**Manual** 12/23 MN040065EN

# 9000X

# Profibus DP OPTE3/E5

# Fieldbus Manual

Powering Business Worldwide

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**Original operating manual**
The German-language edition of this document is the original operating manual.

**Translation of the original operating manual**
All editions of this document other than those in German language are translations of the original German manual.

1. Edition 2023, publication date 12/23

## Danger!
## Dangerous electrical voltage!

**Before commencing the installation**

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally retriggered.
- Verify isolation from the supply.
- Ground and short-circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (IL) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/ system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalizing. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O connection so that a cable or wire breakage on the signal side does not result in undefined states in the automation device.
- Ensure a reliable electrical isolation of the low voltage for the 24 V supply. Only use power supply units complying with IEC 60364-4-41 or HD 384.4.41 S2 (VDE 0100 part 410).
- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the technical data, otherwise this may cause malfunction and dangerous operation.
- Emergency-Stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency switching off devices must not cause restart.
- Built-in devices for enclosures or cabinets must only be run and operated in an installed state, desk-top devices or portable devices only when the housing is closed.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency switching off devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, etc.).
- During operation, and depending on their degree of protection, variable frequency drives may have live, uninsulated, moving, and/or rotating parts, as well as hot surfaces.
- The impermissible removal of the required cover, improper installation or incorrect operation of the motor or variable frequency drive can cause the failure of the device and serious injury and/or material damage.
- Comply with all applicable national accident prevention regulations (e.g. BGV A3) when working with energized variable frequency drives.
- The electrical installation must be carried out in accordance with the relevant regulations (e.g. with regard to cable cross sections, fuses, PE).
- All transport, installation, commissioning and maintenance work must only be carried out by trained personnel (observe IEC 60364, HD 384 or DIN VDE 0100 and national accident prevention regulations).
- If applicable, systems in which variable frequency drives are installed must be equipped with additional monitoring and protective devices in accordance with the applicable safety regulations, e.g., the German Equipment and Product Safety Act, accident prevention regulations, etc. Making changes to the variable frequency drives by using the operating software is allowed.
- Keep all covers and doors closed during operation.
- When designing the machine, the user must incorporate mechanisms and measures that limit the consequences of a drive controller malfunction or failure (an increase in motor speed or the motors sudden stop) so as to prevent hazards to people and property, e.g.:
  - Additional stand-alone devices for monitoring parameters that are relevant to safety (speed, travel, end positions, etc.)
  - Electrical and non-electrical safety devices (interlocks or mechanical locks) for mechanisms that protect the entire system
  - Due to the possibility of there being capacitors that are still holding a charge, do not touch live device parts or terminals immediately after disconnecting the variable frequency drives from the supply voltage. Heed the corresponding labels on the variable frequency drives

# Contents

# 1 About this manual

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

## 1.1 Target Audience

This manual is intended for engineers and electricians. Electrical engineering and practical knowledge and skills will be required in order to be able to commission these devices. We assume that you have a basic knowledge of handling electrical systems and machines, as well as reading technical drawings.

**CAUTION**

Installation requires qualified electrician

## 1.2 Change protocol

| Publication date | Page | Description | new | modified | deleted |
|---|---|---|---|---|---|
| 12/23 | | First edition | √ | | |

## 1.3 Writing conventions

Symbols with the following meaning are used in this manual:

▶ indicates actions to be taken.

### 1.3.1 Safety warning concerning property damage

*WARNING*

Indicates a potentially hazardous situation that may result in property damage.

### 1.3.2 Safety warning concerning personal injury hazards

**CAUTION**

Warns of hazardous situations that may cause slight injury.

**WARNING**

Warns of hazardous situations that could result in serious injury or death.

**DANGER**

Warns of hazardous situations that result in serious injury or death.

### 1.3.3 Hints

→ Indicates useful tips.
→ All the specifications in this manual refer to the hardware and software versions documented in it
→More information on the devices described here can be found on the internet at

Eaton.com/documentation

## 1.4 Abbreviations

The following abbreviations are used in this manual:

| 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 |
| 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 |

## 1.5 Mains supply voltages

The rated operating voltages stated in the following table are based on the standard values for star networks with a grounded central point.
In ring networks (as found in Europe) the rated operating voltage at the transfer point of the power supply companies is the same as the value in the consumer networks (e.g. 230 V, 400 V).
In star networks (as found in North America), the rated operating voltage at the transfer point of the utility companies is higher than in the consumer network.
Example: 120 V → 115 V, 240 V → 230 V, 480 V → 460 V.
The rated mains voltage data is always based on mains frequencies of 50/60 Hz within a range of 48 to 62 Hz.

## 1.6 Units of measurement

Every physical dimension included in this manual uses international metric system units, otherwise known as SI (Système International d'Unités) units. For the purpose of the equipment's UL certification, some of these dimensions are accompanied by their equivalents in imperial units.

Table 1: Unit conversion examples

| Designation | US-American Designation | Anglo American value | SI value | Conversion value |
|---|---|---|---|---|
| Length | inch | 1 in (") | 25.4 mm | 0.0394 |
| Output | horsepower | 1 HP = 1.014 PS | 0.7457 kW | 1.341 |
| Torque | pound-force inches | 1 lbf in | 0.113 Nm | 8.851 |
| Temperature | Fahrenheit | 1 °F ($T_F$) | -17.222 °C ($T_C$) | $T_F = T_C \times 9/5 + 32$ |
| Speed | revolutions per minute | 1 rpm | 1 $min^{-1}$ | 1 |
| Weight | pound | 1 lb | 0.4536 kg | 2.205 |
| Flow rate | cubic feed per minute | 1 cfm | 1.698 $m^3$/min | 0.5889 |

# 2 Introduction

## 2.1 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 Eaton 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.

## 2.2 Additional Resources

Resources available for the drive and optional equipment are:

- Eaton 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.
- EATON OPTEA/OPTE9 Ethernet Board Programming Guide provides information on Ethernet settings.

Supplementary publications and manuals are available from eaton.com/documentation.

## 2.3 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.

## 2.4 Product Overview

### 2.4.1 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.

### 2.4.2 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.
EATON 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.

### 2.4.3 Features of PROFIBUS DP–EATON Interface

Features of the PROFIBUS DP–EATON interface:

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

### 2.4.4 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. |
| Environment | Addresses | 2–126 |
| | 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 |

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

### 2.4.5 Eaton PC Tools

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

- Set parameters for OPTE3/E5 PROFIBUS DP with 9000XDrive
- Read monitor values of OPTE3/E5 PROFIBUS DP with 9000Xdrive

The following table describes what PC tools are supported in each AC drive type and can be downloaded from Eaton Download Center.

Table 3: The Supported PC Tools with Different AC Drives

| Tool | Eaton SPX/SVX |
|---|---|
| 9000XDrive | Serial[1], Ethernet[2] |
| 9000XLoad | 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, a connection via OPTEA/ OPTE9 Dual Port Ethernet option board.

# 3 Commissioning

## 3.1 Before Commissioning

Eaton OPTE3/E5 PROFIBUS DP can be commissioned through the control panel of the AC drive or by using the Eaton 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 Eaton SPX products
- When using Eaton PC tool for commissioning
  - Confirm that the correct tool installed.
- When commissioning an Eaton AC drive in which an OPTE3/E5 PROFIBUS DP option board is installed.
  - See the Eaton RS485 CAN bus Installation Guide for instructions
- When using serial connection:
  - Verify the Eaton SPX is connected to PC with RS232 serial cable. The cable is connected from PC to the 9-pin D-SUB connector (female) of the Eaton SPX control unit. If PC does not contain RS232 serial port, then USB - RS232 converter device is needed between PC and Eaton SPX control unit.
- When using Ethernet connection:
  - Confirm the Ethernet cable is connected to the Ethernet interface of the option board
  - Note that the Eaton SPX requires option board supporting Ethernet communication. For example, OPTEA/OPTE9 Dual Port Ethernet option board.

### 3.1.1 Downloading Fieldbus Option Firmware

Prepare for commissioning by downloading the Fieldbus Option Firmware.

**Procedure**

1. Go to eaton.com.
2. Select Download Center from Support drop-down menu.
3. Filter “Software, firmware, and applications” in the Techical resources.
4. Download the Fieldbus firmware.

