

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Adjustable speed electrical power drive systems –  
Part 7-203: Generic interface and use of profiles for power drive systems –  
Profile type 3 specification**

**Entraînements électriques de puissance à vitesse variable –  
Partie 7-203: Interface générique et utilisation de profils pour les entraînements  
électriques de puissance – Spécification de profil de type 3**



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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

### Part 7-203: Generic interface and use of profiles for power drive systems – Profile type 3 specification

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International Standard IEC 61800-7-203 has been prepared by subcommittee SC 22G: Adjustable speed electric drive systems incorporating semiconductor power converters, of IEC technical committee TC 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) minor updates in the Base Mode Parameter Access mechanism;
- b) minor updates and simplification in the Application Class 3 state machine definition.

The text of this standard is based on the following documents:

| FDIS         | Report on voting |
|--------------|------------------|
| 22G/309/FDIS | 22G/324/RVD      |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61800 series, under the general title *Adjustable speed electrical power drive systems*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

### 0.1 General

The IEC 61800 series is intended to provide a common set of specifications for adjustable speed electrical power drive systems.

IEC 61800-7 specifies profiles for power drive systems (PDS) and their mapping to existing communication systems by use of a generic interface model.

IEC 61800-7 describes a generic interface between control systems and power drive systems. This interface can be embedded in the control system. The control system itself can also be located in the drive (sometimes known as "smart drive" or "intelligent drive").

A variety of physical interfaces is available (analogue and digital inputs and outputs, serial and parallel interfaces, fieldbuses and networks). Profiles based on specific physical interfaces are already defined for some application areas (e.g. motion control) and some device classes (e.g. standard drives, positioner). The implementations of the associated drivers and application programmers interfaces are proprietary and vary widely.

IEC 61800-7 defines a set of common drive control functions, parameters, and state machines or description of sequences of operation to be mapped to the profiles.

IEC 61800-7 provides a way to access functions and data of a drive that is independent of the used drive profile and communication interface. The objective is a common drive model with generic functions and objects suitable to be mapped on different communication interfaces. This makes it possible to provide common implementations of motion control (or velocity control or drive control applications) in controllers without any specific knowledge of the drive implementation.

There are several reasons to define a generic interface:

#### **For a drive device manufacturer**

- less effort to support system integrators;
- less effort to describe drive functions because of common terminology;
- the selection of drives does not depend on availability of specific support;

#### **For a control device manufacturer**

- no influence of bus technology;
- easy device integration;
- independent of a drive supplier;

#### **For a system integrator (builds modules, machines, plants etc.)**

- less integration effort for devices;
- only one understandable way of modeling;
- independent of bus technology.

Much effort is needed to design a motion control application with several different drives and a specific control system. The tasks to implement the system software and to understand the functional description of the individual components may exhaust the project resources. In some cases, the drives do not share the same physical interface. Some control devices just support a single interface which will not be supported by a specific drive. On the other hand, the functions and data structures are specified with incompatibilities. It is up to the systems

integrator to write interfaces to the application software to handle that which should not be his responsibility.

Some applications need device exchangeability or integration of new devices in an existing configuration. They are faced with different incompatible solutions. The efforts to adapt a solution to a drive profile and to manufacturer specific extensions may be unacceptable. This will reduce the degree of freedom to select a device best suited for this application to the selection of the unit which will be available for a specific physical interface and supported by the controller.

IEC 61800-7-1 is divided into a generic part and several annexes as shown in Figure 1. The drive profile types for CiA® 402<sup>1</sup>, CIP Motion™<sup>2</sup>, PROFIdrive<sup>3</sup> and SERCOS®<sup>4</sup> are mapped to the generic interface in the corresponding annex. The annexes have been submitted by open international network or fieldbus organizations which are responsible for the content of the related annex and use of the related trade marks.

This part of IEC 61800-7 specifies the profile type 3 (PROFIdrive).

The profile types 1, 2 and 4 are specified in IEC 61800-7-201, IEC 61800-7-202 and IEC 61800-7-204.

- 
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IEC 61800-7-301, IEC 61800-7-302, IEC 61800-7-303 and IEC 61800-7-304 specify how the profile types 1, 2, 3 and 4 are mapped to different network technologies (such as CANopen®<sup>5</sup>, CC-Link IE® Field Network<sup>6</sup>, EPA™<sup>7</sup>, EtherCAT®<sup>8</sup>, Ethernet Powerlink™<sup>9</sup>, DeviceNet™<sup>10</sup>, ControlNet™<sup>11</sup>, EtherNet/IP™<sup>12</sup>, PROFIBUS<sup>13</sup>, PROFINET<sup>14</sup> and SERCOS®).

