit	Function	Value	Description
6	Zero speed	0	Motor is not at zero speed
		1	Motor is running at zero speed
7	Not supported	-	-
8	Not supported	-	-
9–15	Reserved	-	-

[1] Drive faults have three levels: fault, alarm, and info. Bits 3 and 4 are set to 1 when given fault type is activated.

4.3.3.3 Control and Status Word Monitoring Values

The following tables describe how the control/status words can be read from different drives via panel or PC-tool.

- VACON® 100 Family: Table 25
- VACON® NXP: Table 27
- VACON®20 Family: Table 27

For VACON® 100 family, VACON® 20, and VACON® 20X/CP, VACON® Live PC tool is used for accessing drive parameters. VACON® NCDrive PC tool is used with VACON® NXP drive.

To monitor in VACON® NCDrive, do the following settings:

- View --> Monitoring
- Type: Firmware

Table 25: Monitoring of Control and Status Words for VACON® 100 Family

Signal	Index in panel tree	VACON® Live Monitoring Values
FBFixedControlWord	V2.12.1 (Low Word)	FB Control Word (Low Word)
FBGeneralControlWord	V2.12.1 (High Word)	FB Control Word (High Word)
FBFixedStatusWord	V2.12.11 (Low Word)	FB Status Word (Low Word)
FBGeneralStatusWord	V2.12.11 (Low Word)	FB Status Word (High Word)

Table 26: Monitoring of Control and Status Words for VACON® NXP

Signal	Index in panel tree	VACON® NCDrive Monitoring Values
FBFixedControlWord	V1.24.1[(1)]	FBFixedControlWord
FBGeneralControlWord	-	FBGeneralControlWord
FBFixedStatusWord	V1.24.16[(1)]	MCStatus
FBGeneralStatusWord	V1.24.3[(1)]	FBGeneralStatusWord

[1] Advanced Application only

Table 27: Monitoring of Control and Status Words for VACON®20 Family

Signal	Index in panel tree for VACON®20	VACON® Live Monitoring Values
FBFixedControlWord	-	-
FBGeneralControlWord	-	-
FBFixedStatusWord	V3.1	Drive status word

Signal	Index in panel tree for VACON®20	VACON® Live Monitoring Values
FBGeneralStatusWord	V3.2	Application status word

4.3.4 Echo Operating Mode

In the Echo operating mode, the slave echoes back the data exchange messages sent from the fieldbus master. No processing of the information is performed in the slave or the drive.

Operate mode can be set either on the control panel (see 6.1.2 Operate Mode) or in the PLC (see 6.2.1 Operate Mode).

Table 28: Data Mapping in Echo Operating Mode

Master-to-slave		Slave to master field
PKW request(1)	-->	PKW response(1)
Control word	-->	Status word
Setpoint value	-->	Actual speed value
Process Data 1...16(1)	-->	Process Data 1...16(1)

1 If present in the selected I/O configuration.

4.3.5 PROFIdrive 4.1 Control Profile

4.3.5.1 PROFIdrive 4.1 Profile Overview

To provide interoperability between devices from different manufacturers, a "standard" must be defined so that:

- The devices behave in the same way.
- The devices produce and/or consume the same basic set of I/O data.
- The devices contain the same basic set of configurable attributes.

The formal definition of this information is known as a device profile. Some AC drives support only some of the functionalities. See 4.3.3.1 Control Word Overview and 4.3.3.2 Status Word Overview.

OPTE3/E5 PROFIBUS DP uses PROFIdrive version 2.0 by default when PPO types are used. To use PROFIdrive version 4.1 together with PPO types, enable the "PPO_PROFIdrive" compatibility mode setting. See details in 6.1 PROFIBUS DP Board Parameters.

4.3.5.2 PROFIdrive 4.1 State Machine

STW1 (Control Word) and ZSW1 (Status Word) follow the state machine described in Illustration 5.

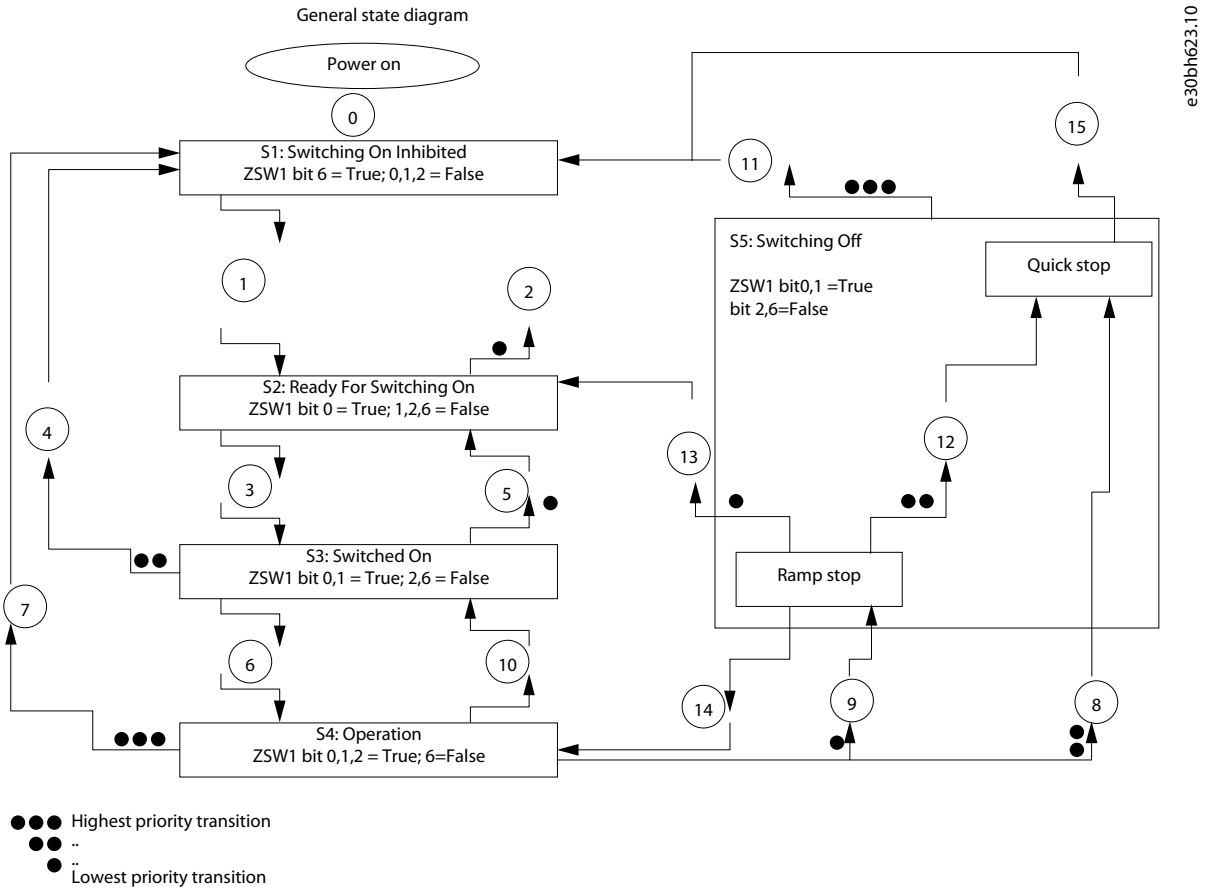


Illustration 5: General State Diagram

Table 29: PROFIdrive State Machine Commands

#	Bits of control word	Value (hex)	Action in VACON® 100 family & VACON® 20X/CP	Action in VACON® 20	Action in VACON® NXP(1)
0	-	-	Self-initiation is performed		
1	OFF AND No Coast Stop AND No Quick Stop STW1 bit 0 = False; 1, 2 = True	0x47E	None, requires that Drive is READY (ZSW1 status word bit 13)		
2	Coast Stop OR Quick Stop STW1 bit 1 = False OR bit 2 = False	-	None		
3	ON STW1 bit 0 = True	0x477	None		
4	Coast Stop OR Quick Stop	-	None		
5	STW1 bit 1 = False OR bit 2 = False	-	None		
6	Enable operation STW1 bit 3 = True	0x47F	Drive function is enabled, requires that Drive is in fieldbus control (ZSW1 status word bit 9)		
7	Coast stop	0x47D	Stop by coast		Stop function

#	Bits of control word	Value (hex)	Action in VACON® 100 family & VACON® 20X/CP	Action in VACON® 20	Action in VACON® NXP[1]
	STW1 bit 1 = False				
8, 12	Quick stop STW1 bit 2 = False	0x47B	Quick stop[2]	Stop by ramp	Stop function
9	Ramp stop STW1 bit 0 = False	0x47E	Stop by ramp		Stop function
10	Disable operation STW1 bit 3 = False	0x477	Drive function is disabled, stop by stop function		
11	Coast stop STW1 bit 1 = False	0x47D	Stop by coast		Stop function
13, 15	Standstill detected OR Disable operation STW1 bit 3 = False	0x477	Drive function is disabled, stop by stop function		
14	ON (Re-enable operation)	0x47F	Drive function is re-enabled		

[1] When using VACON® NXP series AC drives and option board in "PROFIdrive" mode, the stop command always follows configured stop mode and not the stop command given from fieldbus.

[2] Quick stop only occurs if the application supports it. If the application does not support quick stop, a normal ramp stop is executed.

4.3.5.3 Standard Telegrams

The PROFIdrive 4.1 profile specifies two telegrams used for communication. The OPTE3/E5 supports two standard telegrams used for AC drive control: Standard Telegram 1 and Standard Telegram 20 and four vendor-specific telegrams with added process data items. The safety telegrams are not defined in this chapter. See the VACON® NXP Advanced Safety Options Operating Guide about details on Safety Telegram definitions.

Table 30: Supported Telegrams

Telegram number	Telegram
1	Standard Telegram 1
20	Standard Telegram 20
100	Standard Telegram 1 + PD[1..4]
101	Standard Telegram 1 + PD[1..8]
138	Standard Telegram 1 + PD[1..12]
139	Standard Telegram 1 + PD[1..16]
140	FBGeneralControlWord + PD[1..16]

Standard Telegram 1

The Standard Telegram 1 comprises a control word and a setpoint value which is sent to the slave. The slave returns a status word and an actual speed value to the PROFIBUS DP master.

In its basic form, the Standard Telegram 1 consists of 4 bytes. The first 2 bytes contain the control/status word and the next 2 bytes the speed reference/actual value.

Table 31: Definition of Standard Telegram 1

I/O Data number	Bytes	Setpoint	Actual value
1	1...2	STW1	ZSW1

I/O Data number	Bytes	Setpoint	Actual value
2	1...3	NSOLL_A	NIST_A

Standard Telegram 20

The Standard Telegram 20 contains essentially the same control/status word and setpoint/actual speed value fields as the Standard Telegram 1. The data sent by the slave to the master contains more fields regarding the controlled process. In Standard Telegram 20, the output signals are filtered. Filtered signals include the suffix _GLATT.

Table 32: Definition of Standard Telegram 20

I/O Data number	Bytes	Setpoint	Actual value
1	1...2	STW1	ZSW1
2	3...4	NSOLL_A	NIST_A_GLATT
3	5...6	-	IAIST_GLATT
4	7...8		ITIST_GLATT
5	9...10		PIST_GLATT
6	11...12		MELD_NAMUR

Standard Telegram 20 has some modifications to both control word and status word, see Table 33 and Table 34.

Table 33: Control Word (STW1) Modifications in ST20

Bits	Description for value = 1	Description for value = 0
11	Setpoint inversion	No setpoint inversion
12–14	Reserved	Reserved
15	Parameter Set 2[1]	Parameter Set 1

[1] This feature is not supported in OPTE3/E5

Table 34: Status Word (ZSW1) Modifications in ST20

Bits	Description for value = 1	Description for value = 0
4	Coast Stop not activated or Inevitable Line Interruption not activated	Coast Stop activated or Inevitable Line Interruption activated
5	Quick Stop not activated or External Interlock not activated	Quick Stop activated or External Interlock activated
11	Adjustable Current Limit or Torque Limit not reached	Adjustable Current Limit or Torque Limit reached[1]
12	Reserved	Reserved
13	Motor Overload not activated	Motor Overload activated[1]
14	Positive speed direction	No positive speed direction
15	Parameter Set 2 active[1]	Parameter Set 1 active

[1] This feature is not supported in OPTE3/E5

The value in the IAIST_GLATT and ITIST_GLATT fields is the filtered motor current, which is reported in percentages of the value of PNU10116. The value in the "Active Power" field is the filtered motor power, which is reported in percentages of the value of PNU10117.

Table 35: Description of Signals IAIST_GLATT, ITIST_GLATT and PIST_GLATT

Signal	Description	Unit	Reference
IAIST_GLATT	Filtered motor output current	4000 h = 100.00%	100% = PNU10116
ITIST_GLATT	Filtered motor active current	4000 h = 100.00%	100% = PNU10116
PIST_GLATT	Filtered motor active power	4000 h = 100.00%	100% = PNU10117

The MELD_NAMUR field is an extra drive/fault word transferred in process data. The definition of this fault word can be seen in Table 36.

Table 36: Definition of Drive Status/Fault Word (MELD_NAMUR)

Bits[1]	Description for value = 1	Description for value = 0
0	Fault Control Electronics/Software	No Fault Control Electronics/Software
1	Fault Supply Net	No Fault Supply Net
2	DC Link Overvoltage	No DC Link Overvoltage
3	Fault Power Section	No Fault Power Section
4	Overtemperature Converter	No Overtemperature Converter
5	Ground Fault	No ground fault
6	Overload Motor	No Overload Motor
7	Error Communication Bus	No Error Communication Bus
8	External Safety Trip	No External Safety Trip
9	Fault Speed Sensor	No Fault Speed Sensor
10	Fault Internal Communication	No Fault Internal Communication
11	Fault Infeed System (DC Link)	No Fault Infeed System (DC Link)
12	Reserved	Reserved
13	Reserved	Reserved
14	Reserved	Reserved
15	Miscellaneous Faults	No Miscellaneous Faults

[1] In OPTE5/E3, a fault in the drive is indicated by setting bit 15. No other bits are currently controlled.

4.3.5.4 Vendor-Specific Telegrams

VACON® Telegram 100: The vendor-specific telegram 100 is the Standard Telegram 1 appended with 4 drive-specific Process Data items. This telegram is named "ST1+4PD".

Table 37: Definition of VACON® Telegram 100

I/O Data number	Bytes	Setpoint	Actual value
1	1...2	STW1	ZSW1
2	3...4	NSOLL_A	NIST_A
3	5...6	PDI1	PDO1

I/O Data number	Bytes	Setpoint	Actual value
4	7...8	PDI2	PDO2
5	9...10	PDI3	PDO3
6	11...12	PDI4	PDO4

VACON® Telegram 101: The vendor-specific telegram 101 is the Standard Telegram 1 appended with 8 drive-specific Process Data items. This telegram is named "ST1+8PD".

Table 38: Definition of VACON® Telegram 101

I/O Data number	Bytes	Setpoint	Actual value
1	1...2	STW1	ZSW1
2	3...4	NSOLL_A	NIST_A
3	5...6	PDI1	PDO1
4	7...8	PDI2	PDO2
5	9...10	PDI3	PDO3
6	11...12	PDI4	PDO4
7	13...14	PDI5	PDO5
8	15...16	PDI6	PDO6
9	17...18	PDI7	PDO7
10	19...20	PDI8	PDO8

VACON® Telegram 138: The vendor-specific telegram 138 is the Standard Telegram 1 appended with 12 drive-specific Process Data items. This telegram is named "ST1+12PD".

Table 39: Definition of VACON® Telegram 138

I/O Data number	Bytes	Setpoint	Actual value
1	1...2	STW1	ZSW1
2	3...4	NSOLL_A	NIST_A
3	5...6	PDI1	PDO1
4	7...8	PDI2	PDO2
5	9...10	PDI3	PDO3
6	11...12	PDI4	PDO4
7	13...14	PDI5	PDO5
8	15...16	PDI6	PDO6
9	17...18	PDI7	PDO7
10	19...20	PDI8	PDO8
11	21...22	PDI9	PDO9
12	23...24	PDI10	PDO10

I/O Data number	Bytes	Setpoint	Actual value
13	25...26	PDI11	PDO11
14	27...28	PDI12	PDO12

VACON® Telegram 139: The vendor-specific telegram 139 is the Standard Telegram 1 appended with 16 drive-specific Process Data items. This telegram is named "ST1+16PD".

Table 40: Definition of VACON® Telegram 139

I/O Data number	Bytes	Setpoint	Actual value
1	1...2	STW1	ZSW1
2	3...4	NSOLL_A	NIST_A
3	5...6	PDI1	PDO1
4	7...8	PDI2	PDO2
5	9...10	PDI3	PDO3
6	11...12	PDI4	PDO4
7	13...14	PDI5	PDO5
8	15...16	PDI6	PDO6
9	17...18	PDI7	PDO7
10	19...20	PDI8	PDO8
11	21...22	PDI9	PDO9
12	23...24	PDI10	PDO10
13	25...26	PDI11	PDO11
14	27...28	PDI12	PDO12
15	29...30	PDI13	PDO13
16	31...32	PDI14	PDO14
17	33...34	PDI15	PDO15
18	35...36	PDI16	PDO16

VACON® Telegram 140: This telegram (Table 41) contains only FB General Control Word/FB General Status Word and 16 process data items. It allows the application to define fully the content of the telegram, that is, 'Free'. Practical use of this telegram requires custom application in the drive. This telegram is named "GCW+16PD".

Table 41: Definition of VACON® Telegram 140

I/O Data number	Bytes	Setpoint	Actual value
1	1...2	General CW	General SW
2	3...4	PDI1	PDO1
3	5...6	PDI2	PDO2
4	7...8	PDI3	PDO3
5	9…10	PDI4	PDO4

I/O Data number	Bytes	Setpoint	Actual value
6	11…12	PDI5	PDO5
7	13…14	PDI6	PDO6
8	15…16	PDI7	PDO7
9	17…18	PDI8	PDO8
10	19…20	PDI9	PDO9
11	21…22	PDI10	PDO10
12	23…24	PDI11	PDO11
13	25…26	PDI12	PDO12
14	27…28	PDI13	PDO13
15	29…30	PDI14	PDO14
16	31…32	PDI15	PDO15
17	33…34	PDI16	PDO16

4.3.5.5 PPO Types

PROFIdrive version 4.1 can be used together with PPO types by enabling "PPO_PROFIdrive" compatibility setting. See details in 6.1 PROFIBUS DP Board Parameters.

Part of PPO types contains parameter field (PPoPKW) for parameter access. See instructions for PKW usage in 5.2.2 Parameter Field (PKW) in PPO Types.

PPO1 Type

PPO1 contains a parameter field (PKW) for performing parameter access, and control/status word and setpoint/actual value fields.