# 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 6.1 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.

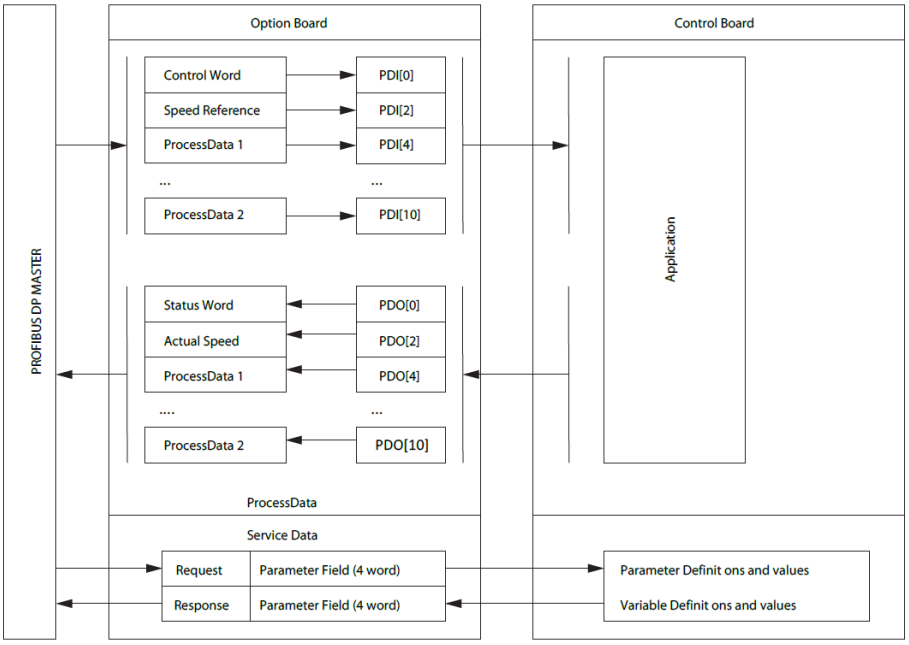


Figure 1: Data Transfer between PROFIBUS DP Master and Eaton AC drive

### 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 Eaton® 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 Eaton 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 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 4: Requirements for Different Fieldbus Communication Modes for Eaton SPX

| Software or hardware | Fast/Normal Extended |
|---|---|
| Control Board | SPX (serial number 761 or later) |
| System Software | SPXV027 |
| Applications[1] | Multipurpose V236 or later (Normal Extended Mode) |
| Fieldbus option firmware version | OPTE3/E5 V006 or later |
| | OPTE9 V007 or later |
| | OPTEA V001 or later |
| | OPTEC V003 or later |
| | OPTE6 V010 or later |
| | OPTE7 V006 or later |
| Advanced safety option | - |

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

### 4.2.2 Fieldbus Communication Mode Features and Limitations

**Fast mode**

- 1 ms process data interval
- Available in Eaton SPX 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 Eaton SPX AC drive.

**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 figure 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.

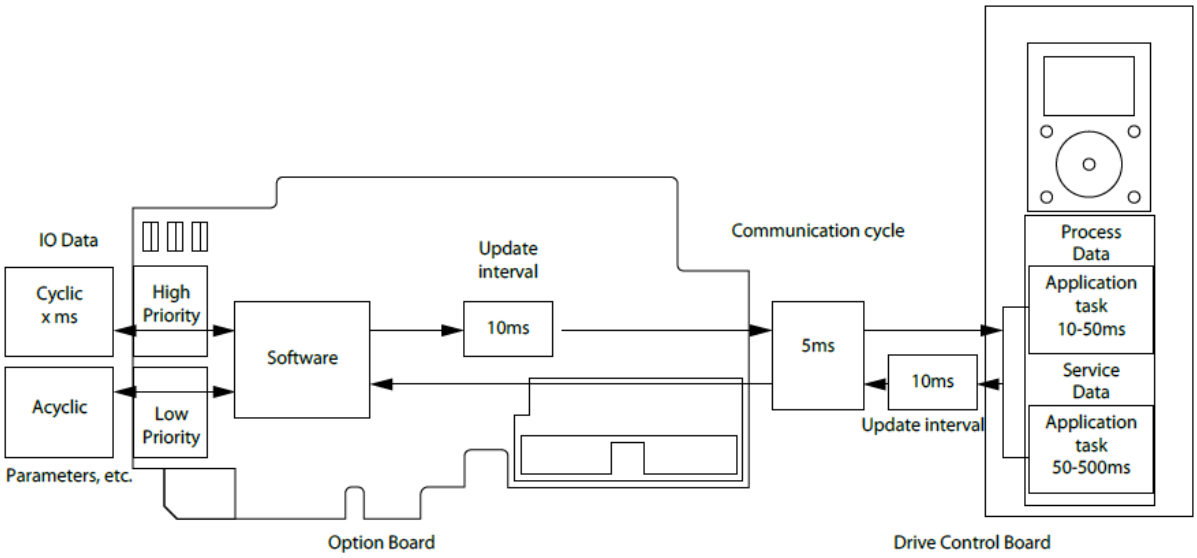


Figure 2: Normal Fieldbus Communication

### 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 figure 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.

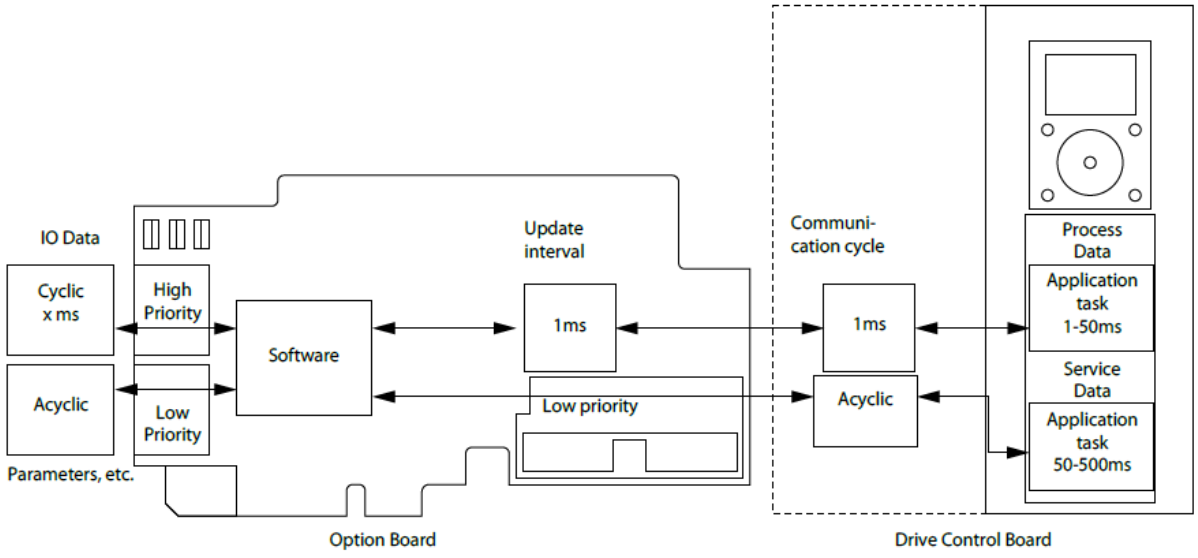


Figure 3: Fast Fieldbus Communication

### 4.2.5 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 Eaton SPX drives is undesirable.
NOTE! This mode can be automatically enabled in Eaton 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 5: OPTE3/E5 Modules

| Module name | Number | Abbreviation | Type | Description |
|---|---|---|---|---|
| Standard Telegram 1 | 7 | ST1 | Drive[1] | See 4.3.5.3 Standard Telegrams. |
| Eaton Telegram 100 | 8 | ST1+4PD | | See 4.3.5.4 Vendor-Specific Telegrams. |
| Eaton Telegram 101 | 9 | ST1+8PD | | |
| Eaton Telegram 138 | 11 | ST1+12PD | | |
| Eaton Telegram 139 | 12 | ST1+16PD | | |
| Eaton 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 31 | 14 | ST31 | | |
| Eaton Telegram 58000 | 15 | ST58000 | | |

[1] Drive module rules:

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

The supported module combinations are described in Table 6.