- 
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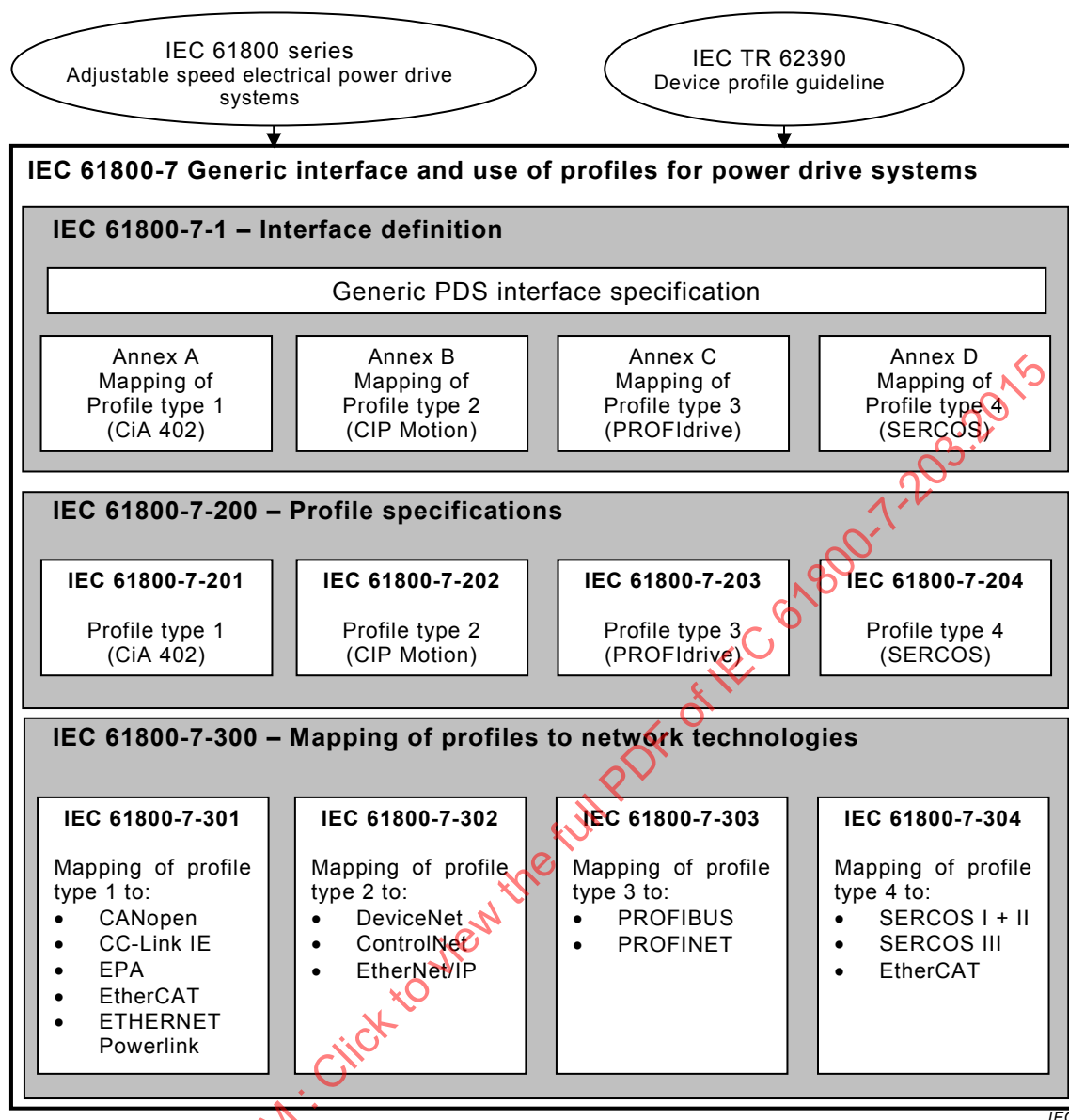


Figure 1 – Structure of IEC 61800-7

## 0.2 Patent declaration

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the following:

| Publication/<br>Application serial<br>number | Holder | Title                                                                                                                                                          | Derwent accession<br>Number | Derwent<br>publication                                                                 |
|----------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------|
| EP844542                                     | [SI]   | Numerical control method and control structure for controlling of movement of objects whereby speed control is effected at a higher rate than position control | 1998-274369                 | EP844542-A1<br>27.05.1998;<br>DE59603496-G<br>02.12.1999;<br>EP844542-B1<br>27.10.1999 |

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## ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

### Part 7-203: Generic interface and use of profiles for power drive systems – Profile type 3 specification

#### 1 Scope

This part of IEC 61800 specifies profile type 3 for power drive systems (PDS). Profile type 3 can be mapped onto different communication network technologies.

The functions specified in this part of IEC 61800 are not intended to ensure functional safety. This requires additional measures according to the relevant standards, agreements and laws.

#### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61158-5-3, *Industrial communication networks – Fieldbus specifications – Part 5-3: Application layer service definition – Type 3 elements*

IEC 61158-5-10, *Industrial communication networks – Fieldbus specifications – Part 5-10: Application layer service definition – Type 10 elements*

IEC 61158-6-3, *Industrial communication networks – Fieldbus specifications – Part 6-3: Application layer protocol specification – Type 3 elements*

IEC 61158-6-10, *Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 elements*

IEC 61800-7-1:2015, *Adjustable speed electrical power drive systems – Part 7-1: Generic interface and use of profiles for power drive systems – Interface definition*

IEC 61800-7-303:2015, *Adjustable speed electrical power drive systems – Part 7-303: Generic interface and use of profiles for power drive systems – Mapping of profile type 3 to network technologies*

#### 3 Terms, definitions and abbreviated terms

##### 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

###### 3.1.1

###### **actual value**

value of a variable quantity at a given instant

Note 1 to entry: Actual value is used in this document as input data of the application control program to monitor variables of the PDS (e.g. feedback variables).

[SOURCE: IEC 61800-7-1:2015, 3.3.1.1]

### 3.1.2

#### **algorithm**

completely determined finite sequence of operations by which the values of the output data can be calculated from the values of the input data

[SOURCE: IEC 61800-7-1:2015, 3.2.1]

### 3.1.3

#### **application**

software functional element specific to the solution of a problem in industrial-process measurement and control

Note 1 to entry: An application may be distributed among resources, and may communicate with other applications.

[SOURCE: IEC 61800-7-1:2015, 3.2.2]

### 3.1.4

#### **application mode**

type of application that can be requested from a PDS

Note 1 to entry: The different application modes reflect the control loop for torque control, velocity control, position control or other applications like homing.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.2]

### 3.1.5

#### **attribute**

property or characteristic of an entity

[SOURCE: IEC 61800-7-1:2015, 3.2.3]

### 3.1.6

#### **axis**

logical element inside an automation system (e.g. a motion control system) that represents some form of movement

Note 1 to entry: Axes can be rotary or linear, physical or virtual, controlled or simply observed.

Note 2 to entry: A physical axis may include one or more of the following components: a motion sensor, a motion control structure, a power amplifier, and a motion actuator.

[SOURCE: IEC 61800-7-1:2015, 3.2.4, modified – A note to entry is added]

### 3.1.7

#### **class**

description of a set of objects that share the same attributes, operations, methods, relationships, and semantics

[SOURCE: IEC 61800-7-1:2015, 3.2.5]

### 3.1.8

#### **clock cycle synchronous application**

synchronisation of sampling and cycle times in the closed-loop control software in digital drives and control systems

### 3.1.9

#### **commands**

set of commands from the application control program to the PDS to control the behaviour of the PDS or functional elements of the PDS

Note 1 to entry: The behaviour is reflected by states or operating modes.

Note 2 to entry: The different commands may be represented by one bit each.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.3]

#### **3.1.10**

##### **control**

purposeful action on or in a process to meet specified objectives

[SOURCE: IEC 61800-7-1:2015, 3.2.6]

#### **3.1.11**

##### **control device**

physical unit that contains – in a module/subassembly or device – an application program to control the PDS

[SOURCE: IEC 61800-7-1:2015, 3.2.7]

#### **3.1.12**

##### **data type**

set of values together with a set of permitted operations

[SOURCE: IEC 61800-7-1:2015, 3.2.8]

#### **3.1.13**

##### **device**

field device

<function blocks> networked independent physical entity of an industrial automation system capable of performing specified functions in a particular context and delimited by its interfaces

[SOURCE: IEC 61800-7-1:2015, 3.2.9]

#### **3.1.14**

##### **device**

field device

<system integration> entity that performs control, actuating and/or sensing functions and interfaces to other such entities within an automation system

[SOURCE: IEC 61800-7-1:2015, 3.2.10]

#### **3.1.15**

##### **device profile**

representation of a device in terms of its parameters, parameter assemblies and behaviour according to a device model that describes the data and behaviour of the device as viewed through a network, independent from any network technology

[SOURCE: IEC 61800-7-1:2015, 3.2.11]

#### **3.1.16**

##### **DO IO Data**

collection of all Input Data and Output Data (cyclic transmission) of a Drive Object (drive axis)

#### **3.1.17**

##### **Drive Object**

functional element of a Drive Unit

### 3.1.18

#### **Drive to Drive communication**

communication (cyclic) between drives from the user's perspective

### 3.1.19

#### **Drive Unit**

logical device which comprises all functional elements related to one central processing unit

### 3.1.20

#### **functional element**

entity of software or software combined with hardware, capable of accomplishing a specified function of a device

Note 1 to entry: A functional element has an interface, associations to other functional elements and functions.

Note 2 to entry: A functional element can be made out of function block(s), object(s) or parameter list(s).