Table 42: Definition of PPO1 Type

Bytes	Setpoint	Actual value
1...2	PKW: Parameter type and number	
3...4	PKW: Parameter sub-index	
5...6	PKW: Parameter value word 1 (high)	
7...8	PKW: Parameter value word 2 (low)	
9...10	STW1	ZSW1
11...12	NSOLL_A	NIST_A

PPO2 Type

PPO2 contains a parameter field (PKW) for performing parameter access, and control/status word and setpoint/actual value fields. Also, four Process Data words are included in this type.

Table 43: Definition of PPO2 Type

Bytes	Setpoint	Actual value
1...2	PKW: Parameter type and number	
3...4	PKW: Parameter sub-index	
5...6	PKW: Parameter value word 1 (high)	

Bytes	Setpoint	Actual value
7...8	PKW: Parameter value word 2 (low)	
9...10	STW1	ZSW1
11...12	NSOLL_A	NIST_A
13...14	PDI1	PDO1
15...16	PDI2	PDO2
17...18	PDI3	PDO3
19...20	PDI4	PDO4

PPO3 Type

PPO3 contains control/status word and setpoint/actual value fields.

Table 44: Definition of PPO3 Type

Bytes	Setpoint	Actual value
1...2	STW1	ZSW1
3...4	NSOLL_A	NIST_A

PPO4 Type

PPO4 contains control/status word and setpoint/actual value fields, and four Process Data words.

Table 45: Definition of PPO4 Type

Bytes	Setpoint	Actual value
1...2	STW1	ZSW1
3...4	NSOLL_A	NIST_A
5...6	PDI1	PDO1
7...8	PDI2	PDO2
9...10	PDI3	PDO3
11...12	PDI4	PDO4

PPO5 Type

PPO5 contains a parameter field (PKW) for performing parameter access, and control/status word and setpoint/actual value fields. Also, eight Process Data words are included in this type.

Table 46: Definition of PPO5 Type

Bytes	Setpoint	Actual value
1...2	PKW: Parameter type and number	
3...4	PKW: Parameter sub-index	
5...6	PKW: Parameter value word 1 (high)	
7...8	PKW: Parameter value word 2 (low)	
9...10	STW1	ZSW1
11...12	NSOLL_A	NIST_A

Bytes	Setpoint	Actual value
13...14	PDI1	PDO1
15...16	PDI2	PDO2
17...18	PDI3	PDO3
19...20	PDI4	PDO4
21...22	PDI5	PDO5
23...24	PDI6	PDO6
25...26	PDI7	PDO7
27...28	PDI8	PDO8

PPO6 Type

PPO6 contains control/status word and setpoint/actual value fields, and eight Process Data words.

Table 47: Definition of PPO6 Type

Bytes	Setpoint	Actual value
1...2	STW1	ZSW1
3...4	NSOLL_A	NIST_A
5...6	PDI1	PDO1
7...8	PDI2	PDO2
9...10	PDI3	PDO3
11...12	PDI4	PDO4
13...14	PDI5	PDO5
15...16	PDI6	PDO6
17...18	PDI7	PDO7
19...20	PDI8	PDO8

4.3.5.6 PROFIdrive 4.1 Control Word (STW1)

Table 48: PROFIdrive 4.1 Control Word (STW1)

Bits	Title	Value = 1	Value = 0	Description
0	Switching ON/OFF	1 = Switch ON	0 = Switch OFF	This bit is used with other bits to enable operation of the drive. When this bit is set to 0 during operation, the drive performs a ramp stop.
1	Coast stop command	1 = No coast stop	0 = Perform coast stop	This bit is used to request a coast stop to be executed. When it is set to 0 during operation, the drive performs a coast stop.
2	Quick stop command	1 = No quick stop	0 = Perform quick stop	This bit is used to request a quick stop to be executed. When it is set to 0 during operation, the drive quickly ramps down to zero speed and stops.
3	Enabling of operation	1 = Enable operation	0 = Disable operation	This bit is used with other bits to enable operation of the drive. When it is set to 0 during operation, the drive performs a coast stop.

Bits	Title	Value = 1	Value = 0	Description
4	Enabling of ramp generator	1 = Enable ramp generator	0 = Reset ramp generator	This bit is used with other bits to enable operation of the drive. When it is set to 0 during operation, the drive quickly decelerates to zero speed.
5	Freezing of setpoint value	1 = Unfreeze setpoint value	0 = Freeze setpoint value	This bit can be used to freeze the setpoint value used by the drive. The value is frozen if this bit is set to 0. If the bit is 1, the setpoint value provided by the PROFIBUS DP master is continuously updated.
6	Enabling of setpoint value	1 = Enable setpoint value	0 = Disable setpoint value	This bit can be used to disable the fieldbus setpoint value. If this bit is set to 0, the PROFIBUS DP option board ignores the setpoint value by the master and instead uses a setpoint value of 0. During operation, if this bit is set to 0, the drive decelerates to a standstill.
7	Fault acknowledge	1 = Acknowledge fault (0 -> 1)		This bit is used to acknowledge faults in the drive. When a rising edge (0 -> 1) is seen in this bit by the PROFIBUS DP option board, it requests the drive to acknowledge present faults. The functionality of this bit is rising-edge sensitive only.
8	Reserved			
9	Reserved			
10	Control by PLC	1 = Control by PLC	0 = No Control by PLC	This bit is used by the PROFIBUS DP master to indicate that it is in control of the slave and that the commands sent via fieldbus are valid. During operation, this bit must be 1. If the drive is not operating and this bit is 0, the drive cannot be started. If the drive is operating, and this bit becomes 0, the option board freezes the process data provided to the drive, and sets its state to FAULT. The drive reaction to this fieldbus fault depends on the drive parameterization.
11–15	Reserved			

4.3.5.7 PROFIdrive 4.1 Status Word (ZSW1)

Table 49: PROFIdrive 4.1 Status Word (ZSW1)

Bits	Title	Value = 1	Value = 0	Description
0	Readiness to switch on	1 = Ready to switch on	0 = Not ready to switch on	This bit indicates whether the drive is ready to switch on the power electronics. When the bit has the value 0, the drive is not ready to switch on the power electronics. When the bit has the value 1, the drive is ready to switch on the power electronics.
1	Readiness to operate	1 = Ready to operate	0 = Not ready to operate	This bit indicates whether the drive is ready to begin operation. When the bit has the value 0, the power electronics is switched off and the drive is unable to begin operation. When the bit has the value 1, the power electronics is switched on and the drive can begin operation when requested by the master.
2	State of operation	1 = Operation enabled (drive follows setpoint)	0 = Operation disabled	This bit indicates whether the drive is operating or not. When the bit has the value 0, the drive is not operating. When the bit has the value 1, the drive is operating.
3	Presence of fault	1 = Fault present	0 =No Fault	This bit indicates the presence of unacknowledged faults in the drive. When the bit has the value 0, no unacknowledged faults are present in the drive. When the bit has the value 1, at least one unacknowledged fault is present in the drive.

Bits	Title	Value = 1	Value = 0	Description
4	Coast stop activated	1 =Coast stop not activated	0 = Coast stop activated	This bit indicates whether a coast stop command is active or not. When the bit has the value 0, a coast stop command is active. When the bit has the value 1, no coast stop command is active.
5	Quick stop activated	1 = Quick stop not activated	0 = Quick stop activated	This bit indicates whether a quick stop command is active or not. When the bit has the value 0, a quick stop command is active. When the bit has the value 1, no quick stop command is active.
6	Switching on inhibition	1 = Switching on inhibited	0 = Switching on not inhibited	This bit indicates whether the power electronics can be switched on or not. When the bit has the value 0, the power electronics can be switched on. When the bit has the value 1, the power electronics are prevented from switching on.
7	Presence of warning	1 = Warning present	0 = No warning present	This bit indicates the presence of warning/alarm information in the drive. When the bit has the value 0, no warning is present. When the bit has the value 1, a warning is present.
8	Running at setpoint	1 = Speed error within tolerance range	0 = Speed error out of tolerance range	This bit indicates whether the drive is operating and the actual speed value matches the setpoint value. When the bit has the value 0, the actual speed value does not match the setpoint value. When the bit has the value 1, the actual speed value matches the setpoint value.
9	Request control by master	1 = Control by PLC requested	0 = Control by PLC not requested	This bit indicates whether the fieldbus master must take control of the drive. When this bit has the value 0, the master need not take control of the drive. When this bit has the value 1, the master is requested take control of the drive. In OPTE3 and OPTE5 , this bit depends on the configuration for the drive control place. If the control place is assigned to fieldbus, the bit has the value 1. If the control place is elsewhere, the bit has the value 0.
10	Setpoint reached or exceeded	1 = f or n reached or exceeded	0 = f or n not reached	This bit indicates whether the setpoint value has been reached or exceeded. When this bit has the value 0, the setpoint value has not been reached or exceeded. When this bit has the value 1, the setpoint value has been reached or exceeded.
11	Reserved			
12	Running indication	1 = Drive is running	0 = Drive is stopped	This bit indicates whether the drive is in the RUN state or not. When this bit has the value 0, the drive is not running. When this bit has the value 1, the drive is in the RUN state.
13	Readiness to operate	1 = Drive is ready for operation	0 = Drive is not ready for operation	This bit indicates whether the drive is in the READY state or not. When this bit has the value 0, the drive is not ready to operate. When this bit has the value 1, the drive is in the READY state.
14-15	Reserved			

4.3.5.8 Setpoint Value

The setpoint value used for controlling the drive is a signed 16-bit integer. The sign of the setpoint indicates the desired direction of rotation. The correspondence to RPM is described in 4.3.5.10 Normalization Reference Parameter.

When using Standard Telegrams 1 or 20, the setpoint signal is called for control and the operate mode is "PROFIdrive profile", and the speed setpoint value (NSOLL_A) used is normalized according to the following table:

Table 50: Setpoint Value with Operate Mode "PROFIdrive Profile"

Setpoint value	Speed	Direction of rotation	Description of command
0xC000 (-16384d)	-100.00%	REVERSE	Full speed in REVERSE direction

Setpoint value	Speed	Direction of rotation	Description of command
0x0000 (0d)	0.00%	N/A	Minimum speed
0x4000 (16384d)	+100.00%	FORWARD	Full speed in FORWARD direction

When using PPO types 1–6 and PROFIdrive 2.0, the value is identical to that of the operate mode "Bypass". Refer to VACON® NX OPTC3-C5 PROFIBUS User Manual for more details.

4.3.5.9 Actual Speed Value

The actual speed value indicating the drive operation is a signed 16-bit integer. The sign of the setpoint indicates the current direction of rotation. The correspondence to RPM is described in 4.3.5.10 Normalization Reference Parameter.

When using Standard Telegrams 1 or 20 for control and the operate mode is "PROFIdrive profile", the speed actual value (NIST_A) used is normalized according to the following table:

Table 51: Actual Speed Value with Operate Mode "PROFIdrive profile"

Actual value	Speed	Direction of rotation	Description of value
0xC000 (-16384d)	-100.00%	REVERSE	Full speed in REVERSE direction
0x0000 (0d)	0.00%	N/A	Standstill
0x4000 (16384d)	+100.00%	Status Word dependent	Full speed in FORWARD direction

Refer to VACON® NXP OPTC3-C5 PROFIBUS User Manual for more details.

4.3.5.10 Normalization Reference Parameter

Since the speed setpoint and actual values are provided in normalized fashion as a ratio, with 0x4000 corresponding to 100.00%, a manufacturer-specific parameter with PNU 10111 is available. The value contained in this parameter indicates the number of RPM that corresponds to 100%.

If value is greater than what fits in Unsigned16 data type, this PNU returns zero. For high speed applications, use PNU 10129. It works like PNU 10111. However, as the RPMs for high speed application are too large to fit in Unsigned16 value, PNU 10129 returns RPMs divided by 100.

See 5.1.2.4 Parameter Valuefor details on how to read parameter values.

Example: The parameter PNU10111 contains the value 1500, which corresponds to 1500 RPM. It means that if the setpoint value provided by the fieldbus master is 0x4000 (100.00%), it corresponds to a 1500 RPM setpoint. A setpoint of 0x2000 (50.00%) thus corresponds to a 750 RPM setpoint. The same calculation method applies in the actual value direction.

4.3.5.11 Shortlist of Commands to Start the Drive

The following sequences of commands are used to operate the drive.

Table 52: Shortlist of Commands to Start the Drive

Stage of the operation	Control word value (hexadecimal)	Description of command
Beginning the operation	0000h	Power-up default command
	047Eh	Ready the drive for beginning the operation
	047Fh	Begin operation
Executing a ramp stop	047Fh	Operating
	047Eh	Execute ramp stop
	047Fh	Cancel ramp stop(1)
Executing a coast stop	047Fh	Operating
	047Dh	Execute coast stop

Stage of the operation	Control word value (hexadecimal)	Description of command
Executing a quick stop	047Fh	Operating
	047Bh	Execute quick stop

[1] It is possible to interrupt a ramp stop and return to the operating mode, by setting the bit 0 in the control word before standstill is reached

4.3.5.12 Coding of Data Signals

The following number coding is used for signals communicated in cyclic data exchange. The signals numbers are categorized according to Table 53 and detailed description of signals can be found in Table 54.

Table 53: PROFIdrive Signal Categories

Signal number	Signal description
0...89	PROFIdrive-specific
90...99	PROFIdrive-specific safety
100...60099	Vendor-specific
61000...61999	Vendor-specific safety

Table 54: Data Signal Description

Signal number	Signal description	Abbreviation	Length (Bits)	Description
1	Profile control word STW1	STW1	16	4.3.5.6 PROFIdrive 4.1 Control Word (STW1)
2	Profile status word ZSW1	ZSW1	16	4.3.5.7 PROFIdrive 4.1 Status Word (ZSW1)
5	Speed setpoint value	NSOLL_A	16	4.3.5.8 Setpoint Value
6	Speed actual value	NIST_A	16	4.3.5.9 Actual Speed Value
51	Filtered output current	IAIST_GLATT	16	4.3.5.3 Standard Telegrams
52	Filtered active current	ITIST_GLATT	16	
54	Filtered active power	PIST_GLATT	16	
57	Filtered speed actual value	NIST_A_GLATT	16	
58	Drive status/fault word	MELD_NAMUR	16	
90	Safety control word 1	S_STW1	16	4.4.2 PROFIdrive on PROFIsafe
91	Safety status word 1	S_ZSW1	16	
93	Safety control word 2	S_STW2	32	
94	Safety status word 2	S_ZSW2	32	
100	Process data out word 1	PDO1	16	4.3.2 Fieldbus Process Data
...	...	...		
107	Process data out word 8	PDO8		
110	Process data in word 1	PDI1		
...	...	...		

Signal number	Signal description	Abbreviation	Length (Bits)	Description
117	Process data in word 8	PDI8		
118	Non-profile control word	-	16	4.3.3 Bypass Operating Mode
119	Non-profile status word	-	16	
120	Non-profile speed setpoint value	-	16	
121	Non-profile speed actual value	-	16	
140	Process data out word 9	PDO9	16	4.3.2 Fieldbus Process Data
...	...	...		
147	Process data out word 16	PDO16		
148	Process data in word 9	PDI9		
...	...	...		
155	Process data in word 16	PDI16		
61000	VACON® safety control word	VS_CW	48	4.4.2 PROFIdrive on PROFIsafe
61010	VACON® safety status word	VS_SW	48	

4.3.6 PROFIdrive 2.0 Control Profile

The OPTE5/OPTE3 option board uses the PROFIdrive 2.0 profile when configured by the master to use PPO types for communication. The implementation is not compliant with the PROFIdrive 2.0 specification to a full extent.

OPTE5/OPTE3 supports the PROFIdrive 2.0 for backward compatibility reasons. The implementation is similar to that of OPTC5/OPTC3.

NOTE! The Standard telegrams cannot be used with PROFIdrive 2.0. The PROFIdrive version 4.1 is used when PROFIdrive is selected and Standard telegrams are used.

NOTE! PROFIdrive 4.1 is used with PPO types if Compatib. Mode parameter value is "PPO_PROFIdrive Mode". See details in 6.1 PROFIBUS DP Board Parameters.

4.3.6.1 PROFIdrive 2.0 Control Word

The control word is composed of 16 bits that have the following meanings:

Table 55: Control Word Bit Descriptions

Bits	Description for value = 0	Description for value = 1
0	STOP 1 (by ramp)	ON 1
1	STOP 2 (by coast)	ON 2
2	STOP 3 (by ramp)	ON 3
3	RUN DISABLE	ENABLE
4	No Action	START
5	No Action	START
6	No Action	START
7	No Action	FAULT RESET (0 -> 1)
8	No Action	No Action

Bits	Description for value = 0	Description for value = 1
9	No Action	No Action
10	Disable PROFIBUS DP control	Enable PROFIBUS DP control
11[1]	Fieldbus DIN 1=OFF	Fieldbus DIN 1=ON
12[1]	Fieldbus DIN 2=OFF	Fieldbus DIN 2=ON
13[1]	Fieldbus DIN 3=OFF	Fieldbus DIN 3=ON
14[1]	Fieldbus DIN 4=OFF	Fieldbus DIN 4=ON
15[1]	Fieldbus DIN 5=OFF	Fieldbus DIN 5=ON

[1] Not supported in VACON® 100 family.

With the help of the control word, the start and stop commands can be given to the device (see Illustration 6). Also a fault can be acknowledged.

There are several stop modes. It depends on the operating situation, which mode is selected.

Table 56: Commands with Control Word

Command	Control word	Description
RUN	047Fhex	Start motor if "Fieldbus" is active control source
STOP 1[1][2]	047Ehex	Stop by Ramp
STOP 2[3]	047Dhex	Stop by Coast
STOP 3[1][2]	047Bhex	Stop by Ramp
RUN DISABLE[3]	0477hex	Stop by stop mode
FAULT RESET (step 1) FAULT RESET (step 2)	bit 7 = 0 bit 7 = 1	Rising edge to bit 7

[1] In VACON® NXP AC drive, the commands STOP 1 and STOP 3 are identical.

[2] The commands STOP1 and STOP3 can be used only with these selections:

- either one of the motor control modes (P2.6.1) selected:
  - Frequency control
  - Speed control
- the fieldbus selected as the control place

[3] In VACON® NXP AC drive, the commands STOP 2 and RUN DISABLE are identical

4.3.6.2 PROFIdrive 2.0 Status Word

Information about the status of the device and messages is indicated in the status word. The status word is composed of 16 bits that have the following meanings:

Table 57: Status Word Bit Descriptions

Bits	Description for value = 0	Description for value = 1
0	Not Ready (initial)	READY 1[1]
1	Not Ready	READY 2[1]
2	DISABLE	ENABLE[1]
3	NO FAULT	FAULT ACTIVE[2]

Bits	Description for value = 0	Description for value = 1
4	STOP 2	NO STOP 2(1)
5	STOP 3	NO STOP 3(1)
6	START ENABLE	START DISABLE(1)
7	No Warning	Warning(2)
8	Reference ≠ Actual value	Reference = Actual value(2)
9	Fieldbus control OFF	Fieldbus control ON(2)
10	Reserved	Reserved
11	Reserved	Reserved
12	FC stopped	Running(2)
13	FC not ready	FC ready(2)
14	Reserved	Reserved
15	Reserved	Reserved

[1] Bits of the State Machine

[2] Received directly from the AC drive

4.3.6.3 State Machine for PROFIdrive 2.0

The state machine describes the device status and the possible control sequence of the AC drive.