Table 6: 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.

### 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 Eaton 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 Eaton 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.

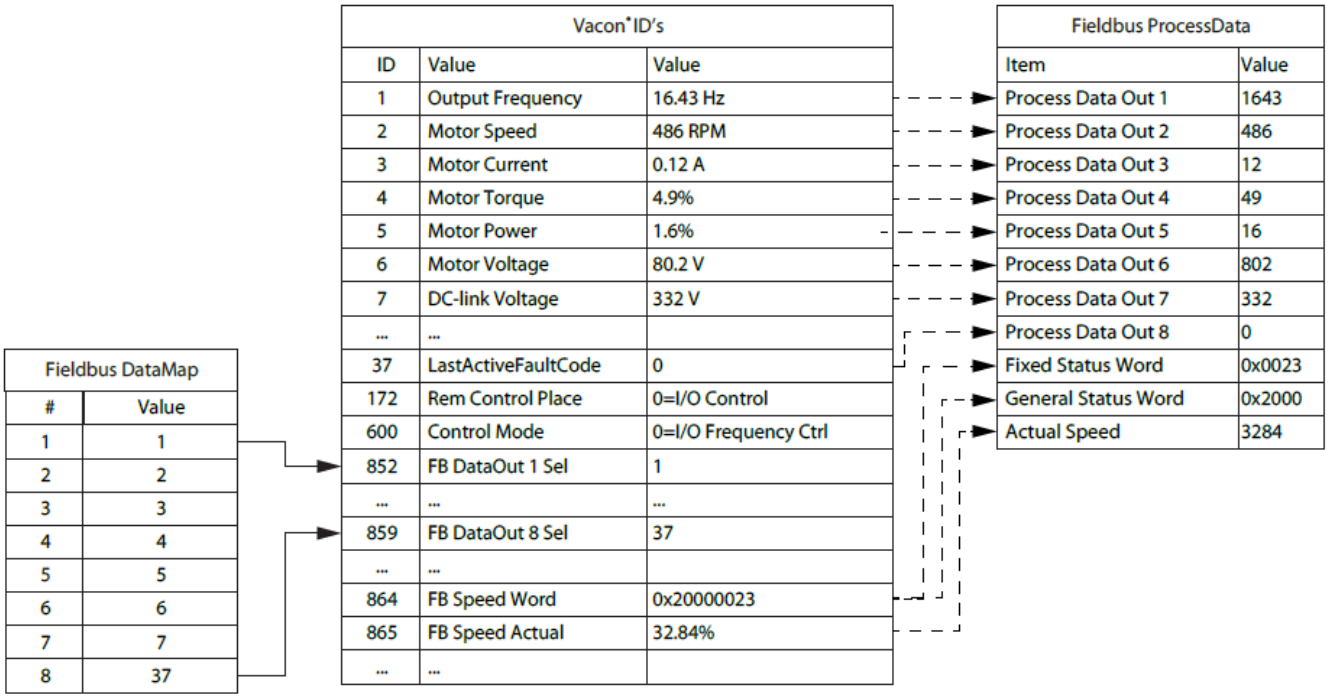


Figure 4: Fieldbus Data Mapping

Table 7: Fieldbus Process Data Selection Indexes in Panel Tree for Eaton AC drives

| Parameter name | ID | Index in panel tree for Eaton SPX Multipurpose application[1] |
|---|---|---|
| Fieldbus min scale | 850.00 | P1.9.1 |
| Fieldbus max scale | 851.00 | P1.9.2 |
| Fieldbus data out 1 selection | 852 | P1.9.3 |
| Fieldbus data out 2 selection | 853 | P1.9.4 |
| Fieldbus data out 3 selection | 854 | P1.9.5 |
| Fieldbus data out 4 selection | 855 | P1.9.6 |
| Fieldbus data out 5 selection | 856 | P1.9.7 |
| Fieldbus data out 6 selection | 857 | P1.9.8 |
| Fieldbus data out 7 selection | 858 | P1.9.9 |
| Fieldbus data out 8 selection | 859 | P1.9.10 |
| FB Data In1 sel | 876 | P1.9.11 |
| FB Data In2 sel | 877 | P1.9.12 |

Table 8: Default Process Data Mapping for Eaton SPX 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 FB | 45 | A | 0.1 A |
| 4 | Motor Current | 3 | A | 0.1 A |
| 5 | Motor Torque | 4 | % | 0.1% |
| 6 | Motor Power | 5 | % | 0.1% |
| 7 | Motor Voltage | 6 | V | 0.1 V |
| 8 | DC-bus voltage | 7 | V | 1 V |
| 9 | Last Active Fault Code | 37 | - | - |

### 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 9: 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 10: 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 Eaton 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 Eaton standard applications, functionality of the FBGeneralControlWord is application-specific and can vary even in Eaton standard applications.
FBFixedControlWord bit definitions are described in the table:.
Set all unused bits to zero.

Table 11: Definition of FBFixedControlWord in Eaton SPX

| 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 | - | - |

### 4.3.3.2 Status Word Overview

The Eaton 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 Eaton standard applications, functionality of the FBGeneralStatusWord is application-specific and can vary even in Eaton standard applications.
FBFixedStatusWord bit definitions are described in the tables. Unused bits are set to zero.

- Eaton SPX: Table 12

NOTE! In Eaton SPX series AC drives, the FBFixedStatusWord comes from firmware variable "MCStatus".

Table 12: Definition of FBFixedStatusWord for Eaton SPX

| 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.

### 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.
Eaton SPX: 13
9000XDrive PC tool is used with Eaton SPX drive.
To monitor in 9000XDrive, do the following settings:

- View –> Monitoring
- Type: Firmware

Table 13: Monitoring of Control and Status Words for Eaton SPX

| Signal | Index in panel tree | 9000XDrive 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

### 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 14: 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 figure 5.