[SOURCE: IEC 61800-7-1:2015, 3.2.13]

### 3.1.21

#### **Input Data**

data to be sent cyclically from the device to the controller

### 3.1.22

#### **interface**

shared boundary between two entities defined by functional characteristics, signal characteristics, or other characteristics as appropriate

[SOURCE: IEC 61800-7-1:2015, 3.2.15]

### 3.1.23

#### **IO Data**

Input Data and Output Data of a device

### 3.1.24

#### **Isochronous Mode**

communication system service for clock cycle synchronism which generates a constant (timing) bus cycle with a clock cycle signal at the start of the cycle

### 3.1.25

#### **model**

mathematical or physical representation of a system or a process, based with sufficient precision upon known laws, identification or specified suppositions

[SOURCE: IEC 61800-7-1:2015, 3.2.17]

### 3.1.26

#### **operating mode**

characterisation of the way and the extent to which the human operator intervenes in the control equipment

[SOURCE: IEC 61800-7-1:2015, 3.2.18]

### 3.1.27

#### **Output Data**

data to be sent cyclically from the controller to the device

**3.1.28****parameter**

data element that represents device information that can be read from or written to a device, for example through the network or a local HMI

Note 1 to entry: A parameter is typically characterized by a parameter name, data type and access direction.

[SOURCE: IEC 61800-7-1:2015, 3.2.20]

**3.1.29****Process data**

data related to the control process, for example gain factor and state variables, typically mapped to parameters

**3.1.30****profile**

representation of a PDS interface in terms of its parameters, parameter assemblies and behaviour according to a communication profile and a device profile

[SOURCE: IEC 61800-7-1:2015, 3.2.21, modified – Note 1 to entry is deleted]

**3.1.31****setpoint**

value or variable used as Output Data of the application control program to control the PDS

**3.1.32****status**

set of information from the PDS to the application control program reflecting the state or mode of the PDS or a functional element of the PDS

Note 1 to entry: The different status information may be coded with one bit each.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.6]

**3.1.33****technological functions**

closed-loop controls and sequence controls for automation of application-specific processes

**3.1.34****type**

hardware or software element which specifies the common attributes shared by all instances of the type

[SOURCE: IEC 61800-7-1:2015, 3.2.23]

**3.1.35****use case**

class specification of a sequence of actions, including variants, that a system (or other entity) can perform, interacting with actors of the system

[SOURCE: IEC 61800-7-1:2015, 3.2.24]

**3.1.36****variable**

software entity that may take different values, one at a time

Note 1 to entry: The values of a variable as well as of a parameter are usually restricted to a certain data type.

[SOURCE: IEC 61800-7-1:2015, 3.2.25]

### 3.2 Abbreviated terms

|          |                                                                                    |
|----------|------------------------------------------------------------------------------------|
| AC       | PROFIdrive Application Class                                                       |
| BERO     | proximity switch                                                                   |
| CO       | Communication Object                                                               |
| CR       | communication relationship                                                         |
| C-LS     | Controller's Sign-Of-Life                                                          |
| DO       | Drive Object                                                                       |
| DO-LS    | Drive Object Sign-Of-Life                                                          |
| DP       | Decentralised (distributed) Periphery                                              |
| DSC      | Dynamic Servo Control                                                              |
| DU       | Drive Unit                                                                         |
| DX       | Data_Exchange                                                                      |
| f        | frequency                                                                          |
| GSD      | General Station Description (device description, input for a bus configuring tool) |
| HMI      | human machine interface                                                            |
| ID       | identifier                                                                         |
| IO Data  | IO Data; is transmitted cyclically                                                 |
| I/O      | input/output                                                                       |
| $K_V$    | position closed loop control gain factor                                           |
| $k_{PC}$ | position closed loop control gain factor                                           |
| LS       | Sign-Of-Life                                                                       |
| LSB      | least significant bit                                                              |
| MSB      | most significant bit                                                               |
| M CR     | Multicast CR                                                                       |
| MDI      | Manual Data Input                                                                  |
| NAMUR    | Standards Working Group for Instrumentation and Control in the Chemical Industry   |
| NC       | numerical control system with a numeric control command set                        |
| Pxxx     | parameter (identified by number xxx)                                               |
| PAP      | Parameter Access Point                                                             |
| PBE      | parameter description                                                              |
| P-Device | peripheral device (PROFIdrive Base Model)                                          |
| PDS      | power drive system                                                                 |
| PI       | PROFIBUS & PROFINET International                                                  |
| PLC      | programmable logic controller without a motion control command set                 |
| PLL      | phase locked loop (phase control loop)                                             |
| PNO      | PROFIBUS user organisation                                                         |
| PNU      | parameter number                                                                   |
| PROFIBUS | process field bus as defined in IEC 61158-5-3 and IEC 61158-6-3                    |
| PROFINET | process field bus as defined in IEC 61158-5-10 and IEC 61158-6-10                  |
| PWE      | parameter value                                                                    |

|                  |                                                                        |
|------------------|------------------------------------------------------------------------|
| RFG              | Ramp Function Generator                                                |
| RMS              | root mean square value (true root mean square value)                   |
| SN               | sign                                                                   |
| STW              | control word                                                           |
| T <sub>a</sub>   | sampling time                                                          |
| T <sub>DC</sub>  | Data-Cycle-Time                                                        |
| T <sub>DX</sub>  | Data_Exchange-Time                                                     |
| T <sub>M</sub>   | Master-Time                                                            |
| T <sub>CAC</sub> | Controller_Application_Cycle-Time                                      |
| T <sub>CLS</sub> | Contoller_Life_Sign-Time                                               |
| T <sub>O</sub>   | Output-Time                                                            |
| T <sub>PC</sub>  | position controller sampling time                                      |
| T <sub>SC</sub>  | speed controller sampling time                                         |
| T <sub>DLS</sub> | DO_Life_Sign-Time                                                      |
| VIK              | Association of the Industrial Customers and Industrial Power Producers |
| x <sub>err</sub> | closed loop control system deviation                                   |
| ZSW              | status word                                                            |

## 4 General

### 4.1 Background

The PROFIdrive profile was generated by the PROFIBUS & PROFINET user organisation PROFIBUS & PROFINET international (PI). It defines a unified device behaviour and access technique to the drive data.