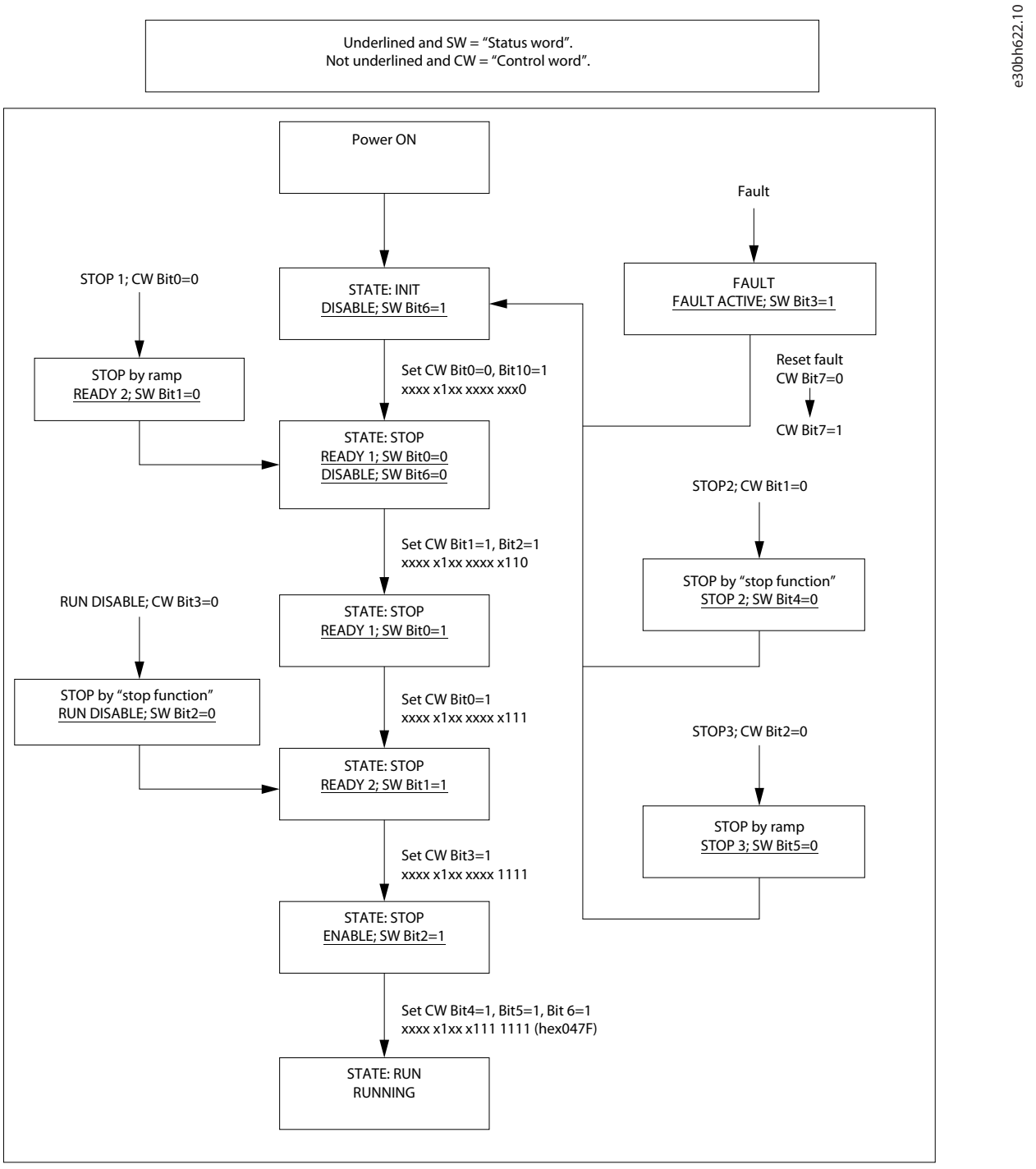


Illustration 6: PROFIdrive 2.0 State Machine

When using a VACON® NXP series AC drive and OPTE3/E5 in "PROFIdrive" mode, the stop command always follows the configured stop mode instead of the command given from the fieldbus.

4.3.6.4 PPO Types

PPO1 contains a parameter field (PKW) for performing parameter access, and control/status word and setpoint/actual value fields.

PPO2 contains a parameter field (PKW) for performing parameter access, and control/status word and setpoint/actual value fields. Also, four Process Data words are included in this type.

PPO3 contains control/status word and setpoint/actual value fields.

PPO4 contains control/status word and setpoint/actual value fields, and four Process Data words.

PPO5 contains a parameter field (PKW) for performing parameter access, and control/status word and setpoint/actual value fields. Also, eight Process Data words are included in this type.

PPO6 contains control/status word and setpoint/actual value fields, and eight Process Data words. The following diagram shows a comparison between different PPO types:

PPO Type	Parameter field								Process data field																			
	ID		IND		VALUE				CW SW		REF ACT		PD1 PD1		PD2 PD2		PD3 PD3		PD4 PD4		PD5 PD5		PD6 PD6		PD7 PD7		PD8 PD8	
PPO1													NOT USED															
PPO2																					NOT USED							
PPO3	NOT USED												NOT USED															
PPO4	NOT USED																				NOT USED							
PPO5																												
PPO6	NOT USED																											
Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

e30bh717.10

Illustration 7: Structure Comparison between Different PPO Types

ID	Parameter type and number	SW	Status Word
IND	Parameter subindex	REF	Reference Value 1
VALUE	Parameter value	ACT	Actual Value 1
CW	Control Word	PD	Process Data

4.4 PROFIsafe

The OPTE3/E5 supports a black channel PROFIsafe interface via PROFIBUS DP to Advanced safety option board to support safety functions. For more detailed information, see VACON® NXP Advanced Safety Options Operating Guide.

This functionality is available in OPTE3/E5 version 006 or later. For the .GSD file, use Revision "2" or later.

See also 6.3 Safety Parameters.

4.4.1 Introduction to PROFIsafe

The following figure shows the PROFIsafe system overview, when using PROFIsafe over PROFIBUS DP.

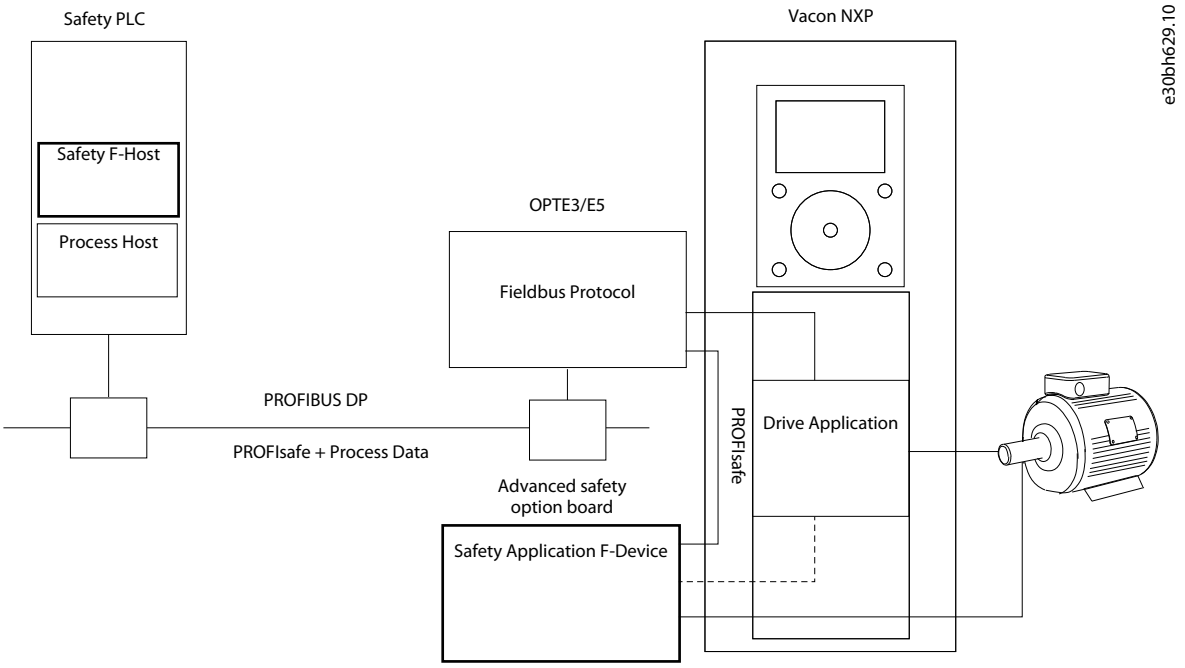


Illustration 8: PROFIsafe System Overview

The option board communicates with the safety PLC via PROFIBUS DP. The exchanged data includes PROFIsafe data and non-safe process data. The option board extracts the process data and the safety frame from the received message and forwards them. The process data is sent to the drive application, and the safety frame is sent to the Advanced safety option board.

The Advanced safety option board receives and sends the PROFIsafe safety enclosures and implements the configured safety functions.

The Advanced safety option board can also interact with the drive application, which can be parameterized to react to safety functions.

See VACON® NXP Advanced Safety Options Operating Guide for more details.

4.4.2 PROFIdrive on PROFIsafe

The VACON® Advanced Safety Options support three safety telegrams consisting of both standard PROFIdrive on PROFIsafe functionality and vendor-specific functionality. These telegrams are Standard Telegram 30, Standard Telegram 31, and VACON®- specific Telegram 58000. The content (signals) of these telegrams are described in the following table.

Table 58: Supported Safety Telegrams

Telegram	Setpoint	Actual value
30	S_STW1	S_ZSW1
31	S_STW2	S_ZSW2
58000	VS_CW	VS_SW

For details on the safety signal bit definitions and the related safety functions, and for mapping the PROFIsafe data to PROFIBUS DP, see VACON® NXP Advanced Safety Options Operating Guide.

5 Parameter Access

5.1 Parameter Access in PROFIdrive 4.1

5.1.1 Parameter Access Sequence

Parameter access over DP-V1 takes place by using the parameter channel. A parameter request is written to the drive, revealing the desired operation and target parameter information. The master then polls the slave using read requests and receives a positive response once the parameter processing is finished. If a problem occurs, a negative response is provided by the slave.

The Parameter Channel can be used to access the parameters of both the drive and the PROFIdrive.

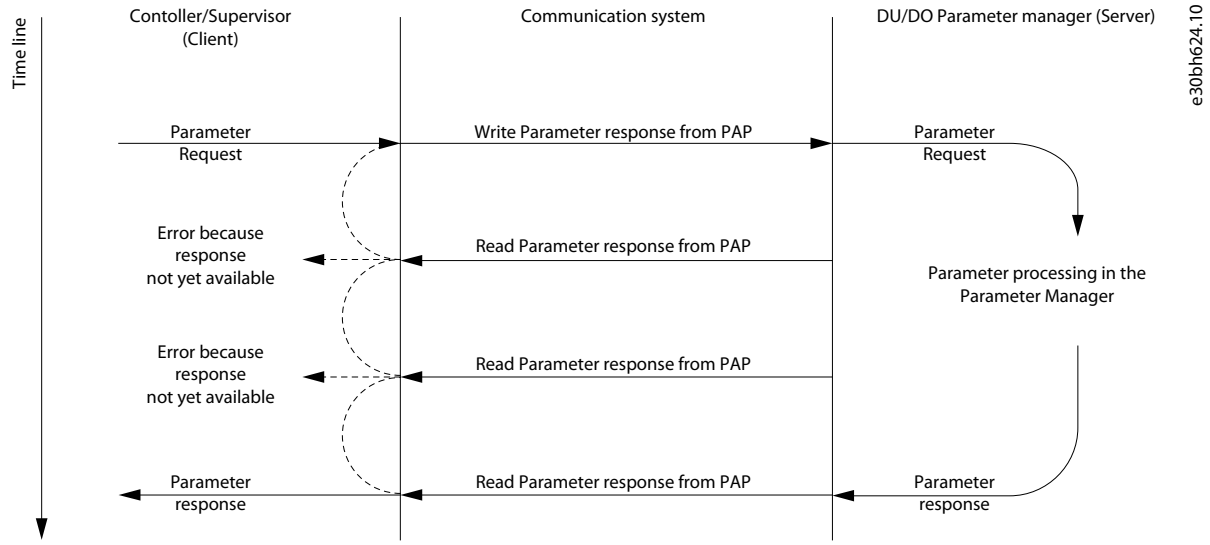


Illustration 9: Data flow for Base Mode Parameter Access

The parameter response can only be read once per successful request. After this, the Parameter manager in the PROFIdrive profile returns to its idle state and begins waiting for a new parameter request. Attempts to read the parameter response to the previous request returns an error.

5.1.2 Parameter Requests

There are two types of parameter requests in PROFIdrive:

- read requests for reading parameters from the device
- change requests for writing parameters to the device

Each parameter request over PROFIBUS DP-V1 consists of four elements:

- PROFIBUS DP-V1 header
- Request header
- Parameter address
- Parameter value (only in Change requests)

DP-V1 header	Request header	Parameter address(es)	Parameter value(s)

OPTE5/E3 supports a maximum of 240 octets of data, which includes the request header, parameter address(es), and parameter value(s).

PROFIBUS DP-V1 Parameter requests are mapped inside the standard PROFIBUS frame as follows:

Table 59: Parameter Request

PROFIBUS frame	
PROFIBUS header	Data (max 240 bytes)

PROFIBUS header	DP-V1 header	Request header (write request or read request)	Parameter address (1..N)	Parameter value (1..N) if write request

Table 60: Parameter Response

PROFIBUS frame				
PROFIBUS header	Data (max 240 bytes)			
PROFIBUS header	DP-V1 header	Response header (read response or write response)	Parameter address (1..N)	Parameter value (1..N) if read response

5.1.2.1 DP-V1 Header

The DP-V1 header consists of 4 fields, each one octet in size.

Table 61: Structure of the DP-V1 Header

Octet number	Field name	Description	Allowed values
1	Function Number	PROFIBUS DP-specific operation number.	• Use 0x5E for read requests. • Use 0x5F for write requests. • The slave returns 0xDE to indicate error in read request. • The slave returns 0xDF to indicate error in write request. • Do not use other values in the Parameter Access.
2	Slot Number	PROFIBUS DP-specific reference to internal device module.	• Use 0 for OPTE5/E3. • Other values must not be used.
3	Index	PROFIBUS DP-specific index used to address different properties.	• Use 47 (decimal) for Parameter Access in OPTE5/E3. • Other values must not be used for Parameter Access.
4	Data Length	Number of data octets in the parameter request frame. This count excludes the DP-V1 header.	Number of octets in request header, parameter address(es), and parameter value(s) fields.

5.1.2.2 Request Header

The request header consists of 4 fields, each one octet in size.

Table 62: Structure of the Request Header

Octet number	Field name	Description	Allowed values
1	Request Reference	Unique number for each request/response pair. The master changes this value for each new request. Slave mirrors it in the response.	• Only values 1–255 are allowed. • Value 0 restricted by PROFIdrive 4.1.
2	Request ID	Defines the type of request.	• Use 0x01 for Read requests. • Use 0x02 for Change requests. • Do not use other values.

Octet number	Field name	Description	Allowed values
3	Axis Number	Not used, must be set to 1.	• Use value 1. • Do not use other values.
4	Requested number of parameters	The number of parameters affected by the request.	• Values 1–39 are allowed. • The value 0 is not allowed. • Values 40–255 are not allowed.

5.1.2.3 Parameter Address

The parameter address consists of 4 fields, totaling six octets in size.

Table 63: Structure of the Parameter Address

Octet number	Field name	Description	Allowed values
1	Attribute	Describes which part of a parameter to access.	• Use 0x10 for reading/writing the value of a parameter. • Use 0x20 for reading the description of a parameter. • Use 0x30 for reading the text of a parameter (not supported). • Do not use other values in OPTE5/OPTE3.
2	Number of elements	Specifies the number of elements which are addressed in an array.	• Values 0 and 1 are allowed for non-array parameters. • Values 1–234 are allowed for array parameters. • Do not use other values.
3...4	Parameter number	The number of the parameter to be addressed.	Allowed values are those of supported parameters, see 5.1.3.3 PROFIdrive 4.1 Error Classes and Codes.
5...6	Subindex	Defines the first array element of the parameter to be accessed.	• Values 0–65535 are allowed. • Do not use other values.

The "Parameter number" and "Subindex" fields are two-octet fields, while the "Attribute" and "No. of elements" fields are one-octet fields.

5.1.2.4 Parameter Value

The parameter value field is included only in Change requests (not in Read requests). The parameter value field consists of a two-octet parameter value header followed by a list of values. Depending on the format of the parameter, the octet size of a single value is one, two, or four octets. The total size of the parameter value field thus depends on the format and number of values in the message.

Table 64: Structure of the Parameter Value

Octet number	Field name	Description	Allowed values
1	Format	Describes the data type of the parameter.	• Use 0x41 for Byte. • Use 0x42 for Word. • Use 0x43 for Double Word.

Octet number	Field name	Description	Allowed values
			• Value 0x44 is used for Error. • Do not use other values.
2	Number of values	Defines the number of values in the parameter value field.	Values 0–234 are possible. Subject to limitations as described below.
3	Value	The value of the parameter.	• Values 0–65535 are allowed. • Do not use other values

5.1.3 Parameter Responses

There are two types of parameter responses in PROFIdrive:

- Write response (response to a Write request)
- Read response (response to a Read request)

A read response over PROFIBUS DP-V1 consists of three elements:

- PROFIBUS DP-V1 header
- Response header
- Parameter value(s) (depending on the request type)

A write response over PROFIBUS DP-V1 contains only the PROFIBUS DP-V1 header.

DP-V1 header	Response header	Parameter value(s)

5.1.3.1 DP-V1 Header

The DP-V1 response header consists of 4 fields, each one octet in size.

Table 65: Structure of the DP-V1 Header

Octet number	Field name	Description	Allowed values
1	Function Number	PROFIBUS DP-specific operation number.	• Use 0x5E for read requests. • Use 0x5F for write requests. • Other values are not allowed in the Parameter Access.
2	Slot Number	PROFIBUS DP-specific reference to internal device module.	This value mirrors the value in the associated request.
3	Index	PROFIBUS DP-specific index used to address different properties.	• Use 47 (decimal) for Parameter Access in OPTE5/E3. • Do not use other for Parameter Access.
4	Data Length	Number of data octets in the parameter request frame. This count excludes the DP-V1 header.	Number of octets in request header, parameter address(es), and parameter value(s) fields.

5.1.3.2 Error Response

If an error occurred in the Parameter Access, the response provided by the slave is an error response. Its PROFIBUS DP-V1 header contents differ from a normal read/write response. An error response contains 4 octets as described in the table.