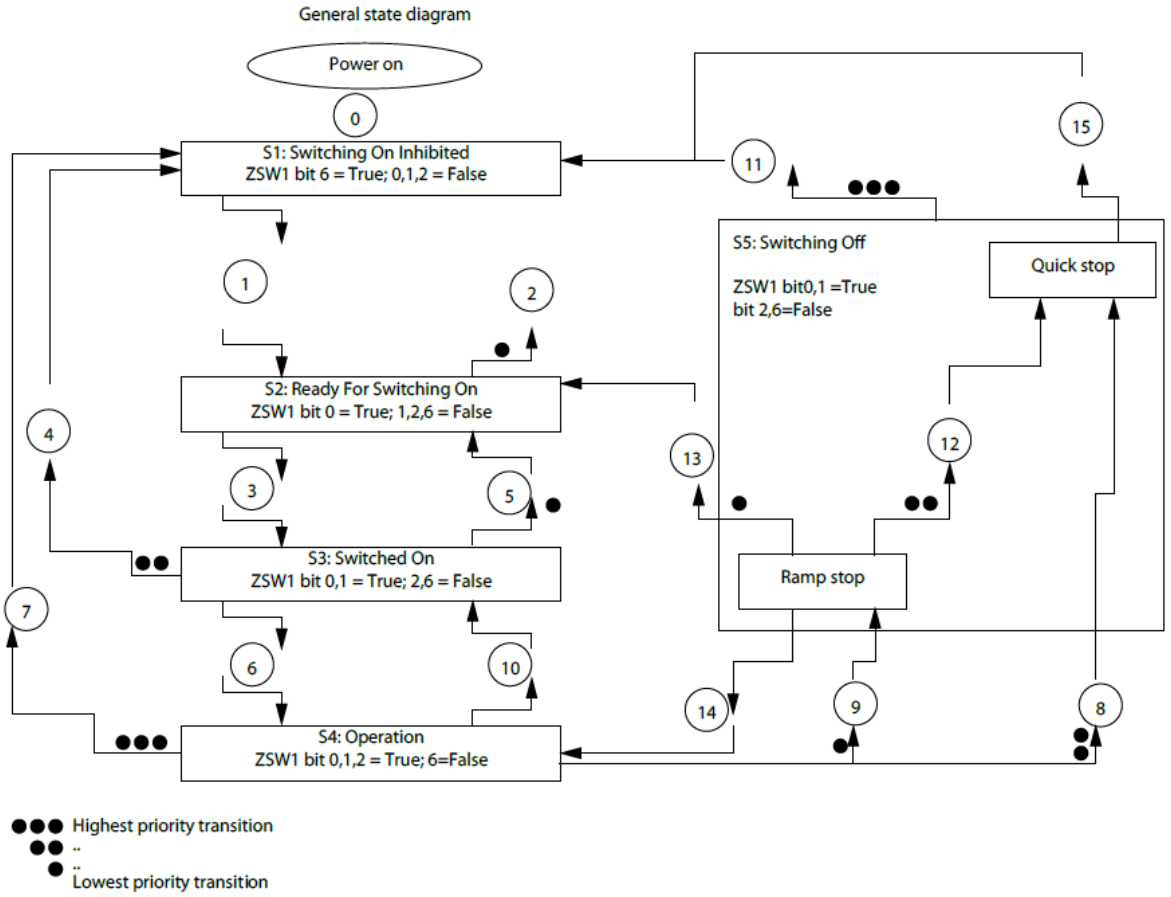


Figure 5: General State Diagram

Table 15: PROFIdrive State Machine Commands

| # | Bits of control word | Value (hex) | Action in Eaton SPX[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, STW1 bit 1 = False | 0x47D | Stop function |
| 8, 12 | Quick stop, STW1 bit 2 = False | 0x47B | Stop function |
| 9 | Ramp stop, STW1 bit 0 = False | 0x47E | Stop function |
| 10 | Disable operation, STW1 bit 3 = False | 0x477 | |
| 11 | Coast stop, STW1 bit 1 = False | 0x47D | 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 Eaton SPX 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 Eaton SPX Advanced Safety Options Operating Guide about details on Safety Telegram definitions.

Table 16: 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 17: Definition of Standard Telegram 1

| I/O Data number | Bytes | Setpoint | Actual value |
|---|---|---|---|
| 1 | 1...2 | STW1 | ZSW1 |
| 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 18: 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 19 and Table 20.

Table 19: 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 20: 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 21: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 22.

Table 22: 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

Eaton 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 23: Definition of Eaton 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 |
| 4 | 7...8 | PDI2 | PDO2 |
| 5 | 9...10 | PDI3 | PDO3 |
| 6 | 11...12 | PDI4 | PDO4 |

Eaton 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 24: Table 38: Definition of Eaton 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 |

Eaton 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 25 Definition of Eaton 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 |
| 13 | 25...26 | PDI11 | PDO11 |
| 14 | 27...28 | PDI12 | PDO12 |

Eaton 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 26: Definition of Eaton 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 |

Eaton 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 27: Definition of Eaton 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 |
| 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 28: 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 29: 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) | |
| 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 30: 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 31: 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 32: 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 |
| 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 33: 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 34: PROFIdrive 4.1 Control Word (STW1)

| Bits | Title | Value = 1 | Value = 0 | Description |
|---|---|---|---|---|
| 0 | Switching ON/OFF0 | 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 op- eration | 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. |
| 4 | Enabling of ramp genera- tor | 1 = Enable ramp generator | 0 = Reset ramp genera- tor | 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 val- ue | 1 = Unfreeze setpoint value | 0 = Freeze set- point 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 val- ue | 1 = Enable set- point 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 opera- tion, if this bit is set to 0, the drive decelerates to a standstill. |
| 7 | Fault ac- knowledge | 1 = Acknowl- edge 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 val- id.<br>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 provi- ded 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 35: 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. |
| 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.<br>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 opera- tion | 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 36: 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 |
| 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".

### 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 direc- tion 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 37: 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 |

### 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 38: 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 |
| 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 39 and detailed description of signals can be found inTable 40.

Table 39: PROFIdrive Signal Categories

| Signal number | Signal description |
|---|---|
| 0...89 | PROFIdrive-specific |
| 100...60099 | Vendor-specific |

Table 40: 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 | |
| 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 | | |
| ... | ... | ... | | |
| 117 | Process data in word 8 | PDI8 | | |
| 118 | Non-profile control word | - | 16 | 4.3.3 Bypass Operating Mode |
| 119 | Non-profile status word | - | | |
| 120 | Non-profile speed setpoint value | - | | |
| 121 | Non-profile speed actual value | - | | |
| 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 | | |

### 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 41: 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 |
| 9 | No Action | No Action |
| 10 | Disable PROFIBUS DP control | Enable PROFIBUS DP control |
| 11 | Fieldbus DIN 1=OFF | Fieldbus DIN 1=ON |
| 12 | Fieldbus DIN 2=OFF | Fieldbus DIN 2=ON |
| 13 | Fieldbus DIN 3=OFF | Fieldbus DIN 3=ON |
| 14 | Fieldbus DIN 4=OFF | Fieldbus DIN 4=ON |
| 15 | Fieldbus DIN 5=OFF | Fieldbus DIN 5=ON |

With the help of the control word, the start and stop commands can be given to the device (see Figure 6). Also a fault can be acknowledged.
There are several stop modes. It depends on the operating situation, which mode is selected.

Table 42: 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) | bit 7 = 0 | Rising edge to bit 7 |
| FAULT RESET (step 2) | bit 7 = 1 | |

[1] In Eaton SPX 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 Eaton SPX 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 43: 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] |
| 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.