For the user, this means that engineering costs are reduced when planning and implementing plants and systems, as the various drives respond the same way to control instructions.

The programming costs are significantly reduced by using standardised program blocks in the open loop and closed loop control systems for controlling the drive. For drive manufacturers, as a result of the profile definition, development costs are reduced and the implementation of non-proprietary standardised interface improves the chances of being successful in the market.

The mapping to the generic interface is given in IEC 61800-7-1:2015, Annex C.

### 4.2 Requirements

Today, variable-speed electric drives from basic AC drive converters up to high-dynamic performance servo controllers are being increasingly connected to higher-level open loop and closed-loop control systems in automated plants and systems via digital interfaces.

In today's systems, the speed interface is mostly common. The speed setpoint is entered from a higher-level automation system which controls the drive. Generally, the speed actual value is signalled back to the automation system to monitor the drive.

In order that the digital field bus interface in distributed automation concepts may also be used in the area of motion control with several drive axes, today's standard field busses shall be expanded by specific features. This involves fulfilling the following requirements:

**Clock cycle synchronism:** If a central motion controller is being used which handles the interpolation and closed-loop position control, the control loop shall be closed via the bus. The speed setpoint is transferred to the drive in the setpoint direction. In the actual value direction, the drive provides a position actual value. In order to implement sufficiently high loop gains to fulfil the required dynamic performance, the delays shall be minimal and it is especially important that they be absolutely constant. If the motion control task requires the coordination of several axes, the position actual values shall be acquired precisely at the same time and evaluated in synchronism in the motion controller. Furthermore, the setpoints shall take effect precisely at the same time in the axes. The actual value acquisition, transfer and setpoint activation are in clock cycle synchronism with the closed-loop position controller.

**Drive-to-Drive communication:** State-of-the-art automation solutions with digital Drive Units also use distributed concepts where the open loop and closed-loop control tasks, which were previously implemented centrally, are shifted into intelligent drives. Examples are single-axis-positioning drives or drives with integrated software for winding functions or synchronous operating applications.

If automation functions are to be decentralised and distributed, then data shall be directly transferred between the drives, which, for example for an electronic shaft, shall be realised with precise angular synchronism and also with clock cycle synchronism.

**Acyclic communication:** The acyclic communication services are requested to transfer parameter requests for operator control and monitoring of drives in parallel to the Cyclic Data Exchange.

With modern automation profiles, it is a strong requirement that state of the art communication systems be supported.

### 4.3 Goals of the PROFIdrive Profile

To protect investments in engineering tools, automation program libraries and training of staff, it is important to have a stable generic application profile functionality which migrates to future enhanced field bus systems by keeping its application platform interface stable.

## 5 Data types

### 5.1 Data types overview

Profile-specific data types corresponding to the particular drive requirements are defined. The profile-specific data types are individually defined in 5.3. The standard types are defined in IEC 61158-5-10. An overview of all of the permissible data types (standard data types and profile-specific data types) is given in Table 1 and Table 2.

It is strongly recommended to use standard and profile specific data types out of Table 1 and Table 2 for all drive device parameters. In addition, because of compatibility to older systems, all Controller and Device implementations also shall support the basic data types Byte, Word, Double word as defined in Table 31. For further information about handling of data types in the PROFIdrive Base Mode Parameter Access, see 6.2.3.6.

### 5.2 Standard data types

Table 1 shows references of data types used in this profile and the related definitions.