Table 66: Structure of the Error Response

Octet number	Field name	Description	Allowed values
1	Function Number	PROFIBUS DP-specific operation number.	• The slave returns 0xDE to indicate an error read response. • The slave returns 0xDF to indicate an error write response. • Other values are not allowed in the Parameter Access.
2	Error Decode	Defines how the error information in the following two fields must be decoded.	• Always 128 in PROFIdrive. • Other values are not used in the Parameter Access.
3	Error Code 1	High 4 bits indicate error class, 4 lower bits indicate error code.	See 5.1.3.3 PROFIdrive 4.1 Error Classes and Codes.
4	Error Code 2	Application-specific.	Always 0 in PROFIdrive.

5.1.3.3 PROFIdrive 4.1 Error Classes and Codes

Table 67: PROFIdrive 4.1 Error Classes and Codes

Error class	Error codes	Explanation in PROFIdrive
0x0...0x9 = reserved (not used)	-	-
0xA = application	0x0 = read error 0x1 = write error 0x2 = module failure 0x3…0x7 = reserved (not used) 0x8 = version conflict 0x9 = feature not supported 0xA…0xF = user-specific (not used)	-
0xB = access	0x0 = invalid index	0xB0 = parameter requests are not supported
-	0x1 = write lengtherror 0x2 = invalid slot 0x3 = type conflict 0x4 = invalid area	-
-	0x5 = state conflict	0xB5 = parameter access is temporarily not possible due to internal processing status
-	0x6 = access denied	-
-	0x7 = invalid range	0xB7 = Write request with error in the parameter request header
-	0x8 = invalid parameter 0x9 = invalid type 0xA…0xF = user-specific (not used)	-
0xC = resource	0x0 = read constraint conflict 0x1 = write constraint conflict	-
-	0x2 = resource busy	-
-	0x3 = resource unavailable	-

Error class	Error codes	Explanation in PROFIdrive
-	0x4…0x7 = reserved (not used) 0x8…0xF = user-specific (not used)	-
0xD…0xF = userspecific (not used)	-	-

5.1.3.4 PROFIdrive Parameter Access Errors

In addition to the error indications in the PROFIBUS DP-V1 header, details about the error are provided in the parameter value field. The third octet in the parameter value is set to 0x00 and the fourth octet is assigned the error number, as described in the table.

Table 68: PROFIdrive Parameter Access Errors

Error number	Description	When used
0x00	Impermissible parameter number	Access to unavailable parameter
0x01	Parameter value cannot be changed	Change request to a read-only parameter
0x02	Low or high limit exceeded	Change request which exceeds parameter value range
0x03	Invalid sub-index	Access to an unavailable sub-index of an array parameter
0x04	Non-array parameter	Attempt to access sub-index of a non-array parameter
0x05	Incorrect data type	Change request containing invalid data type for the accessed parameter
0x06	Setting not permitted (must only be reset)	Change request to non-zero value, where it is not allowed
0x07	Description element cannot be changed	Change request to a read-only parameter description element
0x08	Reserved (not used)	-
0x09	No description data available	Access to unavailable parameter description
0x0A	Reserved (not used)	-
0x0B	No operation priority	Change request without access rights to perform the change
0x0C...0x0E	Reserved (not used)	-
0x0F	No text array available	Access to unavailable parameter text array
0x10	Reserved (not used)	-
0x11	Request cannot be executed	Access is temporarily not possible due to unspecified reasons
0x12...0x13	Reserved (not used)	-
0x14	Value impermissible	Change request with a value within the allowed range, but is otherwise not allowed.
0x15	Response too long	The length of the response exceeds the maximum transmittable length
0x16	Impermissible parameter address	Error in the parameter address field
0x17	Illegal format	Illegal format was provided in write request

Error number	Description	When used
0x18	Number of values are not consistent	Number of values in the write request does not match the number of values in the parameter
0x19	Axis non-existent	Access to non-existent axis number
0x20	Parameter text cannot be changed	Change request to unavailable parameter text
0x21	Invalid request ID	If a parameter request does not have the request ID 01h or 02h, this error code is returned.
0x22...0x64	Reserved (not used)	-
0x65	Invalid request reference	Unallowed value for request reference
0x66	Invalid request ID	Unallowed value in request ID (not Request Parameter nor Change Parameter)
0x67	Reserved (not used)	-
0x68	Invalid number of parameters	Invalid number of parameters in request (0 or greater than 39)
0x69	Invalid attribute	Invalid attribute specified in request
0x6A	Reserved (not used)	-
0x6B	Request is too short	Not enough parameter value data was transmitted in a Change request. Alternatively, the request did not contain a complete parameter address.
0x6C	Drive parameter was not found	Access to a drive parameter through PNU10001 could not be completed, because a drive parameter with the matching ID could not be found.
0x6D	An invalid change request was provided	The length and contents of the parameter change request could not be verified.
0x6E...0xFF	Reserved (not used)	-

5.1.3.5 Response Header

The response header consists of 4 fields, each one octet in size.

Table 69: Structure of the Response Header

Octet number	Field name	Description	Allowed values
1	Request Reference	Unique number for each request/response pair.	Mirrored by the slave.
2	Response ID	Defines the type of response. An error in the execution of a request is indicated by setting bit 7 in this field.	• Uses 0x01 for successful request parameter operation. • Uses 0x02 for successful change parameter operation. • Uses 0x80 to indicate that an invalid request ID was received. • Uses 0x81 for unsuccessful request parameter operation. • Uses 0x82 for unsuccessful change parameter operation. Other values are not used.
3	Axis Number	Not used, must be set to 1 in OPTE5/E3.	Mirrored by the slave.

Octet number	Field name	Description	Allowed values
4	Requested number of parameters	The number of parameters affected by the request.	Number of parameters in the response. Mirrored from the request.

5.1.3.6 Parameter Values

Parameter values are included in the response only if the request was of "Request parameter" type. For details on the contents of this field, see 5.1.2.4 Parameter Value.

5.1.3.7 Parameter Description Elements

For each implemented parameter, there exists a corresponding parameter description element which can be read from the device. A complete parameter description element consists of 46 octets which are structured as shown in the table.

The sub-index 0 for the parameter description element corresponds to the complete description element. Thus, if a parameter access targets this sub-index of a parameter description, all the above 12 fields are returned for a total of 46 octets.

Table 70: Structure of the DP-V1 Header

Sub-index	Field name	Data type	Description
1	Identifier (ID)	Unsigned16	Bitmask with information about the parameter characteristics.
2	Number of array elements	Unsigned16	For array parameters, the number of elements in the array.
3	Standardization factor	FloatingPoint	If the information shown by the parameter can be converted into some standardized form, this field contains factor for this conversion.
4	Variable attribute	Array of two Unsigned8	Contains two index numbers for describing the parameter information.
5	Reserved	Array of four Unsigned8	Reserved, always 0.
6	Name	ASCII string, 16 characters	Symbolic name of the parameter.
7	Low limit	Array of four Unsigned8	Limit for valid values of the parameter.
8	High limit	Array of four Unsigned8	Limit for valid values of the parameter.
9	Reserved	Array of two Unsigned8	Reserved, always 0.
10	ID extension	Unsigned16	Not used, always 0.
11	Normalization reference parameter	Unsigned16	Parameter number, the value of which is used as normalization reference for the parameter whose description it is.
12	Normalization field	Unsigned16	Contains information about normalization of this parameter.

5.1.3.8 Identifier Field

The identifier field consists of the following parts:

Table 71: Structure of the Identifier Field

Bits	Name	Description
0–7	Data type	• Specifies the data type of the parameter value. • Value 3 corresponds to Integer16. • Value 6 corresponds to Unsigned16. • Value 10 corresponds to array of Unsigned8.
8	Standardization factor and variable attribute not relevant	If this bit is set, then physical values cannot be calculated for the parameter. Values in standardization factor and variable attribute fields are not relevant. If this bit is cleared, then the standardization factor and variable attribute are valid.
9	Parameter is read-only	If this bit is set, then the value of the parameter cannot be changed.
10	Additional text array available	Not supported, is always 0.
11	Reserved	Always 0.
12	Parameter was changed according to the factory setting	If this bit is set, the parameter value is unequal to the factory setting. **NOTE!** In OPTE3/E5, this bit is always set because it is not possible to detect in detail which parameters have changed. The bit is always set so that a master is encouraged to read the up-to-date value from the slave.
13	Parameter value can only be reset	If this bit is set, then the parameter value can only be set to "0", that is, reset. If this bit is cleared, then the parameter value can be changed to any value, providing that the parameter is writeable.
14	Parameter is array	If this bit is set, then the parameter is an array of the specified data type.
15	Reserved	Always 0.

5.1.3.9 Number of Array Elements Field

For an array type parameter, this field contains the number of elements which the array consists of.

5.1.3.10 Standardization Factor Field

This field contains a factor which helps to convert the device internal value into an external, standardized variable. For more information, see the examples in 5.1.3.11 Variable Attribute Field.

5.1.3.11 Variable Attribute Field

This field consists of two Unsigned8 values. The most significant octet is referred to as variable index and describes the physical quantity which is shown by the parameter value. The variable index also includes information about the base unit of the quantity.

The least significant octet is referred to as conversion index. Using the conversion index, it is possible to convert a parameter value into the base quantity as specified by the variable index. Each conversion index corresponds to a factor A and an offset B.

Table 72: Variable Attribute Field

Variable index	Physical quantity	Base unit	Allowed units	Conversion indexes
0	No dimension	N/A	N/A	0
9	Power	Watt	W kW	0 3
11	Speed	1/second	1/second 1/minute 1/hour	0 67 72

Variable index	Physical quantity	Base unit	Allowed units	Conversion indexes
22	Electrical current	1 A	1A 0.1A	0 -1
24	Ratio	Percent	%	0

Table 73: Conversion Indexes

Conversion index	Factor A	Factor B
0	N/A	0
-1	1.0 E-1	0
67	1/60=1.667 E-2	0
72	1/3600=2.778 E-4	0

The following two formulas are used to calculate the value of the parameter:

- Physical value in the specified unit: (transmitted value × standardization factor)
- Physical value in the base unit: (transmitted value ×standardization factor × A + B)

Example 1
A parameter has variable index 11, that is, "Speed" and base unit is 1/second. The conversion index is 67, that is, the value transmitted from drive has the unit 1/minute.

- Transmitted value: 1200
- Standardization factor: 1.0
- Variable index: 11 "Speed", base unit is "1/second"
- Conversion index: 67 The transmitted value has the unit "1/minute"

Physical value in the specified unit "1/min": 1200 × 1.0 1/minute= 12001/minute

Physical value in the base unit "1/sec": 1200 ×1.0 × (1/60) + 0= 201/second

Example 2
A parameter has variable index 22, that is, "Electrical current" and base unit is 1 A. The conversion index is -1, that is, the value transmitted from drive has the unit 0.1 A.

- Transmitted value: 35
- Standardization factor: 1.0
- Variable index: 22 "Electrical current", base unit is "1 A"
- Conversion index: -1 The transmitted value has the unit "0.1 A"

Physical value in the **specified** unit "0.1 A": 35 × 1.0 = 35(0.1 Amperes) Physical value in the **base** unit "1 A": 35 ×1.0 × 0.1 + 0 = 3.5 A.

5.1.3.12 Name Field

This field contains 16 ASCII characters which form the symbolic name for the parameter.

5.1.3.13 Low/High Limit Fields

These fields contain the possible low and high limits of the parameter. If the parameter is a string, the limits are irrelevant.

5.1.3.14 ID Extension Field

This field is not used in the PROFIdrive 4.1 specification, and is always 0.

5.1.3.15 Normalization Reference Parameter Field

For parameters with the physical quantity "Ratio", it can be possible to convert the value into another physical unit by use of a reference parameter. If so, this field contains the parameter number (PNU) of the reference parameter for this value.

For example, the speed setpoint, and actual values are in PROFIdrive 4.1 mode normalized as 0x4000 corresponding to 100.00%. The parameter description contains the number of the reference parameter which describes what the physical reference value is. It is announced along with the normalization field contents (see the example in 5.1.3.16 Normalization Field).

The description of the reference parameter contains the variable index and conversion index of the physical reference value, for example, "Speed" and "1/minute".

If no physical reference parameter is available, the contents of this field are 0.

5.1.3.16 Normalization Field

The normalization field contains the following information:

Table 74: Structure of the Normalization Field

Bits	Name	Description
0–5	Identifier (ID)	• Specifies which bit is the normalization bit, which corresponds to the physical reference value. • Values 0–31 are allowed. • Values 32–63 are reserved and thus not allowed.
6–14	Reserved	Always 0.
15	Normalization valid.	This bit is set if the parameter is normalized.

Example

In PROFIdrive 4.1 mode, the speed setpoint value is normalized such that 0x4000 corresponds to 100.00% of a reference value.

The normalization reference parameter field contains the parameter number of the reference parameter.

In the normalization field, bit 15 is set and the bits 0–5 contain the value 14. It means that bit 14 (0x4000) corresponds to the value which is specified in the physical reference parameter.

5.1.4 Example Requests and Responses

5.1.4.1 Request Parameter PNU918 Value

Table 75: Information Used for Request Parameter PNU918 Value

Field	Contents
Request reference	0x01
Request ID	0x01 = Request parameter
Axis Number	0x01
Number of Parameters	0x01
Attribute	0x10 = Value
Number of elements	0x01
Parameter Number	0x0396 (918d)
Sub-index	0x0000 (0d)

Table 76: The Final Request Structure

DP-V1 header	Request header	Parameter address
0x5F 0x00 0x2F 0x0A	0x01 0x01 0x01 0x01	0x10 0x01 0x03 0x96 0x00 0x00

Table 77: The Slave Respond to Request Parameter PNU918 Value

DP-V1 header
0x5F 0x00 0x2F 0x0A

5.1.4.2 Read Response to Request Parameter PNU918 Value

In this example, node address 3 is used.

After the request in 5.1.4.1 Request Parameter PNU918 Value is sent, the following read request is sent to the slave:

Table 78: The Read Request to Slave

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 79: The Response Received from the Device

DP-V1 header	Request header	Parameter value
0x5E 0x00 0x2F 0x08	0x01 0x01 0x01 0x01	0x42 0x01 0x00 0x03

Table 80: Description of the Response Contents

Field	Contents
Request reference	0x01
Response ID	0x01 = Request parameter (successful)
Axis Number	0x01
Number of Parameters	0x01
Format	0x42 = Word
Number of values	0x01
Value	0x0003

5.1.4.3 Request All Elements of Parameter PNU964

Table 81: Information Used for Request All Elements of Parameter PNU964

Field	Contents
Request reference	0x02
Request ID	0x01 = Request parameter
Axis Number	0x01
Number of Parameters	0x01
Attribute	0x10 = Value
Number of elements	0x06
Parameter Number	0x03C4 (964d)
Sub-index	0x0000 (0d)

Table 82: The Final Request Structure

DP-V1 header	Request header	Parameter address
0x5F 0x00 0x2F 0x0A	0x02 0x01 0x01 0x01	0x10 0x06 0x03 0xC4 0x00 0x00

Table 83: The Slave Respond to Write Request

DP-V1 header
0x5F 0x00 0x2F 0x0A

5.1.4.4 Read Response to Request Parameter PNU964

Table 84: The Read Request to Slave

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 85: The Response Received from the Device

DP-V1 header	Request header	Parameter value
0x5E 0x00 0x2F 0x12	0x02 0x01 0x01 0x01	0x42 0x06 0x01 0xBA 0x00 0x02 0x00 0x6B 0x07 0xDA 0x0A 0x2D 0x00 0x01

Table 86: Description of the Response Contents

Field	Contents
Response reference	0x01
Response ID	0x01 = Request parameter (successful)
Axis Number	0x01
Number of Parameters	0x01
Format	0x42 = Word
Number of values	0x06
Values	0x01BA 0x0002 0x006B 0x07DA 0x0A2D 0x0001

Thus the following information can be determined about the device:

- Manufacturer code is 0x01BA
- Drive Unit type is 0x0002 (VACON® 100 Family)
- Software version is 1.7 (0x006B = 107d)
- Firmware date (year) is 2010 (0x07DA)
- Firmware date (day/month) is 26/05 (0x0A2D = 2605d)
- The device contains one axis

5.1.4.5 Request the Value of Unsupported Parameter PNU900

Table 87: Information Used for Request for Value of Unsupported Parameter PNU900

Field	Contents
Request reference	0x03
Request ID	0x01 = Request parameter
Axis Number	0x01

Field	Contents
Number of Parameters	0x01
Attribute	0x10 = Value
Number of elements	0x01
Parameter Number	0x0384 (900d)
Sub-index	0x0000 (0d)

Table 88: The Final Request Structure

DP-V1 header	Request header	Parameter address
0x5F 0x00 0x2F 0x0A	0x03 0x01 0x01 0x01	0x10 0x01 0x03 0x84 0x00 0x00

Table 89: The Slave Respond to Write Request

DP-V1 header
0x5F 0x00 0x2F 0x0A

5.1.4.6 Read Response to Request of Unsupported Parameter PNU900

Table 90: The Read Request to Slave

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 91: The Response Received from the Device

DP-V1 header	Request header	Parameter value
0x5E 0x00 0x2F 0x08	0x03 0x81 0x01 0x01	0x44 0x01 0x00 0x00

The error which occurred is indicated in several parts of the message:

- The second octet in the response header contains 0x80 (negative result).
- The first octet in the parameter value is 0x44 (Error).
- The third octet in the parameter value indicates the error code (0 = impermissible PNU).
- If reading from an array, the fourth octet indicates the first element where the error occurs.

5.1.4.7 Request the Value of Drive Parameter ID 103

Table 92: The Master Write Request

DP-V1 header	Request header	Parameter address
0x5F 0x00 0x2F 0x0A	0x04 0x01 0x01 0x01	0x10 0x01 0x27 0x11 0x00 0x67

Table 93: The Slave Acknowledgement

DP-V1 header
0x5F 0x00 0x2F 0x0A

Table 94: The Master Read Request

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 95: The Slave Response

DP-V1 header	Request header	Parameter address
0x5E 0x00 0x2F 0x08	0x04 0x01 0x01 0x01	0x42 0x01 0x00 0x1E

5.1.4.8 Change the Value of Drive Parameter ID 103 (Successful)

Table 96: The Master Write Request to Change ID 103 Value to 40d

DP-V1 header	Request header	Parameter address	Parameter value
0x5F 0x00 0x2F 0x0E	0x05 0x02 0x01 0x01	0x10 0x01 0x27 0x11 0x00 0x67	0x42 0x01 0x00 0x28

Table 97: The Slave Acknowledgement

DP-V1 header
0x5F 0x00 0x2F 0x0E

Table 98: The Master Read Request

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 99: The Slave Response

DP-V1 header	Request header
0x5E 0x00 0x2F 0x04	0x05 0x02 0x01 0x01

5.1.4.9 Change the Value of Drive Parameter ID 103 (Unsuccessful)

In this example, the value of AC drive parameter ID 103 is requested to be changed to value 0d. This value corresponds to acceleration time = 0.0 s which is not allowed value.