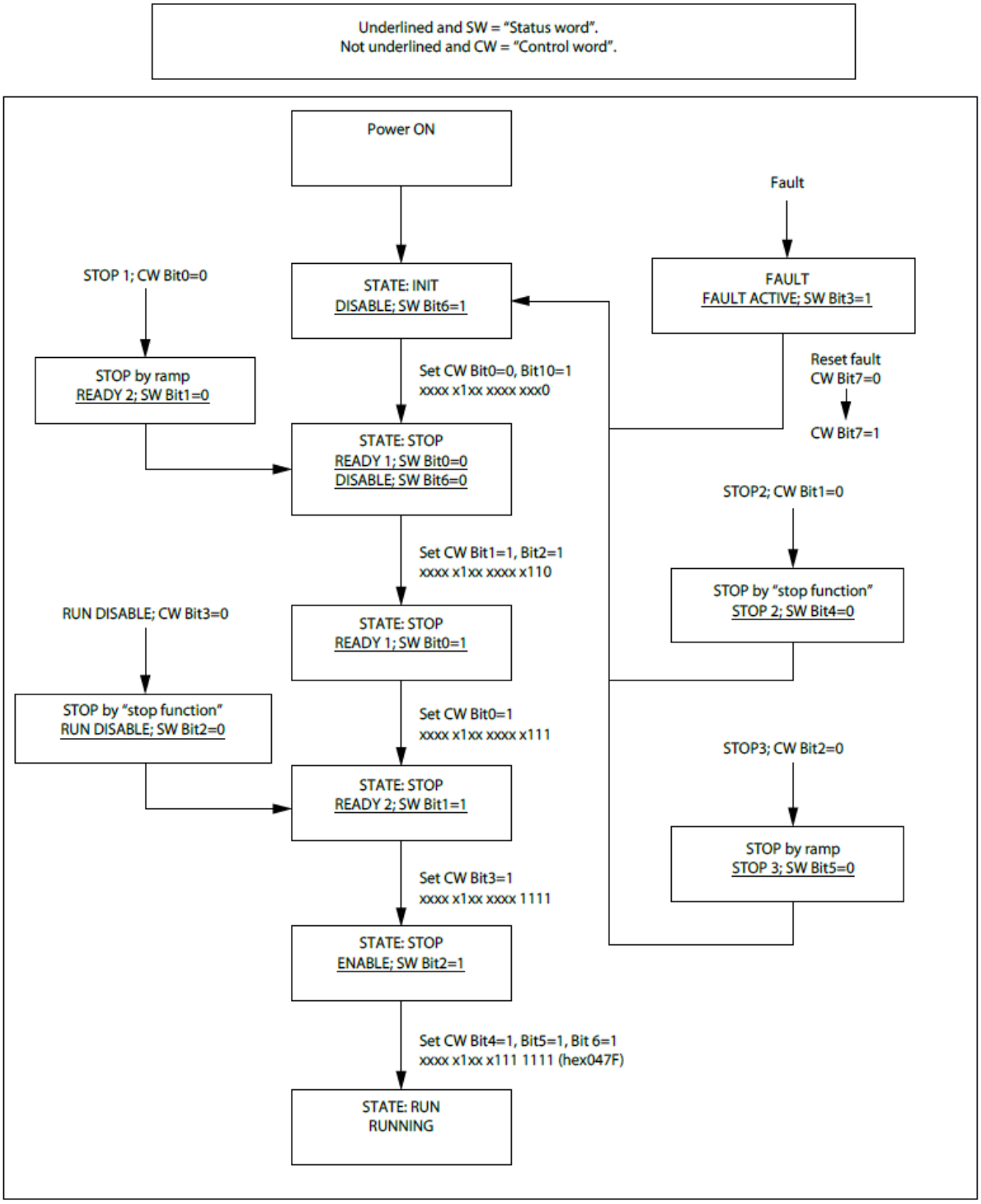


Figure 6 PROFIdrive 2.0 State Machine

When using a Eaton SPX 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 |

Figure 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 |

# 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.

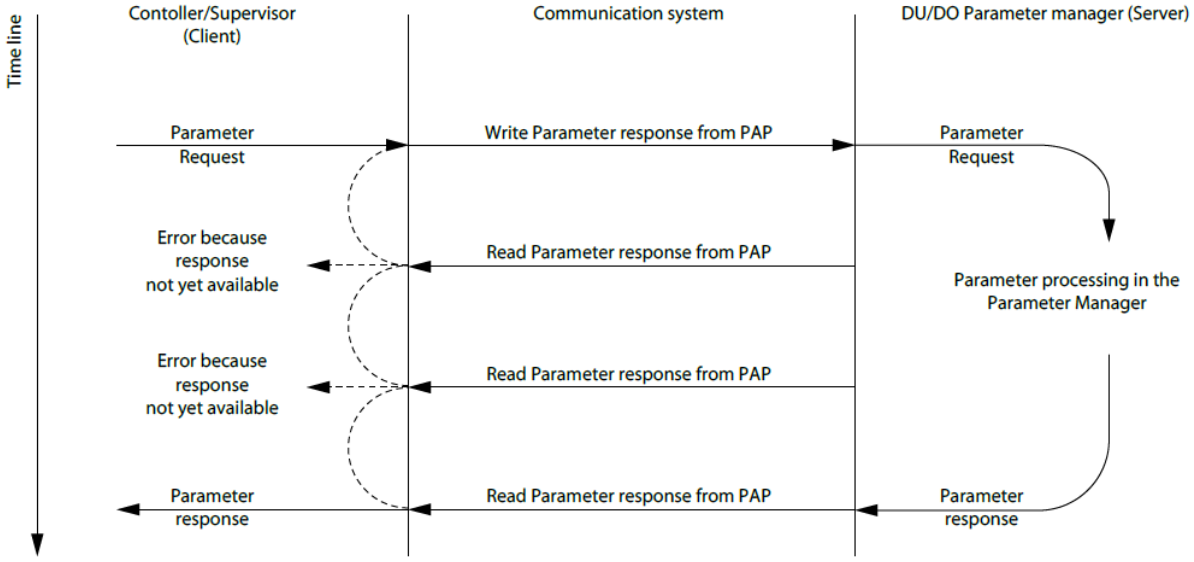


Figure 8: Data flow for Base Mode Parameter Access

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 44: 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 45: 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 46: 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.<br>• Use 0x5F for write requests.<br>• The slave returns 0xDE to indicate error in read request.<br>• The slave returns 0xDF to indicate error in write request.<br>• 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.<br>• 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.<br>• 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 47: 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.<br>• Value 0 restricted by PROFIdrive 4.1. |
| 2 | Request ID | Defines the type of request. | • Use 0x01 for Read requests.<br>• Use 0x02 for Change requests.<br>• Do not use other values. |
| 3 | Axis Number | Not used, must be set to 1. | • Use value 1.<br>• Do not use other values. |
| 4 | Requested number of parameters | The number of parameters affected by the request. | • Values 1–39 are allowed.<br>• The value 0 is not allowed.<br>• 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 48: Structure of the Parameter Address

| Octet num-ber | 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.<br>• Use 0x20 for reading the description of a parameter.<br>• Use 0x30 for reading the text of a parameter (not supported).<br>• 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.<br>• Values 1–234 are allowed for array parameters.<br>• Do not use other values. |
| 3...4 | Paramet er 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.<br>• 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 49: 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.<br>• Use 0x42 for Word.<br>• Use 0x43 for Double Word.<br>• Value 0x44 is used for Error<br>• 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.<br>• 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 50: 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.<br>• Use 0x5F for write requests.<br>• 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.<br>• 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 pa- rameter 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 51: 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.<br>• The slave returns 0xDF to indicate an error write response.<br>• 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.<br>• 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 52: 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<br>0x2 = module failure<br>0x3…0x7 = reserved (not used) 0x8 = version conflict<br>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<br>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<br>0xA…0xF = user-specific (not used) | - |
| 0xC = resource | 0x0 = read constraint conflict 0x1 = write constraint conflict | - |
| - | 0x2 = resource busy | - |
| - | 0x3 = resource unavailable | - |
| - | 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 53: 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 |
| 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 provi- ded | 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 54: 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.<br>• Uses 0x02 for successful change parameter operation.<br>• Uses 0x80 to indicate that an invalid request ID was re- ceived.<br>• Uses 0x81 for unsuccessful request parameter operation.<br>Uses 0x82 for unsuccessful change parameter operation.<br>Other values are not used. |
| 3 | Axis Number | Not used, must be set to 1 in OPTE5/E3. | Mirrored by the slave. |
| 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 55: 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 56: Structure of the Identifier Field

| Bits | Name | Description |
|---|---|---|
| 0–7 | Data type | • Specifies the data type of the parameter value.<br>• Value 3 corresponds to Integer16.<br>• Value 6 corresponds to Unsigned16.<br>• 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.<br>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.<br>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 infor- mation, 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 57: 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 | 0 |
| | | | kW | 3 |
| 11 | Speed | 1/second | 1/second | 0 |
| | | | 1/minute | 67 |
| | | | 1/hour | 72 |

Table 58: 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 5.1.3.1 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 59: 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.<br>Values 0–31 are allowed.<br>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 60: 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 61: Information Used for Request Parameter PNU918 Value

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

Table 62: 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 63: The Read Request to Slave

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

Table 64: 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 65: 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 66: 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 67: 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 68: The Slave Respond to Write Request

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

#### 5.1.4.4 Read Response to Request Parameter PNU964

Table 69: The Read Request to Slave

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

Table 70: 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 71: 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<br>0x0002<br>0x006B<br>0x07DA<br>0x0A2D<br>0x0001 |

Thus the following information can be determined about the device:

- Manufacturer code is 0x01BA
- 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 72: Information Used for Request for Value of Unsupported Parameter PNU900

| Field | Contents |
|---|---|
| Request reference | 0x03 |
| Request ID | 0x01 = Request parameter |
| Axis Number | 0x01 |
| Number of Parameters | 0x01 |
| Attribute | 0x10 = Value |
| Number of elements | 0x01 |
| Parameter Number | 0x0384 (900d) |
| Sub-index | 0x0000 (0d) |

Table 73: 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 74: 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 75: The Read Request to Slave

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

Table 76: 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 77: 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 78: The Slave Acknowledgement

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

Table 79: The Master Read Request

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

Table 80: 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 81: 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 82: The Slave Acknowledgement

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

Table 83: The OPTE3-E5-PROFIBUS-DPMaster Read Request

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

Table 84: 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 85: 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 86: The Slave Acknowledgement

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

Table 87: The Master Read Request

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

Table 88: 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 89: 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 90: 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<br>0x10 0x01 0x27 0x11 0x00 0x66 |

Table 91: The Slave Acknowledgement

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

Table 92: The Master Read Request

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

Table 93: 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 94: 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 |
| 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 95: 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 96: 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 97: The Slave Acknowledgement

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

Table 98: The Master Read Request

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

Table 99: 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 100: Description of Response Contents

| Field | Contents |
|---|---|
| Request reference | 0x05 |
| Request ID | 0x01 = Request parameter |
| Axis Number | 0x01 |
| Number of Parameters | 0x01 |
| 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 101: 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 102: 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 103: The Slave Acknowledgement

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

Table 104: The Master Read Request

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

Table 105: The Slave Response

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

Table 106: 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 107: 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 108: 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 109: The Slave Response

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

Table 110: The Master Read Request

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

Table 111: The Slave Response

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

Table 112: 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 113: 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 114: 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 115: The Slave Response

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

Table 116: The Master Read Request

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

Table 117: 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 118: 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 119: 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 120: 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 121: The Slave Response

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

Table 122: The Master Read Request

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

Table 123: The Slave Response

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

Table 124: 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 125: 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 126.