**Table 1 – Standard data types**

| <b>Data types used in Profile PROFIdrive</b>                                                                                                                                                                                                                                                                                                  | <b>Reference to definition</b>      | <b>Data type numeric identifier</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------|
| Boolean                                                                                                                                                                                                                                                                                                                                       | Boolean (see IEC 61158-5-10)        | 1                                   |
| Integer8                                                                                                                                                                                                                                                                                                                                      | Integer8 (see IEC 61158-5-10)       | 2                                   |
| Integer16                                                                                                                                                                                                                                                                                                                                     | Integer16 (see IEC 61158-5-10)      | 3                                   |
| Integer32                                                                                                                                                                                                                                                                                                                                     | Integer32 (see IEC 61158-5-10)      | 4                                   |
| Integer64                                                                                                                                                                                                                                                                                                                                     | Integer64 (see IEC 61158-5-10)      | 55                                  |
| Unsigned8                                                                                                                                                                                                                                                                                                                                     | Unsigned8 (see IEC 61158-5-10)      | 5                                   |
| Unsigned16                                                                                                                                                                                                                                                                                                                                    | Unsigned16 (see IEC 61158-5-10)     | 6                                   |
| Unsigned32                                                                                                                                                                                                                                                                                                                                    | Unsigned32 (see IEC 61158-5-10)     | 7                                   |
| Unsigned64                                                                                                                                                                                                                                                                                                                                    | Unsigned64 (see IEC 61158-5-10)     | 56                                  |
| FloatingPoint                                                                                                                                                                                                                                                                                                                                 | Float32 (see IEC 61158-5-10)        | 8                                   |
| FloatingPoint64                                                                                                                                                                                                                                                                                                                               | Float64 (see IEC 61158-5-10)        | 15                                  |
| VisibleString                                                                                                                                                                                                                                                                                                                                 | VisibleString (see IEC 61158-5-10)  | 9                                   |
| OctetString                                                                                                                                                                                                                                                                                                                                   | OctetString (see IEC 61158-5-10)    | 10                                  |
| UNICODEString                                                                                                                                                                                                                                                                                                                                 | UNICODEString (see IEC 61158-5-10)  | 39                                  |
| TimeOfDay (with date indication)                                                                                                                                                                                                                                                                                                              | TimeOfDay (see IEC 61158-5-10)      | 12                                  |
| TimeDifference (do not use) <sup>a</sup>                                                                                                                                                                                                                                                                                                      | TimeDifference (see IEC 61158-5-10) | 13                                  |
| Date                                                                                                                                                                                                                                                                                                                                          | BinaryDate (see IEC 61158-5-10)     | 50                                  |
| TimeOfDay without date indication                                                                                                                                                                                                                                                                                                             | TimeOfDay (see IEC 61158-5-10)      | 52                                  |
| TimeDifference with date indication                                                                                                                                                                                                                                                                                                           | TimeDifference (see IEC 61158-5-10) | 53                                  |
| TimeDifference without date indication                                                                                                                                                                                                                                                                                                        | TimeDifference (see IEC 61158-5-10) | 54                                  |
| <sup>a</sup> Data type TimeDifference should not be used for new device implementations. For device implementation use data types TimeDifference with date indication and TimeDifference without date indication instead. For compatibility reasons all three data types of TimeDifference shall be supported by a controller implementation. |                                     |                                     |

### 5.3 Profile-specific data types

#### 5.3.1 General

All profile-specific data types (see Table 2) may be implemented in the drive (optional data types).

**Table 2 – Profile specific data types**

| Data types used in Profile PROFIdrive  | Reference to definition    | Data type numeric identifier |
|----------------------------------------|----------------------------|------------------------------|
| N2 Normalised value (16 bit)           | 5.3.2, Table 3 and Table 4 | 113                          |
| N4 Normalised value (32 bit)           | 5.3.2, Table 3 and Table 4 | 114                          |
| V2 Bit sequence                        | 5.3.6 and Table 10         | 115                          |
| L2 Nibble                              | 5.3.7 and Table 11         | 116                          |
| R2 Reciprocal time constant            | 5.3.10 and Table 14        | 117                          |
| T2 Time constant (16 bit)              | 5.3.8 and Table 12         | 118                          |
| T4 Time constant (32 bit)              | 5.3.8 and Table 12         | 119                          |
| D2 Time constant                       | 5.3.9 and Table 13         | 120                          |
| E2 Fixed point value (16 bit)          | 5.3.4, Table 7 and Table 8 | 121                          |
| C4 Fixed point value (32 bit)          | 5.3.5 and Table 9          | 122                          |
| X2 Normalised value, variable (16 bit) | 5.3.3, Table 5 and Table 6 | 123                          |
| X4 Normalised value, variable (32 bit) | 5.3.3, Table 5 and Table 6 | 124                          |

It is strongly recommended to use the profile specific data types for optimum matching to the application. For compatibility to older drive applications with none of the profile-specific data types:

- Instead of N2, N4 or X2, X4 use Integer16, Integer32 with optional normalisation.

### 5.3.2 Normalised value: N2, N4

#### Meaning

Linear normalised value. 0 % corresponds to 0 (0x0), 100 % corresponds to  $2^{14}$  (0x4000) for N2 or  $2^{30}$  (0x40000000) for N4.