Table 100: The Master Write Request to Change ID 103 Value to 0d

DP-V1 header	Request header	Parameter address	Parameter value
0x5F 0x00 0x2F 0x0E	0x06 0x02 0x01 0x01	0x10 0x01 0x27 0x11 0x00 0x67	0x42 0x01 0x00 0x00

Table 101: The Slave Acknowledgement

DP-V1 header
0x5F 0x00 0x2F 0x0E

Table 102: The Master Read Request

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 103: The Slave Response

DP-V1 header	Request header	Parameter value
0x5E 0x00 0x2F 0x08	0x06 0x82 0x01 0x01	0x44 0x01 0x00 0x02

The error code 0x02 indicates that the low or high limit of the parameter was exceeded.

5.1.4.10 Request Multiple Values from Drive

There are two methods of requesting multiple drive parameters: reading multiple parameters or reading multiple elements. When reading multiple elements, the format (data type) of the parameters must be identical.

For both examples, the master writes a request to read ID 101 (Minimum frequency reference) and ID 102 (Maximum frequency reference).

Method 1: Reading multiple drive parameters

Table 104: Information Used for Request Multiple Drive Parameters

Field	Contents
Request reference	0x04
Request ID	0x01 = Request parameter
Axis Number	0x01
Number of Parameters	0x02
Attribute	0x10 = Value
Number of elements	0x01
Parameter Number	0x2711 (10001d)
Sub-index 1	0x0065 (101d)
Sub-index 2	0x0066 (102d)

Table 105: The Final Request Structure

DP-V1 header	Request header	Parameter address
0x5F 0x00 0x2F 0x10	0x04 0x01 0x01 0x02	0x10 0x01 0x27 0x11 0x00 0x65 0x10 0x01 0x27 0x11 0x00 0x66

Table 106: The Slave Acknowledgement

DP-V1 header
0x5F 0x00 0x2F 0x0A

Table 107: The Master Read Request

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 108: The Slave Response

DP-V1 header	Response header	Parameter value
0x5E 0x00 0x2F 0x0C	0x04 0x01 0x01 0x02	0x42 0x01 0x00 0x00 0x42 0x01 0x13 0x88

Table 109: Description of Response Contents

Field	Contents
Request reference	0x04
Request ID	0x01 = Request parameter
Axis Number	0x01
Number of Parameters	0x02
Parameter format	0x42 = Word

Field	Contents
Number of elements	0x01
Parameter 1 value	0x0000 = 0.0 Hz
Parameter 2 value	0x1388 (5000d) = 50.00 Hz

Method 2: Reading multiple drive parameters as elements

Table 110: Information Used for Request Multiple Drive Parameters as Elements

Field	Contents
Request reference	0x05
Request ID	0x01 = Request parameter
Axis Number	0x01
Number of Parameters	0x01
Attribute	0x10 = Value
Number of elements	0x02
Parameter Number	0x2711 (10001d)
Start index	0x0065 (101d)

Table 111: The Final Request Structure

DP-V1 header	Request header	Parameter address
0x5F 0x00 0x2F 0x0A	0x05 0x01 0x01 0x01	0x10 0x02 0x27 0x11 0x00 0x65

Table 112: The Slave Acknowledgement

DP-V1 header
0x5F 0x00 0x2F 0x0A

Table 113: The Master Read Request

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 114: The Slave Response

DP-V1 header	Response header	Parameter address
0x5E 0x00 0x2F 0x0A	0x05 0x01 0x01 0x01	0x42 0x02 0x00 0x00 0x13 0x88

Table 115: Description of Response Contents

Field	Contents
Request reference	0x05
Request ID	0x01 = Request parameter
Axis Number	0x01
Number of Parameters	0x01

Field	Contents
Parameter format	0x42 = Word
Number of elements	0x02
Parameter 1 value	0x0000 = 0.0 Hz
Parameter 2 value	0x1388 (5000d) = 50.00 Hz

5.1.4.11 Change Values of Multiple Drive Parameters (Successful)

There are two methods of writing multiple drive parameters: writing multiple parameters or writing multiple elements. When writing multiple elements, the format (data type) of the parameters must be identical.

For both examples, the master writes a request to change ID 101 (Minimum frequency reference) to value 1000d (10.00 Hz) and ID 102 (Maximum frequency reference) to value to 4000d (40.00 Hz).

Method 1: Writing multiple drive parameters

Table 116: Information Used for Writing Multiple Drive Parameters

Field	Contents
Request reference	0x06
Request ID	0x02 = Change parameter
Axis Number	0x01
Number of Parameters	0x02
Attribute	0x10 = Value
Number of elements	0x01
Parameter Number	0x2711 (10001d)
Sub-index 1	0x0065 (101d)
Sub-index 2	0x0066 (102d)
Parameter formats	0x42
Number of values	0x01
Parameter 1 value	0x03E8 (1000d)
Parameter 2 value	0x0FA0 (4000d)

Table 117: The Final Master Write Request Structure

DP-V1 header	Request header	Parameter address	Parameter value
0x5F 0x00 0x2F 0x18	0x06 0x02 0x01 0x02	0x10 0x01 0x27 0x11 0x00 0x65 0x10 0x01 0x27 0x11 0x00 0x66	0x42 0x01 0x03 0xE8 0x42 0x01 0x0F 0xA0

Table 118: The Slave Acknowledgement

DP-V1 header
0x5F 0x00 0x2F 0x0E

Table 119: The Master Read Request

DP-V1 header
0x5F 0x00 0x2F 0xF0

Table 120: The Slave Response

DP-V1 header	Response header
0x5E 0x00 0x2F 0x04	0x06 0x02 0x01 0x02

Table 121: Description of Response Contents

Field	Contents
Response reference	0x06
Request ID	0x02 = Change parameter (successful)
Axis Number	0x01
Number of Parameters	0x02

Method 2: Writing multiple drive parameters elements

Table 122: Information Used for Writing Multiple Drive Parameter Elements

Field	Contents
Request reference	0x06
Request ID	0x02 = Change parameter
Axis Number	0x01
Number of Parameters	0x01
Attribute	0x10 = Value
Number of elements	0x02
Parameter Numbers	0x2711 (10001d)
Sub-index	0x0065 (101d)
Parameter format	0x42
Number of values	0x02
Parameter 1 value	0x03E8 (1000d)
Parameter 2 value	0x0FA0 (4000d)

Table 123: The Final Master Write Request Structure

DP-V1 header	Request header	Parameter address	Parameter value
0x5F 0x00 0x2F 0x10	0x06 0x02 0x01 0x01	0x10 0x02 0x27 0x11 0x00 0x65	0x42 0x02 0x03 0xE8 0x0F 0xA0

Table 124: The Slave Response

DP-V1 header
0x5F 0x00 0x2F 0x0E

Table 125: The Master Read Request

DP-V1 header
0x5F 0x00 0x2F 0xF0

Table 126: The Slave Response

DP-V1 header	Request header
0x5E 0x00 0x2F 0x0E	0x06 0x02 0x01 0x01

Table 127: Description of Response Contents

Field	Contents
Response reference	0x06
Request ID	0x02 = Change parameter (successful)
Axis Number	0x01
Number of Parameters	0x01

5.1.4.12 Change Values of Multiple Drive Parameters (Unsuccessful)

Writing maximum frequency (ID 102) value lower than minimum frequency (ID 101) is not allowed.

Method 1: Writing multiple drive parameters

Table 128: Information Used for Writing Multiple Drive Parameters

Field	Contents
Request reference	0x07
Request ID	0x02 = Change parameter
Axis Number	0x01
Number of Parameters	0x02
Attribute	0x10 = Value
Number of elements	0x01
Parameter Number	0x2711 (10001d)
Sub-index 1	0x0065 (101d)
Sub-index 2	0x0066 (102d)
Parameter formats	0x42
Number of values	0x01
Parameter 1 value	0x03E8 (1000d)
Parameter 2 value	0x01F4 (500d)

Table 129: The Final Master Write Request Structure

DP-V1 header	Request header	Parameter address	Parameter value
0x5F 0x00 0x2F 0x18	0x07 0x02 0x01 0x02	0x10 0x01 0x27 0x11 0x00 0x65 0x10 0x01 0x27 0x11 0x00 0x66	0x42 0x01 0x03 0xE8 0x42 0x01 0x0F 0xF4

Table 130: The Slave Response

DP-V1 header
0x5F 0x00 0x2F 0x0E

Table 131: The Master Read Request

DP-V1 header
0x5F 0x00 0x2F 0xF0

Table 132: The Slave Response

DP-V1 header	Response header	Response value
0x5E 0x00 0x2F 0x0A	0x07 0x82 0x01 0x02	0x40 0x00 0x44 0x01 0x00 0x02

Table 133: Description of Response Contents

Field	Contents
Response reference	0x07
Request ID	0x82 = Change parameter (unsuccessful)
Axis Number	0x01
Number of Parameters	0x02
Format 1	0x40 = Zero (indicates successful write)
Number of values	0x00
Format 2	0x44 = Error
Number of values	0x01
Error value	0x00 0x02 = Low or high limit exceeded

Method 2: Writing multiple drive parameters elements

NOTE! When using this method, the remaining operations are skipped when the writing of an element fails.

Table 134: Information Used for Writing Multiple Drive Parameter Elements

Field	Contents
Request reference	0x07
Request ID	0x02 = Change parameter
Axis Number	0x01
Number of Parameters	0x01
Attribute	0x10 = Value
Number of elements	0x02
Parameter Numbers	0x2711 (10001d)
Sub-index	0x0065 (101d)
Parameter format	0x42
Number of values	0x02
Parameter 1 value	0x03E8 (1000d)
Parameter 2 value	0x01F4 (500d)

Table 135: The Final Master Write Request Structure

DP-V1 header	Request header	Parameter address	Parameter value
0x5F 0x00 0x2F 0x10	0x07 0x02 0x01 0x01	0x10 0x02 0x27 0x11 0x00 0x65	0x42 0x02 0x03 0xE8 0x01 0xF4

Table 136: The Slave Response

DP-V1 header
0x5F 0x00 0x2F 0x0E

Table 137: The Master Read Request

DP-V1 header
0x5F 0x00 0x2F 0xF0

Table 138: The Slave Response

DP-V1 header	Request header	Response value
0x5E 0x00 0x2F 0x09	0x07 0x82 0x01 0x01	0x01 0x44 0x01 0x00 0x02

Table 139: Description of Response Contents

Field	Contents
Response reference	0x07
Request ID	0x82 = Change parameter (unsuccessful)
Axis Number	0x01
Number of Parameters	0x01
Format	0x44 = Error
Number of values	0x01
Error value	0x00 0x02 = Low or high limit exceeded

5.1.5 Supported Parameters

The OPTE3/E5 supports several PNUs (Parameter Number) for acyclic data access. These tables describe the list and content of the supported PNUs.

Table 140: PNU Data Type Description

Data type	Description
UINT	Unsigned 16-bit integer
UINT[x]	Array of unsigned integers, x elements
INT	Signed 16-bit integer
INT[x]	Array of signed integers, x elements
BYTE[x]	Array of 8-bit unsigned integers, x elements
LONG	Unsigned 32-bit integer
FLOAT	32-bit floating point

List of all supported PNUs can be seen from Table 141.

Table 141: Supported PNUs

PNU	Significance	Data type	Description
915	Selection switch for DO I/O Data in setpoint telegram	UINT[18]	I/O setpoint data description. Read only.
916	Selection switch for DO I/O Data in actual value telegram	UINT[18]	I/O actual data description. Read only.
918	PROFIBUS DP node address	UINT	See 6.1 PROFIBUS DP Board Parameters.
922	Telegram selection	UINT	Used telegram. See Table 30.
923	List of all parameters for signals	UINT[x]	See 4.3.5.12 Coding of Data Signals.
930	Operating mode	UINT	1 = Speed control mode
944	Fault message counter	UINT	See 5.1.6 PROFIdrive Fault Buffer
947	Fault number	UINT[32]	
950	Scaling of the fault buffer	UINT[2]	
963	PROFIBUS DP actual baud rate	UINT	See Table 142
964	Drive Unit identification	UINT[6]	See Table 143
965	Profile identification number	BYTE[2]	Byte 1 = 3 (PROFIdrive), Byte 2 = 41 (Version 4.1)
975	Drive Object identification	UINT[7]	See Table 144
980	Number list of defined parameters	UINT[46]	List of defined parameters in array
981… 999	Number list of defined parameters	UINT	Not used.
9900	Dummy writeable single parameter	UINT	Test parameter
9901	Dummy writeable array parameter	UINT[8]	Test array parameter
10001	Parameter in drive	UINT	Parameter channel. For example, see 5.1.4.7 Request the Value of Drive Parameter ID 103.
10100	Profile control word (STW1)	UINT	See 4.3.5.6 PROFIdrive 4.1 Control Word (STW1).
10101	Speed setpoint (NSOLL_A)	INT	See 4.3.5.8 Setpoint Value.
10102	Profile status word (ZSW1)	UINT	See 4.3.5.7 PROFIdrive 4.1 Status Word (ZSW1).
10103	Speed actual value (NIST_A)	INT	See 4.3.5.9 Actual Speed Value.
10104	Filtered output current (IAIST_GLATT)	INT	See Table 35.
10105	Filtered active current (ITIST_GLATT)	INT	
10106	Filtered active power (PIST_GLATT)	INT	
10107	Filtered speed actual value (NIST_A_GLATT)	INT	See 4.3.5.3 Standard Telegrams.
10108	Drive status/fault word (MELD_NAMUR)	UINT	See Table 36.
10109	Process Data In word	UINT[16]	See 4.3.2 Fieldbus Process Data.
10110	Process Data Out word	UINT[16]	

PNU	Significance	Data type	Description
10111	Speed physical reference value	UINT	See 4.3.5.10 Normalization Reference Parameter.
10112	Non-profile control word	UINT	See 4.3.3 Bypass Operating Mode.
10113	Non-profile status word	UINT	
10114	Non-profile speed setpoint value	UINT	See 4.3.3 Bypass Operating Mode.
10115	Non-profile speed actual value	UINT	
10116	Motor current physical reference value	UINT	Motor nominal current in 0.1 A.
10117	Power physical reference value	UINT	Motor nominal power in W.
10118	Clear fault history	UINT	Writing to this PNU clears fault history from AC drive.
10119	Read fault history	BYTE[40]	Read fault history as 8-bit error codes.
10124	Operation time	LONG	Operation time in s.
10125	Trip operation time	LONG	Trip operation time in s. Write 0 value to clear trip time.
10126	Energy counter	FLOAT	Energy counter in kWh.
10127	Trip energy counter	FLOAT	Trip energy counter in kWh. Write 0 value to clear trip counter.
10128	Read fault history with time stamps	UINT(115)	See Table 145.
10129	Speed physical reference parameter for High speed applications	Unsigned16	See 4.3.5.10 Normalization Reference Parameter.
10200	Safety control word 1 (S_STW1)	BYTE[2]	See VACON® NXP Advanced Safety Options Operating Guide.
10201	Safety status word 1 (S_ZSW1)	BYTE[2]	
10202	Safety control word 2 (S_STW2)	BYTE[4]	
10203	Safety status word 2 (S_ZSW2)	BYTE[4]	
10204	VACON® safety control word (VS_CW)	BYTE[6]	
10205	VACON® safety status word (VS_SW)	BYTE[6]	
60022	Safety telegram number	UINT	Parameterized safety telegram number. 0 = Not used
60044	Safety fault message counter	UINT	See 5.1.6 PROFIdrive Fault Buffer.
60047	Safety fault number	UINT[64]	
60050	Scaling of the safety fault buffer	UINT[2]	

Table 142: Coding of PNU 963 (PROFIBUS DP Actual Baud Rate)

Value	Significance
0	9.6 kbit/s
1	19.2 kbit/s
2	93.75 kbit/s

Value	Significance
3	187.5 kbit/s
4	500 kbit/s
5	Not defined
6	1500 kbit/s
7	3000 kbit/s
8	6000 kbit/s
9	12000 kbit/s
10	31.25 kbit/s
11	45.45 kbit/s

Table 143: Structure of PNU 964 (Drive Unit Identification)

Sub-index	Content	Value
0	Manufacturer	0x01BA = VACON®
1	Drive Unit type	0x0001 = VACON® NXP family AC drive 0x0002 = VACON® 100 family AC drive 0x0003 = VACON® 20 family AC drive
2	Version (Software)	Varies: for example, 600(d) = 6.0
3	Firmware date (year)	yyyy (decimal)
4	Firmware date (day/month)	ddmm (decimal)
5	Number of Drive Objects (DO)	0x0001

Table 144: Structure of PNU 975 (DO Identification)

Sub-index	Content	Value
0	Manufacturer	0x01BA = VACON®
1	DO type	0x0003
2	Version (Software)	Varies: for example, 0x0600 = 6.0
3	Firmware date (year)	yyyy (decimal)
4	Firmware date (day/month)	ddmm (decimal)
5	PROFIdrive DO type class	0x0001 = Axis
6	PROFIdrive DO sub class 1	0x0001

Table 145: Structure of PNU 10128 (Fault History With Time Stamps)

UINT index	Content
0	Fault 1: 16-bit fault code
1	Fault 1: 16-bit sub code
2	Fault 1: EPOCH time stamp 16-bit high data. 0x386D when 0x386D4D8C.

UINT index	Content
3	Fault 1: EPOCH time stamp 16-bit low data. 0x4D8C when 0x386D4D8C.
4	Fault 1: Time stamp milliseconds 0–999.
5	Fault 2: 16-bit fault code
6	Fault 2: 16-bit sub code
7	Fault 2: EPOCH time stamp 16-bit high data. 0x386D when 0x386D4D8C.
8	Fault 2: EPOCH time stamp 16-bit low data. 0x4D8C when 0x386D4D8C.
9	Fault 2: Time stamp milliseconds 0–999.

5.1.6 PROFIdrive Fault Buffer

The PROFIdrive fault buffer can be used to read drive faults via PROFIBUS DP. The PROFIdrive fault buffer consists of several PNUs, which implement the PROFIdrive fault system. Overview of the PROFIdrive fault buffer can be seen in Illustration 10.