Table 126: Supported PNUs

| PNU | Significance | Data type | Description |
|---|---|---|---|
| 915 | Selection switch for DO I/O Data in setpoint tele- gram | 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 16. |
| 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 127 |
| 964 | Drive Unit identification | UINT[6] | See Table 128 |
| 965 | Profile identification number | BYTE[2] | Byte 1 = 3 (PROFIdrive),<br>Byte 2 = 41 (Version 4.1) |
| 975 | Drive Object identification | UINT[7] | See Table 129 |
| 980 | Number list of defined parameters | UINT[46] | List of defined parameters in array |
| 981…<br>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 21. |
| 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 22. |
| 10109 | Process Data In word | UINT[16] | See 4.3.2 Fieldbus Process Data. |
| 10110 | Process Data Out word | UINT[16] | |
| 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 130. |
| 10129 | Speed physical reference parameter for High speed applications | Unsigned16 | See 4.3.5.10 Normalization Reference Parameter. |

Table 127: 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 |
| 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 128: Structure of PNU 964 (Drive Unit Identification)

| Sub-index | Content | Value |
|---|---|---|
| 0 | Manufacturer | 0x01BA = Eaton |
| 1 | Drive Unit type | 0x0001 = Eaton SPX 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 129: Structure of PNU 975 (DO Identification)

| Sub-index | Content | Value |
|---|---|---|
| 0 | Manufacturer | 0x01BA = Eaton |
| 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 130: 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. |
| 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 Figure 9: PROFIdrive Fault BufferFigure 9.

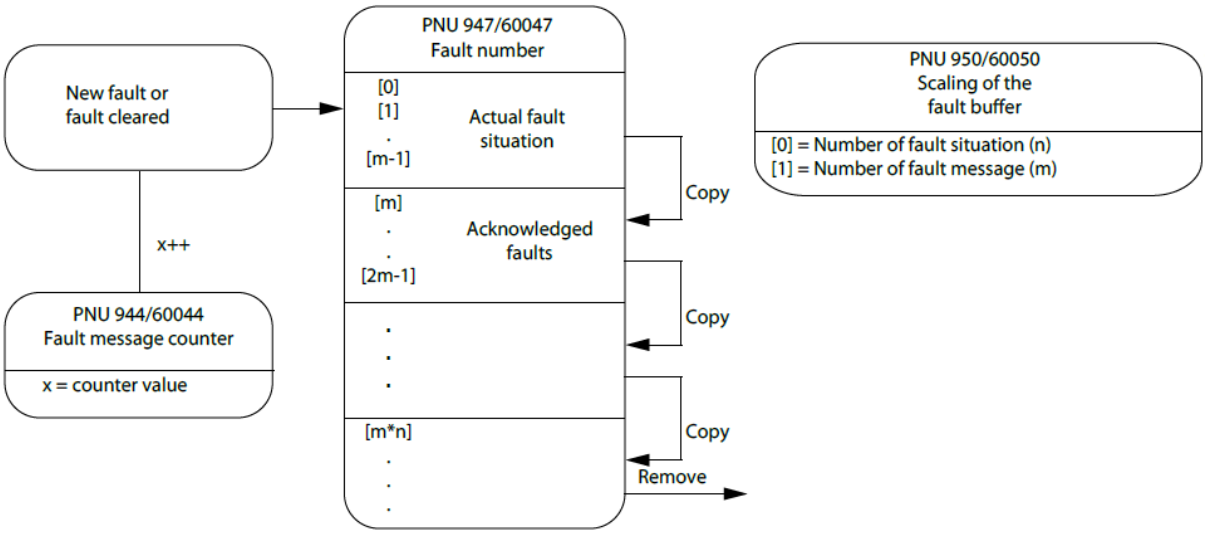


Figure 9: PROFIdrive Fault Buffer

The OPTE3/E5 supports one normal PROFIdrive fault buffers for AC drive errors which appear in normal fault buffer. PNUs 944, 947 and 950 are used for AC drive fault buffer. All used PNUs are listed in Table 131.

Table 131: 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<br>Index 1: The number of fault messages per fault situation | UINT16[2] | 4<br>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 fault code is defined as follows:
0xAABBCCDD, where
AA = Error class
BB = Source
CC = Fault number
DD = Additional Info
NOTE! If no fault is active, the active fault situation (first fault situation) is zero.

### 5.1.7 Drive System Time

System time in Eaton SPX 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.
Eaton SPX AC drive does not have time settings, so value written to this ID must be local time. Eaton SPX 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 PROFI- drive 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 132: 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 133: Acknowledge from AC Drive

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

Table 134: Read "Read Response" Request from PROFIBUS DP Master to AC Drive

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

Table 135: 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 PROFI- drive 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 136: 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 137: Acknowledge from AC Drive

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

Table 138: Read "Write Response" Request from PROFIBUS DP Master to AC Drive

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

Table 139: 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 4.1.2 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 140: 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 141: 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 142: 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 143: 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 144: 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 144: Description of the Request Contents

| Field | Contents | Description |
|---|---|---|
| ID | 0x1066 | 1 = Read parameter value 0x066 = 102d (Maximum Frequency ID) |
| Index | 0x0000 | No meaning |
| Value | 0x00000000 | No meaning |

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

Table 145: 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 146: 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 147: 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 148: 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 149: 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 150: 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 151: OPTE3/E5 parameters

| Index in panel tree for Eaton SPX | Parameter | Min | Max | Default | Description |
|---|---|---|---|---|---|
| P7.x.1.1 | Slave address | 2 | 126 | 126 | Address of the slave, see 6.1.1 Slave Address. |
| P7.x.1.2 | Operate mode | 1 | 3 | 1 | 1 = PROFIdrive<br>2 = Bypass<br>3 = Echo<br>See 6.1.2 Operate Mode. |
| P7.x.1.3 | Compatib. mode | 1 | 2 | 1 | 1 = Normal<br>2 = NX Mode / C3/C5 Mode<br>3 = PPO_PROFIdrive<br>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 Figure 10, Figure 11 and Figure 12). The PRO- FIdrive 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 PROFI- drive 4.1 Control and Status Words. When using PPO types, the default is the PROFIdrive 2.0 State machine, together with PROFI- drive 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 PROFI- BUS 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.

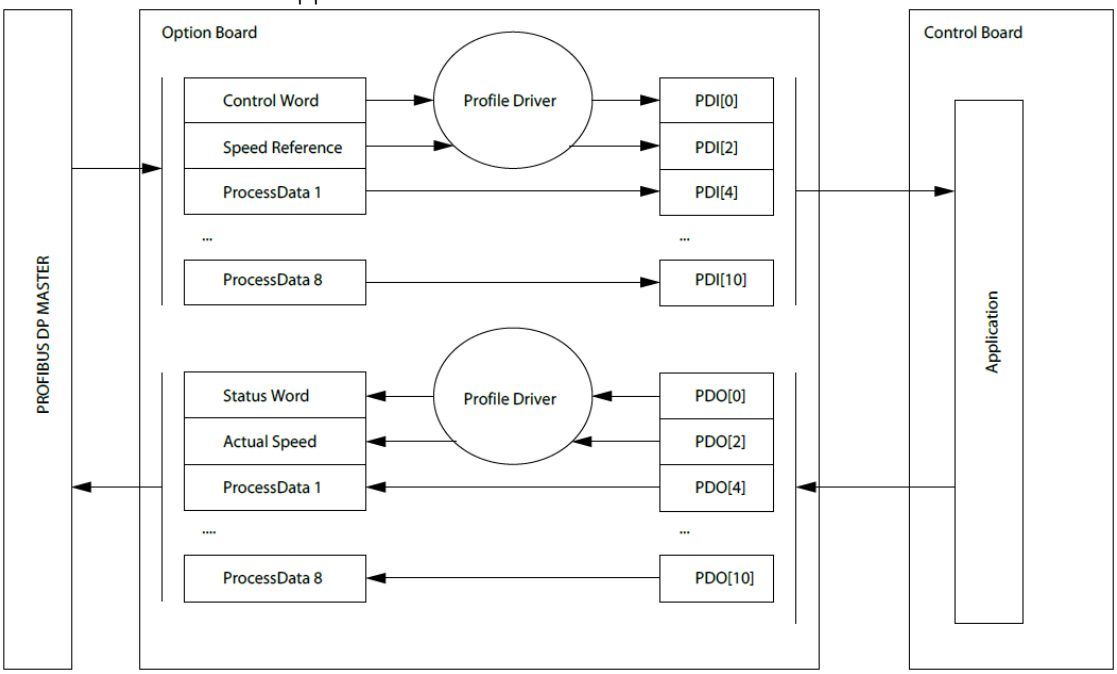


Figure 10,: Operate Mode "PROFIdrive"