**Table 3 – N2, N4-Range of values**

| Coding | Data type | Range of values                        | Resolution                        | Length  |
|--------|-----------|----------------------------------------|-----------------------------------|---------|
| 113    | N2        | $-200 \% \leq i \leq (200-2^{-14}) \%$ | $2^{-14} = 0,0061 \%$             | 2 Octet |
| 114    | N4        | $-200 \% \leq i \leq (200-2^{-30}) \%$ | $2^{-30} = 9,3 \times 10^{-8} \%$ | 4 Octet |

#### Coding

- Representation in twos complement, the MSB (Most significant bit) is the bit after the sign bit (SN) of the first octet.
- SN = 0: positive numbers including zero
- SN = 1: negative numbers

**Table 4 – N2, N4-Coding**

| Octet | Bit       |           |           |           |           |           |           |           |
|-------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|       | 8         | 7         | 6         | 5         | 4         | 3         | 2         | 1         |
| 1     | SN        | $2^0$     | $2^{-1}$  | $2^{-2}$  | $2^{-3}$  | $2^{-4}$  | $2^{-5}$  | $2^{-6}$  |
| 2     | $2^{-7}$  | $2^{-8}$  | $2^{-9}$  | $2^{-10}$ | $2^{-11}$ | $2^{-12}$ | $2^{-13}$ | $2^{-14}$ |
| 3     | $2^{-15}$ | $2^{-16}$ | $2^{-17}$ | $2^{-18}$ | $2^{-19}$ | $2^{-20}$ | $2^{-21}$ | $2^{-22}$ |
| 4     | $2^{-23}$ | $2^{-24}$ | $2^{-25}$ | $2^{-26}$ | $2^{-27}$ | $2^{-28}$ | $2^{-29}$ | $2^{-30}$ |

### 5.3.3 Normalised value (variable normalisation): X2, X4

#### Meaning

Linear normalised value. 0 % corresponds to 0 (0x0), 100 % corresponds to  $2^x$ . The structure is the same as for data types N2 and N4, but the normalisation (100 %) does not automatically refer to bit 14 or bit 30 respectively, but is variable. The normalisation bit is coded in the parameter description element “DO IO Data normalisation” (refer to 6.2.1.3).

**Table 5 – X2, X4-Range of values**

| Coding | Data type                | Range of values                              | Resolution | Length  |
|--------|--------------------------|----------------------------------------------|------------|---------|
| 123    | X2 (e.g. with $x = 12$ ) | $-800 \% \leq i \leq (800 \cdot 2^{-12}) \%$ | $2^{-12}$  | 2 Octet |
| 124    | X4 (e.g. with $x = 28$ ) | $-800 \% \leq i \leq (800 \cdot 2^{-28}) \%$ | $2^{-28}$  | 4 Octet |

#### Coding

- Twos complement representation, the MSB (Most Significant Bit) is the bit after the sign bit (SN) of the first octet.
- SN = 0: positive numbers including zero.
- SN = 1: negative numbers.

**Table 6 – X2, X4-Coding (example  $x=12/28$ )**

| Octet | Bit       |           |           |           |           |           |           |           |
|-------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|       | 8         | 7         | 6         | 5         | 4         | 3         | 2         | 1         |
| 1     | SN        | $2^2$     | $2^1$     | $2^0$     | $2^{-1}$  | $2^{-2}$  | $2^{-3}$  | $2^{-4}$  |
| 2     | $2^{-5}$  | $2^{-6}$  | $2^{-7}$  | $2^{-8}$  | $2^{-9}$  | $2^{-10}$ | $2^{-11}$ | $2^{-12}$ |
| 3     | $2^{-13}$ | $2^{-14}$ | $2^{-15}$ | $2^{-16}$ | $2^{-17}$ | $2^{-18}$ | $2^{-19}$ | $2^{-20}$ |
| 4     | $2^{-21}$ | $2^{-22}$ | $2^{-23}$ | $2^{-24}$ | $2^{-25}$ | $2^{-26}$ | $2^{-27}$ | $2^{-28}$ |

### 5.3.4 Fixed point value: E2

#### Meaning

Linear fixed-point value with seven binary places after the decimal point. 0 corresponds to 0 (0x0), 128 corresponds to  $2^{14}$  (0x4000).

**Table 7 – E2-Range of values**

| Coding | Data type | Range of values                      | Resolution               | Length  |
|--------|-----------|--------------------------------------|--------------------------|---------|
| 121    | E2        | $-256+2^{-7} \leq i \leq 256-2^{-7}$ | $2^{-7} = 0,007\ 812\ 5$ | 2 Octet |

**Coding**

- Twos complement representation, the MSB (Most significant bit) is the bit after the sign bit (SN) of the first octet.
- SN = 0: positive numbers including zero.
- SN = 1: negative numbers.

**Table 8 – E2-Coding**

| Octet | Bit   |          |          |          |          |          |          |          |
|-------|-------|----------|----------|----------|----------|----------|----------|----------|
|       | 8     | 7        | 6        | 5        | 4        | 3        | 2        | 1        |
| 1     | SN    | $2^7$    | $2^6$    | $2^5$    | $2^4$    | $2^3$    | $2^2$    | $2^1$    |
| 2     | $2^0$ | $2^{-1}$ | $2^{-2}$ | $2^{-3}$ | $2^{-4}$ | $2^{-5}$ | $2^{-6}$ | $2^{-7}$ |

**5.3.5 Fixed point value: C4****Meaning**

Linear fixed point value with four decimal places. 0 corresponds to 0 (0x0), 0,0001 corresponds to  $2^0$  (0x0000 0001).