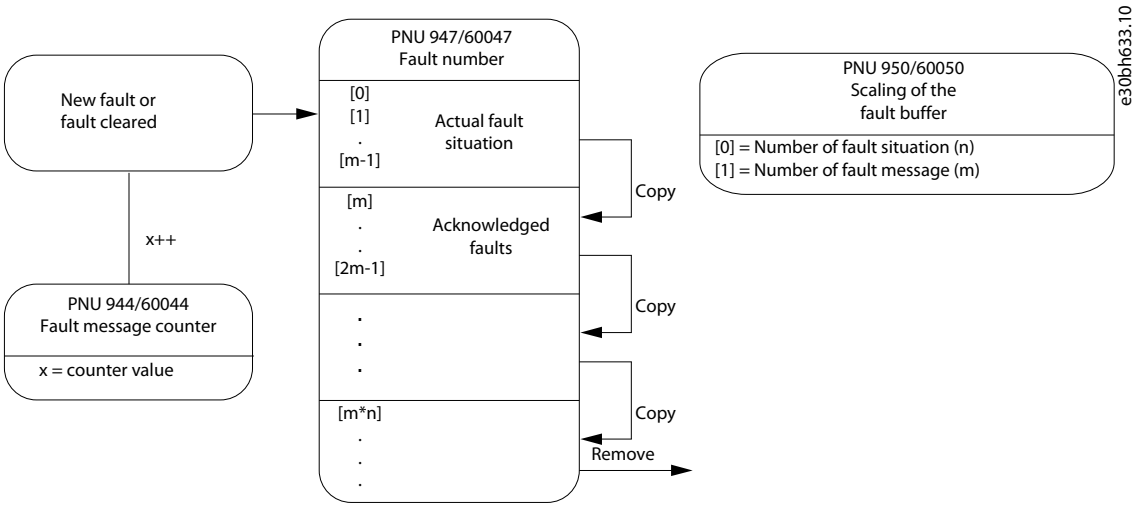


Illustration 10: PROFIdrive Fault Buffer

The OPTE3/E5 supports two PROFIdrive fault buffers, one for AC drive errors, and the other for safety-related errors. All safety-related errors appear in the safety fault buffer and all error codes in normal fault buffer. PNUs 944, 947 and 950 are used for AC drive fault buffer and PNUs 60044, 60047 and 60050 for safety fault buffer. All used PNUs are listed in Table 146.

Table 146: PROFIdrive Fault Buffer Parameters

PNU	Designation	Explanation	Data type	Value
944	Fault message counter	Incremented each time that the fault buffer changes	UINT16	-
947	Fault number	Contains the internal fault number for each fault message	UINT16[32]	-
950	Scaling of the fault buffer	Index 0: The number of fault situations of the fault buffer	UINT16[2]	4
		Index 1: The number of fault messages per fault situation		8
60044	Safety fault message counter	Incremented each time that the safety fault buffer changes	UINT16	-
60047	Safety fault number	32-bit safety fault codes (2 messages per active fault)	UINT16[64]	-
60050	Scaling of the safety fault buffer	Index 0: The number of fault situations of the fault buffer	UINT16[2]	8
		Index 1: The number of fault messages per fault situation		8

The PNU 947 fault number error codes are linked directly from the AC drive fault system (16-bit). The definition of these fault codes can be found in application-specific manuals. 4 active faults can be shown at once, and the fault history is 8 faults long.

The PNU 60047 safety fault number error codes are 32-bit long, each fault taking two messages from the fault buffer. Therefore the number of active fault situations is 8/2 = 4. The safe fault history holds 8 fault situations.

The fault code is defined as follows:

0xAABBCCDD, where

AA = Error class

BB = Source

CC = Fault number

DD = Additional Info

The definition of these fault codes can be found in the VACON® NXP Advanced Safety Options Operating Guide.

NOTE! If no fault is active, the active fault situation (first fault situation) is zero.

5.1.7 Drive System Time

System time in VACON® 100 family and VACON® NXP AC drives can be updated by writing 32-bit unsigned value to ID 2551. This value is seconds since 1.1.1970 (Unix time). If there is OPTE3/E5 PROFIBUS DP option board, ID 2551 can be read and written by using PROFIdrive parameter channel.

In VACON® 100 family, the default time zone is UTC. Local time can be configured by changing the time zone and setting the day-light saving mode. If the VACON® 100 AC drive is equipped with a battery for the real-time clock, then setting of the time is not necessary after power cycle.

VACON® NXP AC drive does not have time settings, so value written to this ID must be local time. VACON® NXP system time is zero after the drive boots up. The system time is started after writing into ID 2551.

5.1.7.1 Read Drive System Time

In a following example PROFIBUS DP master reads system time 1523859228 (16-Apr-2018 06:13:42) from AC drive by using PROFIdrive parameter access. The time is mentioned in hexadecimal format (0x5AD43F1C) at the end of response frame. See details of parameter access in 5.1.2 Parameter Requests.

Table 147: Read Request from PROFIBUS DP Master to AC drive

DP-V1 header	Request header	Parameter address
0x5F 0x00 0x2F 0x0A	0x01 0x01 0x01 0x01	0x10 0x01 0x27 0x11 0x09 0xF7

Table 148: Acknowledge from AC Drive

DP-V1 header
0x5F 0x00 0x2F 0x0A

Table 149: Read "Read Response" Request from PROFIBUS DP Master to AC Drive

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 150: Read Response from AC drive

DP-V1 header	Response header	Parameter value
0x5E 0x00 0x2F 0x08	0x01 0x01 0x01 0x01	0x43 0x01 0x5A 0xD4 0x3F 0x1C

5.1.7.2 Write Drive System Time

In the following example PROFIBUS DP master writes system time 1523859228 (16-Apr-2018 06:13:42) to AC drive by using PROFIdrive parameter access. The time is mentioned in hexadecimal format (0x5AD43F1C) at the end of request frame. See details of parameter access in 5.1.2 Parameter Requests.

Table 151: Read Request from PROFIBUS DP Master to AC drive

DP-V1 header	Request header	Parameter address	Parameter value
0x5F 0x00 0x2F 0x10	0x01 0x02 0x01 0x01	0x10 0x01 0x27 0x11 0x09 0xF7 0x43 0x01	0x5A 0xD4 0x3F 0x1C

Table 152: Acknowledge from AC Drive

DP-V1 header
0x5F 0x00 0x2F 0x10

Table 153: Read "Write Response" Request from PROFIBUS DP Master to AC Drive

DP-V1 header
0x5E 0x00 0x2F 0xF0

Table 154: Write Response from AC drive

DP-V1 header	Response header
0x5E 0x00 0x2F 0x04	0x01 0x02 0x01 0x01

5.2 Parameter Access in PROFIdrive 2.0

5.2.1 DP-V1 with PROFIdrive 2.0

In the PROFIdrive 2.0 mode, only the following parameters are supported through DP-V1:

- 918 (node address)
- 963 (current baud rate)
- 980 (number list of defined parameters)
- 10001 (read parameter from drive)

In this case the parameter 980 contains four elements: 918, 963, 10001 and 0.

For information on using DP-V1 with PROFIdrive 2.0 configuration, see 5.1.2 Parameter Requests.

When using PPO1, PPO2 or PPO5, the PKW field is used to access parameters from the drive only. The parameter number which is provided in the PKW field is interpreted as an application ID and is read from/written to the drive.

5.2.2 Parameter Field (PKW) in PPO Types

The parameter request field is structured into three subfields:

- ID field (2 octets)
- Index field (2 octets)
- Value field (4 octets)

ID field	Index field	Value field

The master formulates a task for parameter processing by issuing a request in the PKW field. The master repeats this request until it receives a response from the slave. The slave repeats its response until it receives a new request from the master.

ID Subfield

The ID subfield consists of three subsections:

Table 155: ID Subfield Structure

ID field octet 1								ID field octet 2							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Request/response type				Not used	Parameter Number (= Drive Application ID number)										

Table 156: Possible Request/Response Types

Value	Meaning if request	Meaning if response
0	No request	No response
1	Read parameter value (word)	Parameter value ready (word)
2	Write parameter value (word)	Reserved
3...6	Reserved	Reserved
7	Reserved	Request rejected (+ fault code)

If a request is rejected, a fault code from the table is provided:

Table 157: Fault Codes

Fault Code	Description
0	Illegal parameter
1	Parameter is read-only (for example, actual value)
2	Parameter value is out of limits
17	Request is temporarily rejected (for example, can be changed only when drive is in STOP state)
18	Unspecified fault
101	Unknown request type

Index Subfield

This field is not used in the PKW processing. Its contents must be set to 0.

Value Subfield

The Value subfield consists of two words that is, four octets:

Table 158: Value Subfield Structure

Data word 1 (HIGH)		Data word 2 (LOW)	
Octet 0	Octet 1	Octet 2	Octet 3

When writing a parameter to the drive, the data to be written must be placed in the "Data word 2 (LOW)" field by the master.
When reading a parameter from the drive, the response is placed in the "Data word 2 (LOW)" field by the slave.
The "Data word 1 (HIGH)" field is zero.

5.2.3 Example Requests and Responses

5.2.3.1 Read Maximum Frequency (ID = 102)

Table 159: The Master PKW Request

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
0x10	0x66	0x00	0x00	0x00	0x00	0x00	0x00

Table 160: Description of the Request Contents

Field	Contents	Description
ID	0x1066	1 = Read parameter value 0x066 = 102d (Maximum Frequency ID)
Index	0x0000	No meaning

Field	Contents	Description
Value	0x00000000	No meaning

Assuming that the drive is parameterized with Maximum Frequency = 50.00 Hz, the response is:

Table 161: Slave Response

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
0x10	0x66	0x00	0x00	0x00	0x00	0x13	0x88

Table 162: Description of the Response Contents

Field	Contents	Description
ID	0x1066	1 = Parameter value ready (word) 0x066 = 102d (Maximum Frequency ID)
Index	0x0000	No meaning
Value	0x00001388	0x1388 = 5000d (Maximum Frequency is 50.00 Hz)

5.2.3.2 Write Control Place (ID = 125)

Table 163: The Master PKW Request

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
0x20	0x7D	0x00	0x00	0x00	0x00	0x00	0x02

Table 164: Description of the Request Contents

Field	Contents	Description
ID	0x207D	2 = Write parameter value 0x07D = 125d (Control Place ID)
Index	0x0000	No meaning
Value	0x00000002	Value to be written is 2

If the write is successful, the slave responds:

Table 165: Slave Response

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
0x10	0x7D	0x00	0x00	0x00	0x00	0x00	0x00

Table 166: Description of the Response Contents

Field	Contents	Description
ID	0x1066	1 = Parameter value ready (word) 0x07D = 125d (Control Place ID)
Index	0x0000	No meaning
Value	0x00000000	No meaning

6 Parameters

6.1 PROFIBUS DP Board Parameters

Table 167: OPTE3/E5 parameters

Index in panel tree for VACON® 100 family	Index in panel tree for VACON® NXP	Index in panel tree for VACON® 20 family	Parameter	Min	Max	Default	Description
P5.x.3.1	P7.x.1.1	P2.6	Slave address	2	126	126	Address of the slave, see 6.1.1 Slave Address.
P5.x.3.2	P7.x.1.2	P2.7	Operate mode	1	3	1	1 = PROFIdrive 2 = Bypass 3 = Echo See 6.1.2 Operate Mode.
P5.x.3.3	P7.x.1.3	P2.8	Compatib. mode	1	2	1	1 = Normal 2 = NX Mode / C3/C5 Mode 3 = PPO_PROFIdrive See 6.1.3 Compatib. Mode.

6.1.1 Slave Address

Valid PROFIBUS DP device addresses are in the range of 0–127 (decimal). The address 0 is reserved for Service-, diagnosis-, and programming tools. Address 1 is reserved for the fieldbus master. Address 127 is a broadcast address. Address 126 is only for commissioning. Do not use it permanently. Thus, values in the range 2–125 can be assigned to individual slave devices.

6.1.2 Operate Mode

Three different operate modes are available in OPTE3/E5 (see the figures Illustration 11, Illustration 12, and Illustration 13). The PROFIdrive mode uses telegrams specified in the profile specification. The bypass mode uses manufacturer-specific control and status word. The echo mode echoes the data back to the fieldbus master.

Operate Mode can also be configured in PLC, see 6.2.1 Operate Mode.

NOTE!When using ST1 and ST20 telegrams in PROFIdrive-Operate Mode, use PROFIdrive 4.1 State machine, together with PROFIdrive 4.1 Control and Status Words. When using PPO types, the default is the PROFIdrive 2.0 State machine, together with PROFIdrive 2.0 Control and Status Words. To use PROFIdrive 4.1 with PPO types, select "PPO_PROFIdrive Mode" as Compatib. mode.

NOTE! When using an application supporting PROFIdrive, set the application fieldbus state machine to "PROFIdrive" and the PROFIBUS DP option board to bypass mode.

Operate Mode "PROFIdrive"

The Operate Mode "PROFIdrive" can be used to enable the profile driver in the OPTE3/E5 option board for PROFIdrive support.

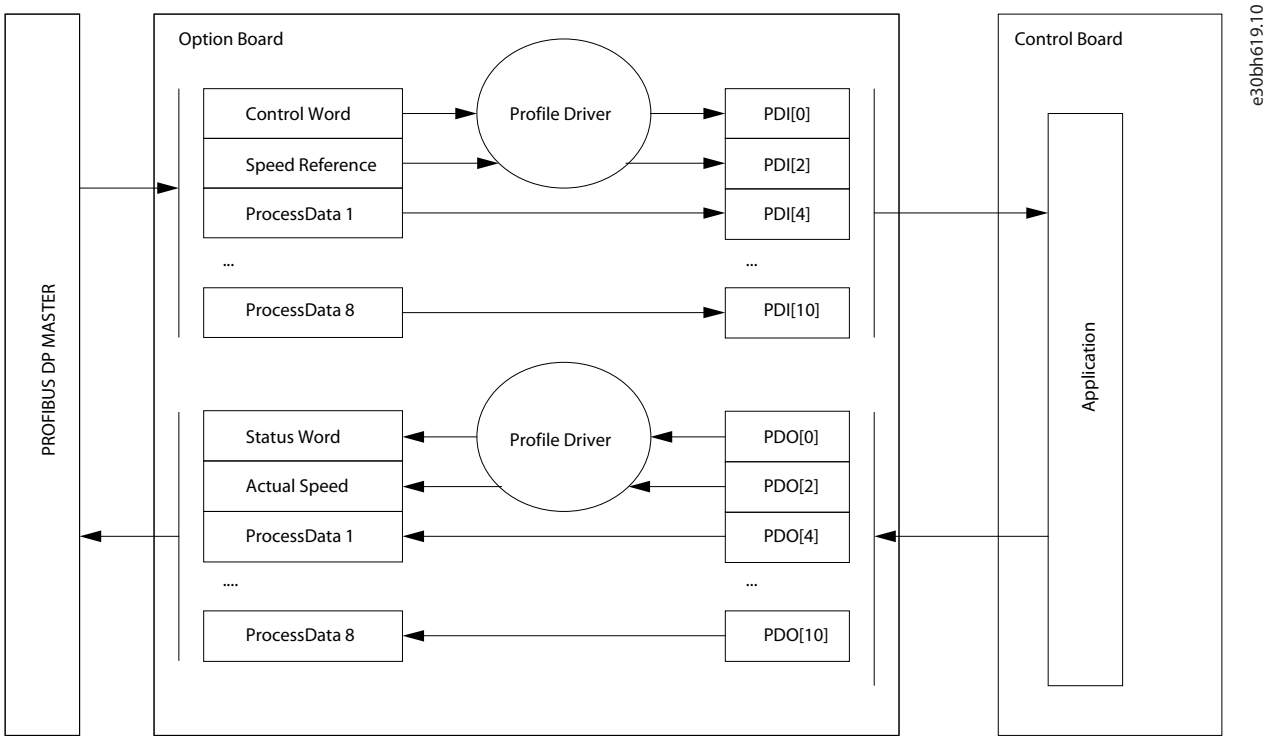


Illustration 11: Operate Mode "PROFIdrive"

Operate Mode "Bypass"

The information of the process data field is transferred to the application without handling.

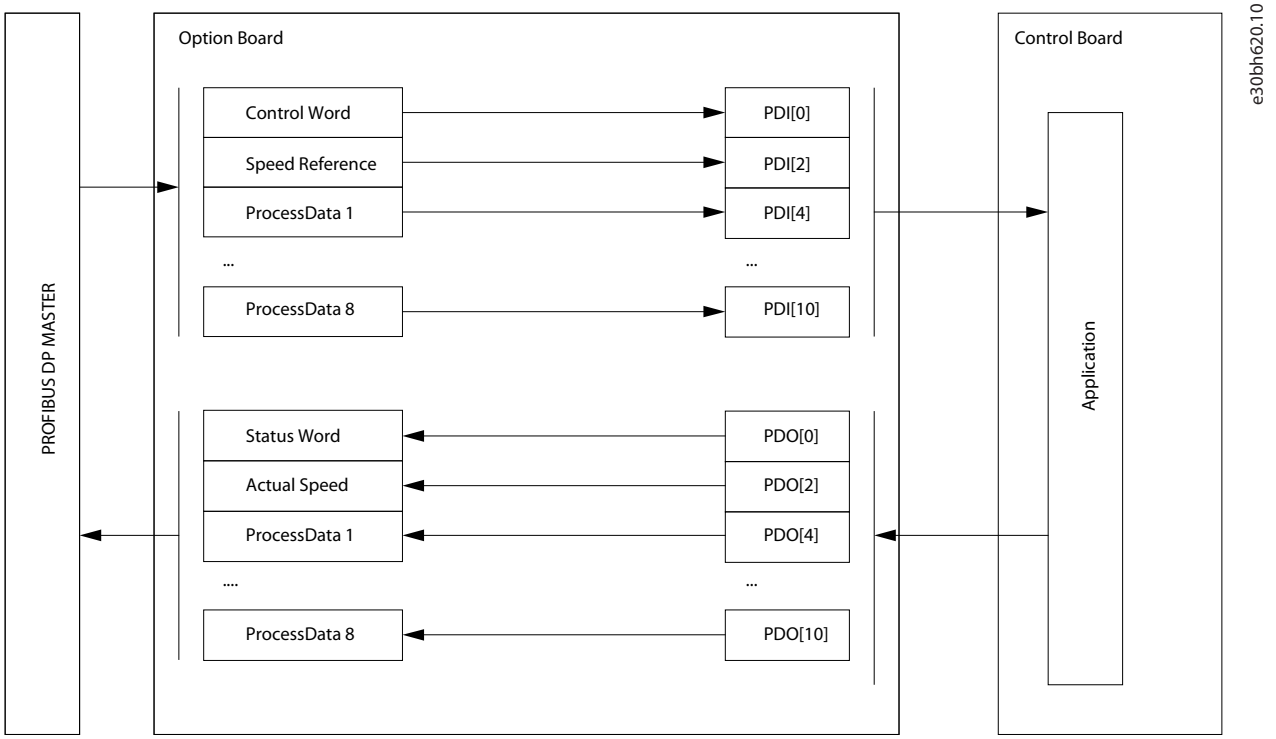


Illustration 12: Operate Mode "Bypass"

NOTE! The Status Word content is different between VACON® AC drives, when using bypass mode.

- VACON® 100 and VACON® 20 family AC drives return PDO [0] (Fixed Status Word)
- VACON® NXP series drives return PDI [1] (General Status Word)

It is not possible to use the Bypass mode when the Standard Telegram 20 is used. In this case, only PROFIdrive mode is allowed.

Operate Mode "Echo"

The received information is echoed back to Master (Output -> Input), without accessing the application.