### Operate Mode "Bypass"

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

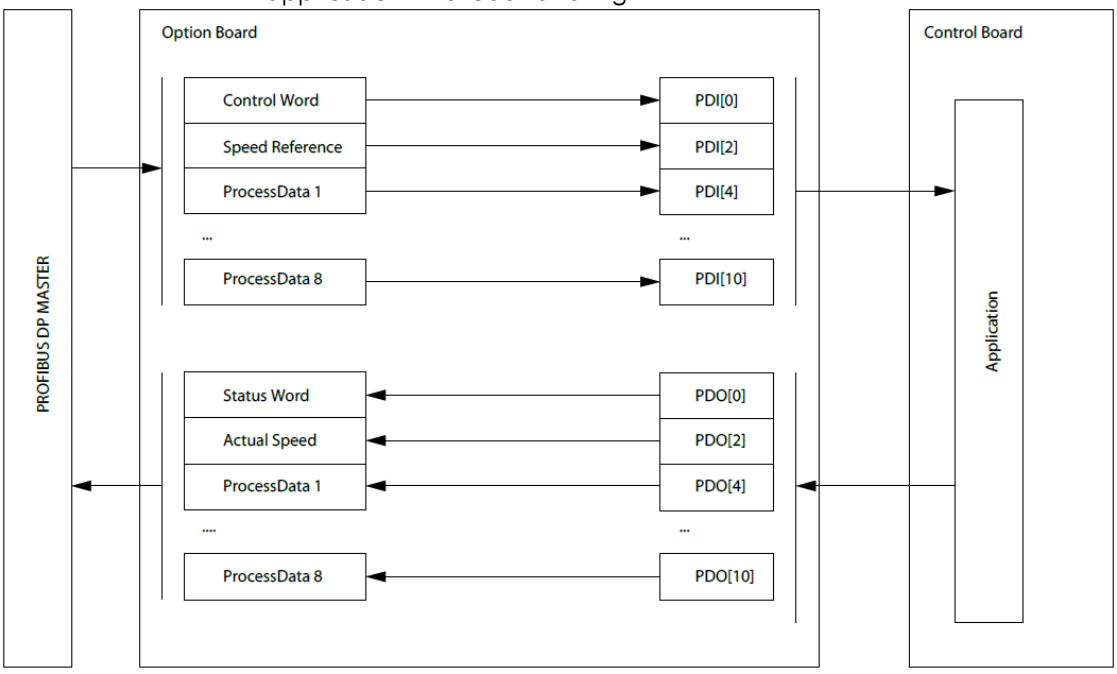


Figure 11: Operate Mode "Bypass"

Eaton 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.

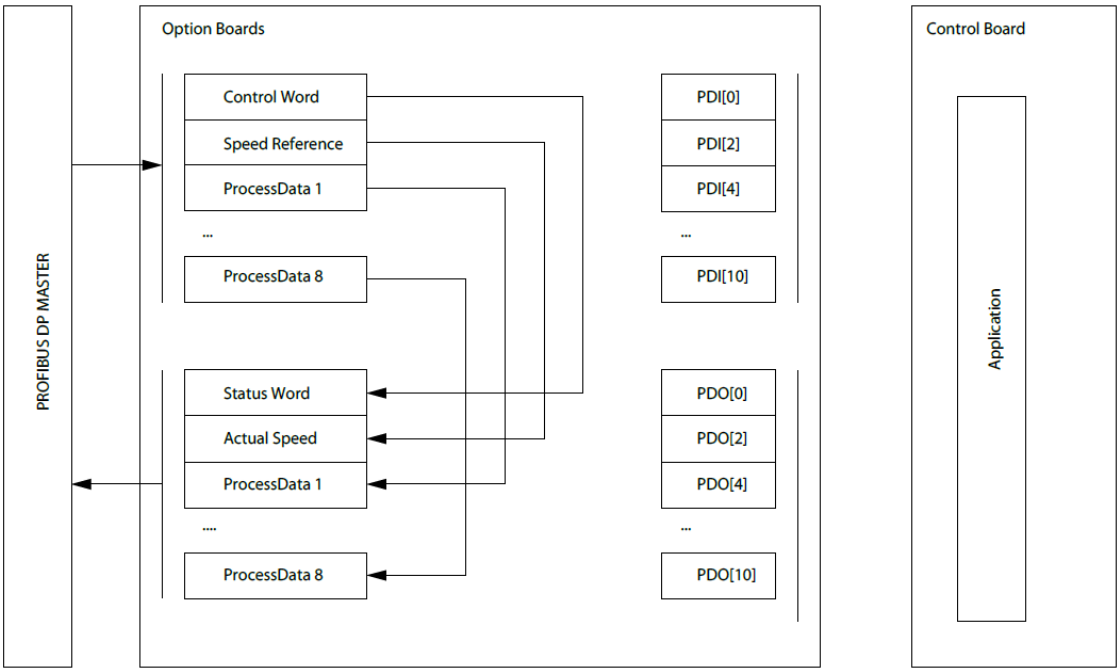


Figure 12: Operate Mode "Echo"

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.
- 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 152: Modifiable Parameters in GSD File

| Parameter | Value[1] | Range | Default | Description |
|---|---|---|---|---|
| Operate mode | 0 = Local<br>1 = Remote, PROFIdrive<br>2 = Remote, Bypass<br>3 = Remote, Echo | 0–3 | 0 | See 5.2.1 Operate Mode. |
| DP mode | 0 =DP-V0<br>1 = DP-V0 + DP-V1 | 0–1 | 1 | See 5.2.2 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 AC Drive Parameters

### 6.3.1 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.

### 6.3.2 Fieldbus Parameters for Eaton SPX Multipurpose Application

Table 153: Fieldbus Parameters for Eaton SPX Multipurpose Application

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

## 6.4 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 154: Response to Fieldbus Fault in Eaton SPX drives

| Panel Code | ID | AC Drive | Value | Default |
|---|---|---|---|---|
| P2.7.22 | | Eaton SPX | 0 = No action<br>1 = Warning<br>2 = Fault: Stop function<br>3 = Fault: Coast | 2 |

## 6.5 Eaton SPX System Software Parameters for Application Developers

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

Table 155: System Software Variables

| Parameter | Value | Default | Description |
|---|---|---|---|
| FBMode-SlotD_fwu8 | 0 = Normal mode<br>1 = Fast safety mode[1]<br>2 = Fast mode<br>3 = Fast PROFIBUS DP mode[2]<br>4 = Normal extended mode | 0 | See 6.5.1 System Software Variables for Selecting Communication Modes. |
| FBMode-SlotE_fwu8 | | 0 | |
| FBModeSlotD - SupModes_fwu16 | 0x00 = Not yet updated. Read again later<br>0x01 = Fieldbus communication not supported 0x02 = Normal mode supported<br>0x04 = Fast safety mode supported[1]<br>0x08 = Fast mode supported<br>0x10 = Fast PROFIBUS DP mode supported 0x20 = Normal exten- ded mode supported | 0 | See 6.5.2 System Software Variables for Monitoring Supported Communication Modes. |
| FBMode-SlotE_fwu8 | | 0 | |
| FBControlSlotSelector_fwu8[3] | 0 = All slots<br>4 = Slot D only<br>5 = Slot E only<br>6 = Fast PROFIBUS DP D slot<br>7 = Fast PROFIBUS DP E slot | 0 | See 6.5.3 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.