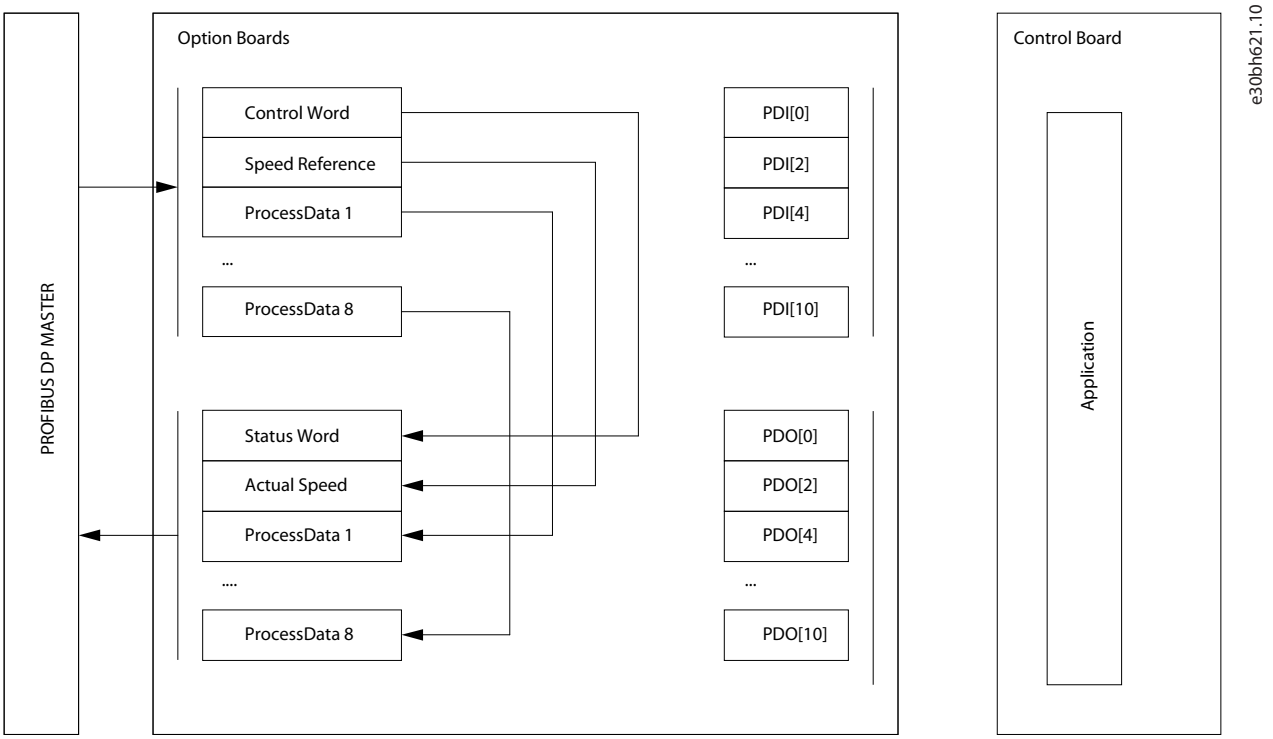


Illustration 13: Operate Mode "Echo"

It is not possible to use the Echo mode when the Standard Telegram 20 is used. In this case, only PROFIdrive mode is allowed.

Local versus Remote Mode

In the GSD for OPTE3/E5, it is possible to select the operating mode for the slave. Possible options are:

- Local mode
- Remote PROFIdrive mode
- Remote Bypass mode
- Remote Echo mode

In the Remote modes, the fieldbus master can force the slave into a specific operating mode. It allows the operating mode of the slave to be changed in the master configuration, without a need to use the keypad.

In the Local mode, the operating mode of the slave can be parameterized in the drive (for example, manually through the keypad). When the drive powers up, the last value configured in the drive determines the operating mode of the PROFIBUS DP slave.

NOTE! When the operating mode of the OPTE3/E5 board is remotely selected, its mode cannot be changed from the drive keypad.

6.1.3 Compatib. Mode

This setting can be used to set a compatibility mode.

- Normal mode: OPTE3/E5 PROFIBUS DP works with a default setting.
- NX Mode/C3 C5 Mode: OPTE3/E5 PROFIBUS DP identifies as NXP OPTC3/C5 option board. For more details, see 3.3 Replacing VACON® NXS or NXL AC Drive with VACON® 100 Family AC Drive. Mode is mentioned as "NX Mode" in VACON® 100 family and VACON® 20 family. Mode is mentioned as "C3 C5 Mode" in VACON® NXP.
- PPO_PROFIdrive mode: PROFIdrive version 4.1 is used with PPO types. For more details, see 4.3.5.5 PPO Types. If PPO_PROFIdrive mode is not used, then PROFIdrive version 2.0 is used with PPO types. For more details, see 4.3.6.4 PPO Types.

6.2 Parameters Configured in PLC

Table 168: Modifiable Parameters in GSD File

Parameter	Value[1]	Range	Default	Description
Operate mode	0 = Local 1 = Remote, PROFIdrive 2 = Remote, Bypass 3 = Remote, Echo	0–3	0	See 6.2.1 Operate Mode.
DP mode	0 =DP-V0 1 = DP-V0 + DP-V1	0–1	1	See 6.2.2 DP Mode.

[1] In the GSD for OPTE3/E5, it is possible to select also operating modes for the slave.

6.2.1 Operate Mode

In the Remote modes, the fieldbus master can force the slave into a specific operating mode. It allows the operating mode of the slave to be changed in the master configuration, without a need to use the keypad. When these modes are used, the drive keypad cannot be used to change the operating mode.

In the Local mode, the operating mode of the slave can be parameterized in the drive (for example, manually through the keypad). When the drive powers up, the last value configured in the drive determines the operating mode of the PROFIBUS DP slave.

Operate Mode can also be configured with AC Drive control panel, see 6.1.2 Operate Mode.

6.2.2 DP Mode

The fieldbus master selects the PROFIBUS DP communication method.

- DP-V0: Cyclic data exchange and diagnosis
- DP-V1: Acyclic data exchange and alarm handling

For more details, see 4.1 PROFIBUS DP Communication Overview.

6.3 Safety Parameters

When a PROFIsafe connection is used, extra safety parameters (F-Parameters) must be provided for the safety module to verify the safety connection settings. All F-Parameters must match the parameterization of the safety system. If any of the parameters are incorrectly parameterized, a system fault and a channel-related diagnosis are triggered.

NOTE! In addition, the configured Safety Telegram number must match the configuration with the Advanced Safety option board. The Safety PLC is not allowed to select the used Safety Telegram. If the safety telegram does not match, an error and channel-related diagnosis is triggered.

For more details on PROFIsafe parameterization and commissioning, refer to VACON® NXP Advanced Safety Options Operating Guide.

6.4 AC Drive Parameters

6.4.1 AC Drive Parameters for Fieldbus Control and Reference Selection

The following tables list the parameters that must be set in the AC drive in order for the motor to be controllable via fieldbus. The tables cover some basic applications. See the application-specific manuals for more detailed information and latest updates.

In order for the AC drive to accept commands from the fieldbus network, the control place of the AC drive has to be set to fieldbus. The default value of the parameter "Control Place" is usually I/O. If the control unit software is updated, the default settings are restored.

Some applications can also have the remote speed reference selection set by default to other than fieldbus. In these cases, set the speed reference selection to fieldbus, so that the speed reference can be controlled via fieldbus.

NOTE! The motor control mode must be selected to support the used process and profile.

The parameters can be read and written by using:

- the drive panel
- PC Tools
- fieldbus protocol.

6.4.2 Fieldbus Parameters for VACON® 100 Family Standard Application

Table 169: Fieldbus Parameters for VACON® 100 Family (Standard Application)

Index in panel tree	Parameter name	ID	Default	Value	Description
P3.1.2.1	Control mode	600	0	0 = Frequency 1 = Speed 2 = Torque	-
P3.2.1	Remote control place	172	0	1 = Fieldbus CTRL	-
P3.2.2	Local/remote	211	0	0 = Remote	-
P3.3.1.10	Fieldbus ref. sel.	122	3	3 = Fieldbus	-
P5.13.1	Controlling fieldbus	2539	1	1 = Automatic 2 = Slot D 3 = Slot E	See Controlling Fieldbus Parameter

Controlling Fieldbus Parameter

The "Controlling Fieldbus" parameter is available in VACON® 100 family products for situations when multiple fieldbus options or protocols are active at the same time. Use the "Controlling Fieldbus" parameter for selecting the instance from which the process data is sent to the drive application. This parameter is located under I/O and Hardware/Fieldbus General (5.13.1).

By default, the setting is in "Automatic" and the functionality (when receiving process data from multiple sources) is application-dependent.

For example, if a fieldbus option board has been installed to slot E and it is used to control the drive, select "Slot E" as value for this parameter. With this setting, only the process data from the option board in slot E is forwarded to the application. All other fieldbuses still receive process data out. It prevents the monitoring fieldbuses from accidentally writing process data in.

Table 170: Selections for Controlling Fieldbus Parameter

Value name	Value	Description
Automatic	1	Process data from all sources is forwarded to application
Slot D	2	Only process data from slot D is forward to application. Value is visible only, if option board is installed to slot D.
Slot E	3	Only process data from slot E is forward to application. Value is visible only, if option board is installed to slot E.
RS485	4	Only process data from VACON® 100 family internal RS485 protocol is forwarded to application
PROFINET I/O	5	Only process data from VACON® 100 family internal PROFINET I/O protocol is forwarded to application
EtherNet/IP	6	Only process data from VACON® 100 family internal EtherNet/IP protocol is forwarded to application
Modbus TCP/UDP	7	Only process data from VACON® 100 family internal Modbus TCP/UDP protocol is forwarded to application
BACnet/IP	8	Only process data from VACON® 100 family internal BACnet/IP protocol is forwarded to application

6.4.3 Fieldbus Parameters for VACON® 20 Standard Application

Table 171: Fieldbus Parameters for VACON® 20 (Standard Application)

Index in panel tree	Parameter name	ID	Value	Default
P17.2	Disable showing of quick menu	-	0 = Advanced menu 1 = Quick set-up parameters	1

Index in panel tree	Parameter name	ID	Value	Default
P1.8	Motor control mode	600	0 = Frequency 1 = Speed 2 = Torque	0
P2.1	Rem. Control place 1 sel.	172	1 = Fieldbus CTRL	0
P2.5	Local/remote	211	0 = Remote	0
P3.3	Rem. Control place 1 freq. ref. sel.	122	3 = Fieldbus	7

6.4.4 Fieldbus Parameters for VACON® 20 X Multipurpose Application

Table 172: Fieldbus Parameters for VACON® 20 X Multipurpose Application

Index in panel tree	Parameter name	ID	Value	Default
P8.1	Motor control mode	600	0 = Frequency 1 = Speed	0
P1.11	Control place selection	125	2 = Fieldbus	0
P1.12	Frequency ref. sel.	1819	5 = Fieldbus	0

6.4.5 Fieldbus Parameters for VACON® NXP Multipurpose Application

Table 173: Fieldbus Parameters for VACON® NXP Multipurpose Application

Index in panel tree	Parameter name	ID	Value	Default
P2.6.1	Motor control mode	600	0 = Frequency 1 = Speed 2 = Torque	0
P3.1	Control place selection	125	3 = Fieldbus	1
P2.1.13	Fieldbus control reference	122	9 = Fieldbus	3

6.5 Response to Fieldbus Fault Parameter

If there is a fieldbus fault (loss of connection, for example), a fieldbus fault is triggered. To get desired response, set the value for the Response to Fieldbus Fault Parameter in the application. Always check the application-specific manual for details as responses vary between used applications. For common fault responses used commonly in standard applications, see the following table.

Table 174: Response to Fieldbus Fault in VACON® AC drives

Panel Code	ID	AC Drive	Value	Default
P3.9.1.6	733	VACON® 100 family	0 = No action 1 = Alarm 2 = Alarm + preset frequency 3 = Fault: Stop function 4 = Fault: Coast	3
P13.19		VACON® 20		
P9.15		VACON® 20 X	0 = No action 1 = Warning 2 = Fault	2
P2.7.22		VACON® NXP	0 = No action 1 = Warning	2

Panel Code	ID	AC Drive	Value	Default
			2 = Fault: Stop function 3 = Fault: Coast	

6.6 VACON® NXP System Software Parameters for Application Developers

The application developers and system integrators can use these VACON® NXP system software variables to activate and control different fieldbus communication modes and features.

Table 175: System Software Variables

Parameter	Value	De-fault	Description
FBMode-SlotD_fwu8	0 = Normal mode 1 = Fast safety mode[1] 2 = Fast mode 3 = Fast PROFIBUS DP mode[2] 4 = Normal extended mode	0	See 6.6.1 System Software Variables for Selecting Communication Modes.
FBMode-SlotE_fwu8		0	
FBModeSlotD-SupMo-des_fwu16	0x00 = Not yet updated. Read again later 0x01 = Fieldbus communication not supported 0x02 = Normal mode supported 0x04 = Fast safety mode supported[1] 0x08 = Fast mode supported 0x10 = Fast PROFIBUS DP mode supported 0x20 = Normal extended mode supported	0	See 6.6.2 System Software Variables for Monitoring Supported Communication Modes.
FBMode-SlotE_fwu8		0	
FBControlSlotSelector_fwu8[3]	0 = All slots 4 = Slot D only 5 = Slot E only 6 = Fast PROFIBUS DP D slot 7 = Fast PROFIBUS DP E slot	0	See 6.6.3 System Software Variables for Selecting the Input Process Data Slot.

[1] Automatically enabled/disabled by system software. User cannot set this value.

[2] Fast PROFIBUS DP mode is not supported in OPTE3/5 PROFIBUS DP.

[3] Selections 6 and 7 are for backward compatibility only. Same as FBModeSlotX_fwu8 variable setting '3'. Fast PROFIBUS DP is not supported in OPTE3/5 PROFIBUS DP.

6.6.1 System Software Variables for Selecting Communication Modes

FBModeSlotX_fwu8 variables are used to select the active fieldbus option board communication mode. If no fieldbus option board is connected to the related slot, the selection of the FBModeSlot parameter is set to 0 = Normal mode.

6.6.2 System Software Variables for Monitoring Supported Communication Modes

FBModeSlotXSupModes_fwu16 variables can be used to determine the different supported modes of the fieldbus option boards. All features are set as bit fields as multiple modes can be supported.

Value '0' is returned while the feature set of the option board is not yet retrieved. Value must be asked again. Any option board not supporting fieldbus communication returns value '1'.

Example 1: OPTE3-E5_FW0083V006 PROFIBUS DP board returns value: 0x2A, indicating support for Normal, Fast, and Normal extended modes.

Example 2 (PROFIsafe is used): OPTE3-E5_FW0083V006 board returns value: 0x04, indicating that only Fast safe mode is allowed to be set.

Example 3: OPTE9_FW0196V006 Dual Port Ethernet board returns value: 0x0A, indicating support for Normal and Fast modes.

6.6.3 System Software Variables for Selecting the Input Process Data Slot

FBControlSlotSelector_fwu8 variable is used to select the controlling fieldbus option board slot. When selected (other than '0'), process data is accepted only from the selected slot and all other process data is discarded. Process data out is still updated normally to all slots.

This selector can be used to support redundant fieldbus connection. In fieldbus redundancy mode, 2 fieldbus option boards are installed to VACON® NXP option board slots D and E. The application selects with FBControlSlotSelector_fwu8 variable which fieldbus option board can deliver process data from fieldbus master to the application.

Default value for FBControlSlotSelector_fwu8 is '0' which means that process data is accepted from both fieldbus option boards.

7 Monitoring Values

7.1 PROFIBUS DP Board Monitoring Values

Table 176: VACON® OPTE3/E5 Monitor Values for VACON® 100 Family

Index in panel tree[1]	Parameter	Minimum	Maximum	Unit[1]	Description[1]
V5.x.2.1	PROFIBUS DP Status	0.0	5000.2	xxxx.y	xxxx = Message counter y = Status of communication y(0) = Wait_Prm y(1) = Wait_Cfg y(2) = Data_Exchange See 7.1.1 PROFIBUS DP Status.
V5.x.2.2	FB Protocol Status	1	4	-	1 = Initializing 2 = Stopped 3 = Operational 4 = Faulted See 7.1.2 FB Protocol Status.
V5.x.2.3	Protocol	0	1	-	0 = DP-V0 1 = DP-V1 See 7.1.3 Protocol.
V5.x.2.4	Baud Rate	1	10	-	1 = 9.6 kBd 2 = 19.2 kBd 3 = 93.75 kBd 4 = 187.6 kBd 5 = 500 kBd 6 = 1500 kBd 7 = 3 MBd 8 = 6 MBd 9 = 12 MBd 10 = Auto See 7.1.4 Baud Rate.
V5.x.2.5	PPO Type	0	6	-	0 = Not Used 1 = PPO1 2 = PPO2 3 = PPO3 4 = PPO4 5 = PPO5 6 = PPO6 See 7.1.5 PPO Type.
V5.x.2.6	Telegram Type	0	4	-	0 = Not Used 1 = ST1 2 = ST1 + 4PD 3 = ST1 + 8PD 4 = ST20 5=ST1 + 12PD 6=ST1 + 16PD 7=GCW + 16PD See 7.1.6 Telegram Type.

Index in panel tree[1]	Parameter	Minimum	Maximum	Unit[1]	Description[1]
-	Safety Telegram	0	3	-	0 = Not Used 1 = ST30 2 = ST31 3 = ST58000 See 7.1.7 Safety Telegram.
V5.x.2.8	Protocol CW	0	65535	-	Control Word from PLC See 7.1.8 Protocol CW/Fieldbus CW.
V5.x.2.9	Protocol SW	0	65535	-	Status Word from AC drive See 7.1.9 Protocol SW/Fieldbus SW.
V.x.2.10	Drive CW	0	65535	-	Control Word in AC drive format See 7.1.10 Drive CW.
V5.x.2.11	Drive SW	0	65535	-	Status Word in AC drive format See 7.1.11 Drive SW.

[1] x = Depends on used option board slot

Table 177: VACON® OPTE3/E5 Monitor Values for VACON® NXP

Index in panel tree[1]	Parameter	Minimum	Maximum	Unit[1]	Description[1]
V7.x.2.1	PROFIBUS DP Status	0.0	5000.2	xxxx.y	xxxx = Message counter y = Status of communication y(0) = Wait_Prm y(1) = Wait_Cfg y(2) = Data_Exchange See 7.1.1 PROFIBUS DP Status.
V7.x.2.2	FB Protocol Status	1	4	-	1 = Initializing 2 = Stopped 3 = Operational 4 = Faulted See 7.1.2 FB Protocol Status.
V7.x.2.3	Protocol	0	1	-	0 = DP-V0 1 = DP-V1 See 7.1.3 Protocol.
V7.x.2.4	Baud Rate	1	10	-	1 = 9.6 kBd 2 = 19.2 kBd 3 = 93.75 kBd 4 = 187.6 kBd 5 = 500 kBd 6 = 1500 kBd 7 = 3 MBd 8 = 6 MBd 9 = 12 MBd 10 = Auto See 7.1.4 Baud Rate.