### 6.5.1 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.

### 6.5.2 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 exten- ded 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.

### 6.5.3 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 Eaton SPX 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 156: Eaton OPTE3/E5 Monitor Values for Eaton SPX

| 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<br>y = Status of communication y(0) = Wait_Prm<br>y(1) = Wait_Cfg<br>y(2) = Data_Exchange<br>See 7.1.1 PROFIBUS DP Status. |
| V7.x.2.2 | FB Protocol Status | 1 | 4 | - | 1 = Initializing<br>2 = Stopped<br>3 = Operational<br>4 = Faulted<br>See 7.1.2 FB Protocol Status. |
| V7.x.2.3 | Protocol | 0 | 1 | - | 0 = DP-V0<br>1 = DP-V1<br>See 7.1.3 Protocol. |
| V7.x.2.4 | Baud Rate | 1 | 10 | - | 1 = 9.6 kBd<br>2 = 19.2 kBd<br>3 = 93.75 kBd<br>4 = 187.6 kBd<br>5 = 500 kBd<br>6 = 1500 kBd<br>7 = 3 MBd<br>8 = 6 MBd<br>9 = 12 MBd<br>10 = Auto<br>See 7.1.4 Baud Rate. |
| V7.x.2.5 | PPO Type | 0 | 6 | - | 0 = Not Used<br>1 = PPO1<br>2 = PPO2<br>3 = PPO3<br>4 = PPO4<br>5 = PPO5<br>6 = PPO6<br>See 7.1.5 PPO Type. |
| V7.x.2.6 | Telegram Type | 0 | 4 | - | 0 = Not Used<br>1 = ST1<br>2 = ST1 + 4PD<br>3 = ST1 + 8PD<br>4 = ST20<br>5=ST1 + 12PD<br>6=ST1 + 16PD<br>7=GCW + 16PD<br>See 7.1.6 Telegram Type. |
| V7.x.2.8 | Protocol CW | 0 | 65535 | - | Control Word from PLC<br>See 7.1.7 Protocol CW/Fieldbus CW. |
| V7.x.2.9 | Protocol SW | 0 | 65535 | - | Status Word from AC drive<br>See 7.1.8 Protocol SW/Fieldbus SW. |
| V7.x.2.10 | Drive CW | 0 | 65535 | - | Control Word in AC drive format See 7.1.9 Drive CW. |
| V7.x.2.11 | Drive SW | 0 | 65535 | - | Status Word in AC drive format See 7.1.10 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 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 Eaton format. Special applications can use other formats.

### 7.1.8 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 Eaton format. Special applications can use other formats.

### 7.1.9 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 Eaton format.
If PROFIdrive operate mode is used, the control word is converted into Eaton 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.

### 7.1.10 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 Eaton 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.

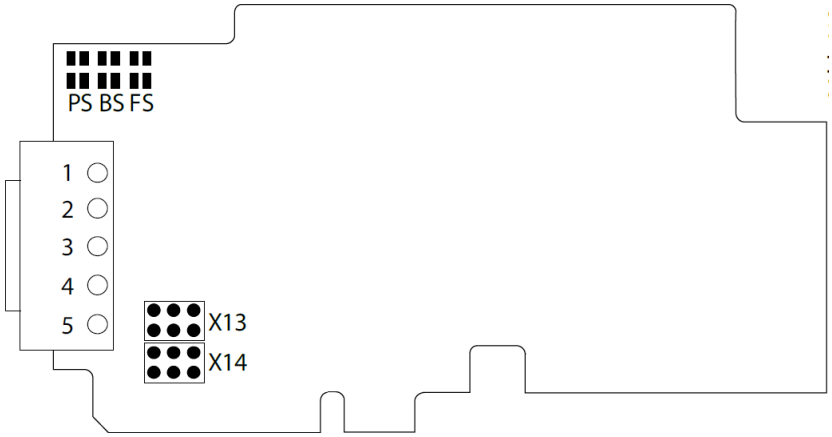


Figure 13: LED Indications on Eaton PROFIBUS Option

| | |
|---|---|
| • PS PROFIBUS status, RED<br>• BS PROFIBUS board status, YELLOW | • FS Fieldbus status, GREEN |

Table 157: PS = PROFIBUS Status, RED

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

Table 158: 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<br>• Option board is ready for external communication |
| Blinking slow (once per 5 s) | Option board is activated and in FAULT state<br>• Internal fault on optionboard |

Table 159: FS = Fieldbus Status, GREEN

| **LED status** | **Description** |
|---|---|
| OFF | Fieldbus module is waiting for parameters from the AC drive<br>• No external communication |
| ON | Fieldbus module is activated<br>• Parameters received and module activated<br>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<br>• No messages from Net within the watchdog time<br>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.

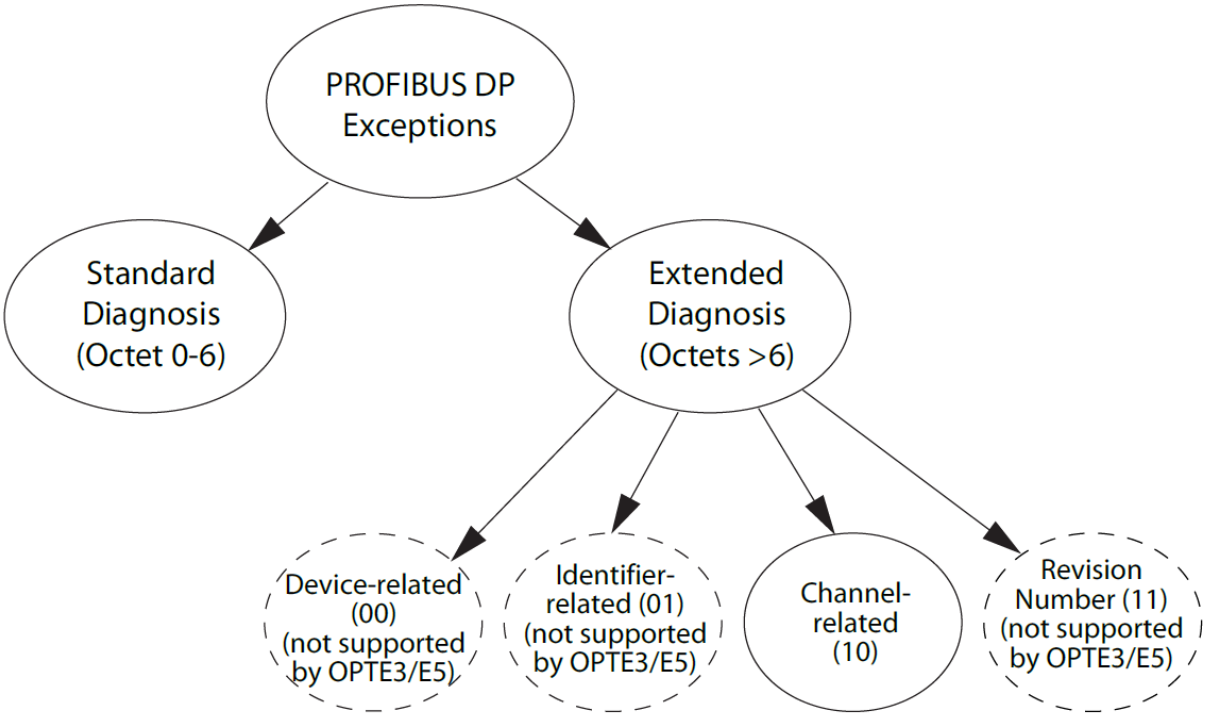


Figure 14: Overview of PROFIBUS DP Diagnosis

### 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 160: 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)<br>1 = Slave indicates serious faults, usually with extended diagnosis data |
| | 4 | Diag.Not_Supported | Slave does not support the required function |
| | 5 | Diag.Invalid_Slave_Response | 0 = Set by slave<br>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)<br>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<br>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 161: 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 162: 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
3. If possible, also get fieldbus communication log from the fault situation if applicable.

Table 163: 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: eaton.com

## 8.5 Typical Fault Conditions

Table 164: 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 |
| | | 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. |

# 9 Index

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## V



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## Z