Index in panel tree[1]	Parameter	Minimum	Maximum	Unit[1]	Description[1]
V7.x.2.5	PPO Type	0	6	-	0 = Not Used 1 = PPO1 2 = PPO2 3 = PPO3 4 = PPO4 5 = PPO5 6 = PPO6 See 7.1.5 PPO Type.
V7.x.2.6	Telegram Type	0	4	-	0 = Not Used 1 = ST1 2 = ST1 + 4PD 3 = ST1 + 8PD 4 = ST20 5=ST1 + 12PD 6=ST1 + 16PD 7=GCW + 16PD See 7.1.6 Telegram Type.
V7.x.2.7	Safety Telegram	0	3	-	0 = Not Used 1 = ST30 2 = ST31 3 = ST58000 See 7.1.7 Safety Telegram.
V7.x.2.8	Protocol CW	0	65535	-	Control Word from PLC See 7.1.8 Protocol CW/Fieldbus CW.
V7.x.2.9	Protocol SW	0	65535	-	Status Word from AC drive See 7.1.9 Protocol SW/Fieldbus SW.
V7.x.2.10	Drive CW	0	65535	-	Control Word in AC drive format See 7.1.10 Drive CW.
V7.x.2.11	Drive SW	0	65535	-	Status Word in AC drive format See 7.1.11 Drive SW.

[1] x = Depends on used option board slot

Table 178: VACON® OPTE3/E5 Monitor Values for VACON® 20

Index in panel tree	Parameter	Minimum	Maximum	Unit[1]	Description[1]
V2.1	PROFIBUS DP Status	0.0	5000.2	xxxx.y	xxxx = Message counter y = Status of communication y(0) = Wait_Prm y(1) = Wait_Cfg y(2) = Data_Exchange See 7.1.1 PROFIBUS DP Status.
V2.2	FB Protocol Status	1	4	-	1 = Initializing 2 = Stopped 3 = Operational

Index in panel tree	Parameter	Minimum	Maximum	Unit[1]	Description[1]
					4 = Faulted See 7.1.2 FB Protocol Status.
V2.3	Protocol	0	1	-	0 = DP-V0 1 = DP-V1 See 7.1.3 Protocol.
V2.4	Baud Rate	1	10	-	1 = 9.6 kBd 2 = 19.2 kBd 3 = 93.75 kBd 4 = 187.6 kBd 5 = 500 kBd 6 = 1500 kBd 7 = 3 MBd 8 = 6 MBd 9 = 12 MBd 10 = Auto See 7.1.4 Baud Rate.
V2.6	PPO Type	0	6	-	0 = Not Used 1 = PPO1 2 = PPO2 3 = PPO3 4 = PPO4 5 = PPO5 6 = PPO6 See 7.1.5 PPO Type.
V2.5	Telegram Type	0	4	-	0 = Not Used 1 = ST1 2 = ST1 + 4PD 3 = ST1 + 8PD 4 = ST20 See 7.1.6 Telegram Type.
-	Safety Telegram	0	3	-	0 = Not Used 1 = ST30 2 = ST31 3 = ST58000 See 7.1.7 Safety Telegram.
V2.9	Protocol CW	0	65535	-	Control Word from PLC See 7.1.8 Protocol CW/Fieldbus CW.
V2.10	Protocol SW	0	65535	-	Status Word from AC drive See 7.1.9 Protocol SW/Fieldbus SW.
-	Drive CW	0	65535	-	Control Word in AC drive format See 7.1.10 Drive CW.
-	Drive SW	0	65535	-	Status Word in AC drive format

Index in panel tree	Parameter	Minimum	Maximum	Unit(1)	Description(1)
					See 7.1.11 Drive SW.

[1] x = Depends on used option board slot

Table 179: VACON® OPTE3/E5 Monitor Values for VACON® 20 X

Index in panel tree	Parameter	Minimum	Maximum	Unit(1)	Description(1)
V2.1	PROFIBUS DP Status	0.0	5000.2	xxxx.y	xxxx = Message counter y = Status of communication y(0) = Wait_Prm y(1) = Wait_Cfg y(2) = Data_Exchange See 7.1.1 PROFIBUS DP Status.
V2.2	FB Protocol Status	1	4	-	1 = Initializing 2 = Stopped 3 = Operational 4 = Faulted See 7.1.2 FB Protocol Status.
V2.3	Protocol	0	1	-	0 = DP-V0 1 = DP-V1 See 7.1.3 Protocol.
V2.4	Baud Rate	1	10	-	1 = 9.6 kBd 2 = 19.2 kBd 3 = 93.75 kBd 4 = 187.6 kBd 5 = 500 kBd 6 = 1500 kBd 7 = 3 MBd 8 = 6 MBd 9 = 12 MBd 10 = Auto See 7.1.4 Baud Rate.
V2.6	PPO Type	0	6	-	0 = Not Used 1 = PPO1 2 = PPO2 3 = PPO3 4 = PPO4 5 = PPO5 6 = PPO6 See 7.1.5 PPO Type.
V2.5	Telegram Type	0	4	-	0 = Not Used 1 = ST1 2 = ST1 + 4PD 3 = ST1 + 8PD 4 = ST20 See 7.1.6 Telegram Type.

Index in panel tree	Parameter	Minimum	Maximum	Unit[1]	Description[1]
-	Safety Telegram	0	3	-	0 = Not Used 1 = ST30 2 = ST31 3 = ST58000 See 7.1.7 Safety Telegram.
V2.9	Protocol CW	0	65535	-	Control Word from PLC See 7.1.8 Protocol CW/Fieldbus CW.
V2.10	Protocol SW	0	65535	-	Status Word from AC drive See 7.1.9 Protocol SW/Fieldbus SW.
-	Drive CW	0	65535	-	Control Word in AC drive format See 7.1.10 Drive CW.
-	Drive SW	0	65535	-	Status Word in AC drive format See 7.1.11 Drive SW.

[1] x = Depends on used option board slot

7.1.1 PROFIBUS DP Status

This monitoring value field has two values:

- incrementing message counter
- PROFIBUS DP communication status.

The first part is an incrementing message counter. It increases every time a message is received and holds a maximum value of 5000 (after which it starts from 0).

The second part is the PROFIBUS DP communication status. In Wait_prm, the board is expecting a parameter assignment message. In Wait_Cfg, the board is waiting for a configuration message. After a successful configuration, the device goes into Data_Exchange, where an exchange of user data with master is initialized.

7.1.2 FB Protocol Status

This monitoring value shows the fieldbus protocol status.

7.1.3 Protocol

This monitoring value shows the Used PROFIBUS DP protocol. DP-V0 (cyclic data exchange) and DP-V1 (acyclic and cyclic data exchange) are supported.

7.1.4 Baud Rate

This monitoring value shows the actual communication baud rate. Value stays at 10, "Auto" (Auto baud), as long as a valid baud rate is found.

7.1.5 PPO Type

This monitoring value shows the used PPO type. If Standard Telegram is used, this field shows as "Not Used".

7.1.6 Telegram Type

This monitoring value shows the used Standard Telegram type. If PPO1-6 is used, this field shows as "Not Used".

7.1.7 Safety Telegram

This monitoring value shows the used Standard Safety Telegram. This value is only valid when using VACON® Advanced safety options. It shows the value configured by master (PLC).

7.1.8 Protocol CW/Fieldbus CW

This monitoring value shows the Control Word that was sent from master (PLC).

In PROFIdrive operating mode, Control Word is in PROFIdrive format.

In Bypass operating mode, Control Word is usually in VACON® format. Special applications can use other formats.

7.1.9 Protocol SW/Fieldbus SW

This monitoring value shows the Status Word that is sent to master (PLC).

In PROFIdrive operating mode, Status Word is in PROFIdrive format.

In Bypass operating mode, Status Word is usually in VACON® format. Special applications can use other formats.

7.1.10 Drive CW

This monitoring value shows the Control Word that is sent from master (PLC) in AC drive specific format. Usually, the Control Word is transferred to AC drive in VACON® format.

If PROFIdrive operate mode is used, the control word is converted into VACON® format before transmitting it to the application.

In Bypass mode, the PLC can send Control Word in a special application-specific format to the application.

7.1.11 Drive SW

This monitoring value shows the Status Word that is sent to master (PLC) in AC drive specific format.

Usually, the Status Word is transferred from AC drive application to OPTE3/5 PROFIBUS DP in VACON® format.

If PROFIdrive operate mode is used, the OPTE3/5 PROFIBUS DP converts the Status Word into PROFIdrive format before transmitting it to the PLC.

In Bypass mode, the AC drive application can send Status Word in a special application-specific format to OPTE3/5 PROFIBUS DP which then passes the Status Word to the PLC.

8 Fault Tracing

8.1 LED Indications on PROFIBUS Option Boards

The LED indications are the same on all PROFIBUS option boards.

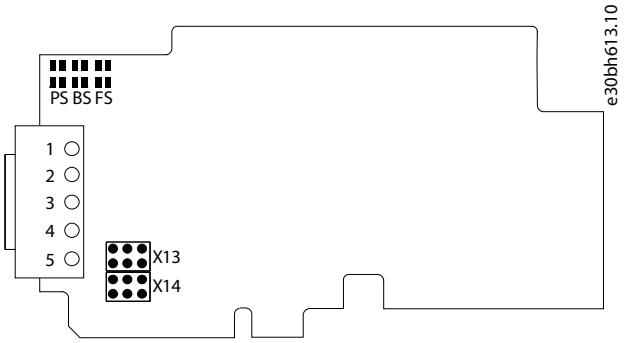


Illustration 14: LED Indications on VACON® PROFIBUS Option Boards

PS	PROFIBUS status, RED	FS	Fieldbus status, GREEN
BS	PROFIBUS board status, YELLOW		

Table 180: PS = PROFIBUS Status, RED

LED status	Description
OFF	PROFIBUS DP communicates normally
ON	PROFIBUS DP communication is broken or not started • Bus cable broken or incorrectly connected • Wrong configuration or parameterization data ofMaster • Master is offline or shutdown
Blinking yellow	The software is restarting

Table 181: BS = PROFIBUS Board Status, YELLOW

LED status	Description
OFF	Option board not activated
ON	Option board in initialization state waiting for activation command from the AC drive
Blinking fast (once per 1 s)	Option board is activated and in RUN state • Option board is ready for external communication
Blinking slow (once per 5 s)	Option board is activated and in FAULT state • Internal fault on optionboard

Table 182: FS = Fieldbus Status, GREEN

LED status	Description
OFF	Fieldbus module is waiting for parameters from the AC drive • No external communication

LED status	Description
ON	Fieldbus module is activated • Parameters received and module activated • Module is waiting for messages from the bus
Blinking fast (once per 1 s)	Module is activated and receiving messages from the bus
Blinking slow (once per 5 s)	Module is in FAULT state • No messages from Net within the watchdog time • Bus broken, cable loose, or Master offline

8.2 PROFIBUS DP Diagnosis

The PROFIBUS DP defines several different ways to report status and diagnosis information. An overview of the defined and OPTE3/E5 supported diagnosis methods is shown in the following figure.

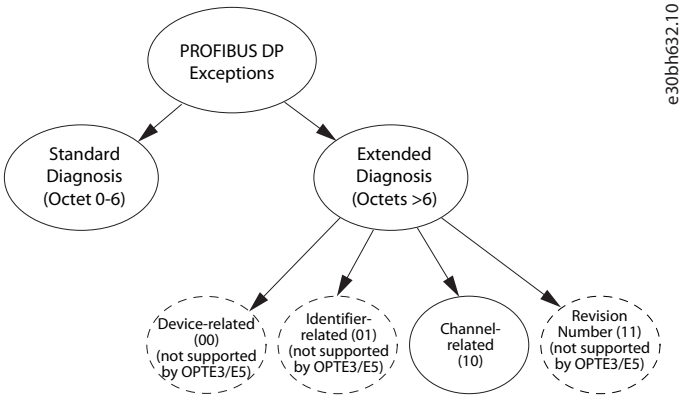


Illustration 15: Overview of PROFIBUS DP Diagnosis

8.2.1 Standard Diagnosis

The standard diagnosis consists of the first 6 octets of any diagnosis message within PROFIBUS DP.

The diagnosis information is related to:

- communication
- device identification
- readiness
- watchdogs
- parameterization/configuration faults.

Detailed information of the bit fields is described in the following table.

Table 183: Description of Standard Diagnosis Message

Octet	Bit	Name	Description
1	0	Diag.Station_Non_Existent	1 = Slave does not exist
	1	Diag.Station_Not_Ready	1 = Slave not ready for data exchange
	2	Diag.Cfg_Fault	1 = Slave has mismatching configuration data
	3	Diag.Ext_Diag	0 = Slave sends standard diagnosis data only (6 bytes) 1 = Slave indicates serious faults, usually with extended diagnosis data
	4	Diag.Not_Supported	Slave does not support the required function

Octet	Bit	Name	Description
	5	Diag.Invalid_Slave_Response	0 = Set by slave 1 = Set by master if there is fault
	6	Diag.Prm_Fault	Slave got wrong parameterization
	7	Diag.Master_Lock	Another master has parameterized the slave
2	0	Diag.Prm_Req	1 = Slave requests parameterization
	1	Diag.Stat_Diag	1 = Slave not able to provide valid diagnosis data. Master repeats diagnosis requests while in Data Exchange mode until this bit is set (0) Only valid within the start-up phase of a slave
	2	DP	Always set to 1
	3	Diag.WD_On	1 = Slave reports exceeded watchdog time
	4	Diag.Freeze_Mode	1 = Slave is in FREEZE mode
	5	Diag.Sync_Mode	1 = Slave is in SYNC mode
	6	Reserved	-
	7	Diag.Deactivated	1 = Diagnosis deactivated
3	0...6	Reserved	-
	7	Diag.Ext_Diag_Overflow	1 = Slave has more diagnosis data than fit into the buffer
4	0...7	Diag_Master_Add	0–125: Address of the master that has parameterized the slave 126–254: Not allowed 255: Not parameterized
5	0...7	Ident_Number (High)	High byte of the ident number of the slave
6	0...7	Ident_Number (Low)	Low byte of the ident number of the slave

8.2.2 Channel-Related Diagnosis

The standard diagnosis consists of the first 6 octets of any diagnosis message within PROFIBUS DP.

The channel-related diagnosis is used in OPTE3/E5 for informing errors and failures of PROFISafe.

Table 184: Description of Extended Diagnosis Message

Octet	Bit	Name	Description
1	0...5	Identifier_Number	Slot of diagnosis (1)
	6...7	Selection	2 = Channel-related diagnosis
2	0...5	Channel_Number	Channel of diagnosis (0)
	6...7	Input_Output_Selection	3 = Input and output
3	0...4	Error_Type	16...31 manufacturer specific
	5...7	Channel_Type	0 = unspecific, can be used for any type

The OPTE3/E5 has 1 channel per module, so the error is always given to channel 0. As safety modules must always be inserted in the first slot (see chapter 5.3), the slot of these safety-related diagnosis errors is always 1.

The diagnosis errors 0–15 are predefined or reserved by PROFIBUS DP, and 16–31 are manufacturer-specific. These error codes are defined via .GSD entries. These entries are described in the following table.

Table 185: Manufacturer-specific Channel Diagnosis Error Codes

Error type	Channel diagnosis	Description
16	PROFIsafe not responding	Connection between PROFIBUS DP option board and advanced safety option board cannot be established. Check the option board connections and firmware revisions.
17	Safety module mismatch	Safety telegram configured in use by PROFIBUS DP master is different than the one that is configured in advanced safety option board. These settings must match.
18	PROFIsafe configuration mismatch	F-Parameters between PROFIBUS DP master and advanced safety option board do not match. Compare all F-Parameters and the F-Par CRC value from the advanced safety option board configuration and from PROFIBUS DP master.

8.3 Fault Handling

When the option board or the AC drive control diagnostics detect an unusual operating condition, the drive opens a notification, for example, on the keypad. The keypad shows:

- the ordinal number of the fault
- the fault code
- a short fault description.

The fault can be reset with the Reset button on the control panel, via the I/O terminal, or via the used fieldbus protocol.

The faults are stored in the Fault history menu, which can be browsed.

8.4 Gathering Diagnostic Data

This topic explains how to gather all the needed information for getting support in fault situation.

Procedure

1. Write down all the texts and codes on the keypad display.
2. Read the Drive Info (Service Info) File from the drive with PC-tool.

   - VACON® Live: connect to the drive and select from VACON® Live menu bar: Drive - > Service information…
   - NCDrive: connect to the drive and select from NCDrive menu bar: File -> Service Info…

3. If possible, also get fieldbus communication log from the fault situation if applicable.

   Table 186: Fieldbus Communication Log Tools

Recommended Tool	Fieldbus Option	Boards
Wireshark	Ethernet-based fieldbuses	OPTEA, OPTE9
ProfiTrace	PROFIBUS	OPTE3-E5
CANalyzer	CAN-based boards	OPTE6, OPTE7

4. Send the problem description together with the gathered files to the local distributor.

   For contact information, go to: www.danfoss.com/ -> Contact us -> Distributors. Select "Drives" as Business unit.

8.5 Typical Fault Conditions

Table 187: Typical Fieldbus Fault Conditions

Fault condition	Possible cause	Remedy
No communication or faulty communication	Cabling	Supply or motor cables are located too close to the fieldbus cable

Fault condition	Possible cause	Remedy
		Wrong type of fieldbus cable, for example, insufficient shielding
		Too long cabling
		Invalid termination
	Grounding	Inadequate or invalid grounding
	Connections	Excessive stripping of cables
		Conductors in wrong terminals
		Too loose connections of conductors
Drive does not start	Parameterization	Wrong control place selected
	PLC programming	Check received control word
Fieldbus fault (F53)	PROFIBUS DP watchdog time has elapsed. Check PLC settings and cabling.	-
Slot fault (F54)	Bad communication between option board and control board.	Interference. Check cabling and grounding. Otherwise faulty board, update firmware or replace hardware.

8.5.1 Source3 Fault Codes

In VACON®100 family, there is a detailed fault code for fieldbuses called "Source3" in the fault history.

This feature is available from firmware version V026 (INDUSTRIAL) and V018 (FLOW).

This information can be read with:

- Panel (4.1.x.26): Diagnostics -> Active Faults -> "FB Timeout" -> Details -> Source 3
- Panel (4.3.x.26): Diagnostics -> Fault History -> "FB Timeout" -> Details -> Source 3
- VACON® Live: View -> Fault Diagnostics -> Icon "Load active faults" -> Source3
- VACON® Live: View -> Fault Diagnostics -> Icon "Load fault history" -> Source3.

Table 188: Source3 Fault Codes Relevant to OPTE3/E5 PROFIBUS DP Board

Code	Name	Description
1	I/O watchdog	No I/O data received within watchdog time
2	I/O Connection closed	Connection closed by fieldbus master and watchdog time elapsed

Index

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