**Table 9 – C4-Range of values**

| Coding | Data type | Range of values                                | Resolution           | Length  |
|--------|-----------|------------------------------------------------|----------------------|---------|
| 122    | C4        | $-214\ 748,364\ 8 \leq i \leq 214\ 748,364\ 7$ | $10^{-4} = 0,000\ 1$ | 4 Octet |

**Coding**

As by Integer32, weighting of the bits has been reduced by a factor of 10 000.

**5.3.6 Bit sequence: V2****Meaning**

Bit sequence to control and represent application functions. 16 Boolean variables are combined in two octets. (Coding: 115)

**Table 10 – V2-Coding**

| Octet | Bit |    |    |    |    |    |   |   |
|-------|-----|----|----|----|----|----|---|---|
|       | 8   | 7  | 6  | 5  | 4  | 3  | 2 | 1 |
| 1     | 15  | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| 2     | 7   | 6  | 5  | 4  | 3  | 2  | 1 | 0 |

### 5.3.7 Nibble: L2

#### Meaning

Four associated bits form a nibble. Four nibbles are represented in two octets.

The definition of the nibble is not specified. (Coding: 116)

**Table 11 – L2-Coding**

| Octet | Bit      |   |   |   |          |   |   |   |
|-------|----------|---|---|---|----------|---|---|---|
|       | 8        | 7 | 6 | 5 | 4        | 3 | 2 | 1 |
| 1     | Nibble 3 |   |   |   | Nibble 2 |   |   |   |
| 2     | Nibble 1 |   |   |   | Nibble 0 |   |   |   |

Comment regarding time parameters

The value of time parameters of types D2, T2, T4, R2 always refer to the specified constant sampling time  $T_a$ . The associated sampling time (value of profile parameter 962) is required in order to interpret the internal value.

### 5.3.8 Time constant: T2, T4

#### Meaning

Time data as a multiple of constant sampling time  $T_a$ .

**Table 12 – T2, T4-Range of values**

| Coding | Data type | Range of values                             | Resolution | Length  |
|--------|-----------|---------------------------------------------|------------|---------|
| 118    | T2        | $0 \leq i \leq 32\,767 \times T_a$          | $T_a$      | 2 Octet |
| 119    | T4        | $0 \leq i \leq 4\,294\,967\,295 \times T_a$ | $T_a$      | 4 Octet |

Interpreted value = Internal value  $\times T_a$

#### Coding of internal value

- T2: As by Unsigned16 with a restricted Range of values  $0 \leq x \leq 32\,767$ . When interpreted, internal values outside this range are set to 0.
- T4: As by Unsigned 32.

### 5.3.9 Time constant: D2

#### Meaning

Time data as a fraction of the constant sampling time  $T_a$ .

**Table 13 – D2-Range of values**

| Coding | Data type | Range of values                        | Resolution           | Length  |
|--------|-----------|----------------------------------------|----------------------|---------|
| 120    | D2        | $0 \leq i \leq (2-2^{-14}) \times T_a$ | $2^{-14} \times T_a$ | 2 Octet |

Interpreted value = Internal value  $\times T_a/16\,384$

#### Coding of internal value

As by Unsigned16 with a restricted Range of values  $0 \leq x \leq 32\,767$ .

When interpreted, internal values outside this range are set to 0.

#### 5.3.10 Reciprocal time constant: R2

##### Meaning

Time data as a reciprocal multiple of a constant sampling time  $T_a$ .

**Table 14 – R2-Range of values**

| Coding | Data type | Range of values                               | Resolution | Length  |
|--------|-----------|-----------------------------------------------|------------|---------|
| 117    | R2        | $1 \times T_a \leq i \leq 16\,384 \times T_a$ | $T_a$      | 2 Octet |

Interpreted value =  $16\,384 \times T_a/\text{internal value}$

#### Coding of internal value

As by Unsigned16 with a limited Range of values  $1 \leq x \leq 16\,384$ .

When interpreted, internal values outside this range are set to 16 384

## 6 Specifications

### 6.1 Integration of drives in automation systems

#### 6.1.1 General

This clause specifies the abstract modelling and different variants for integration of PROFIdrive drive axis in automation systems. This PROFIdrive model is generally independent of the communication system used as network platform (PROFIBUS, PROFINET). Depending on the communication system, limitations to the general model and functionality may be possible.

#### 6.1.2 Base Model

##### 6.1.2.1 Communication devices

The PROFIdrive Base Model defines as basic elements the following three classes of devices:

#### Controller

The Controller is a controlling device which is associated with one or more drives (axes). Related to the automation system, the Controller is the host for the overall automation.

#### P-Device

The P-Device (peripheral device) is a field device and the host device for the drives (closed loop control, inverter). The P-Device typically is associated with one or more Controller devices.

## Supervisor

The Supervisor typically is an engineering device which manages provisions of configuration data (parameter sets) and collections of diagnosis data from P-Devices and/or Controllers.

### 6.1.2.2 Communication relationship

The PROFIdrive Base Model defines the following types of communication relationships between the devices:

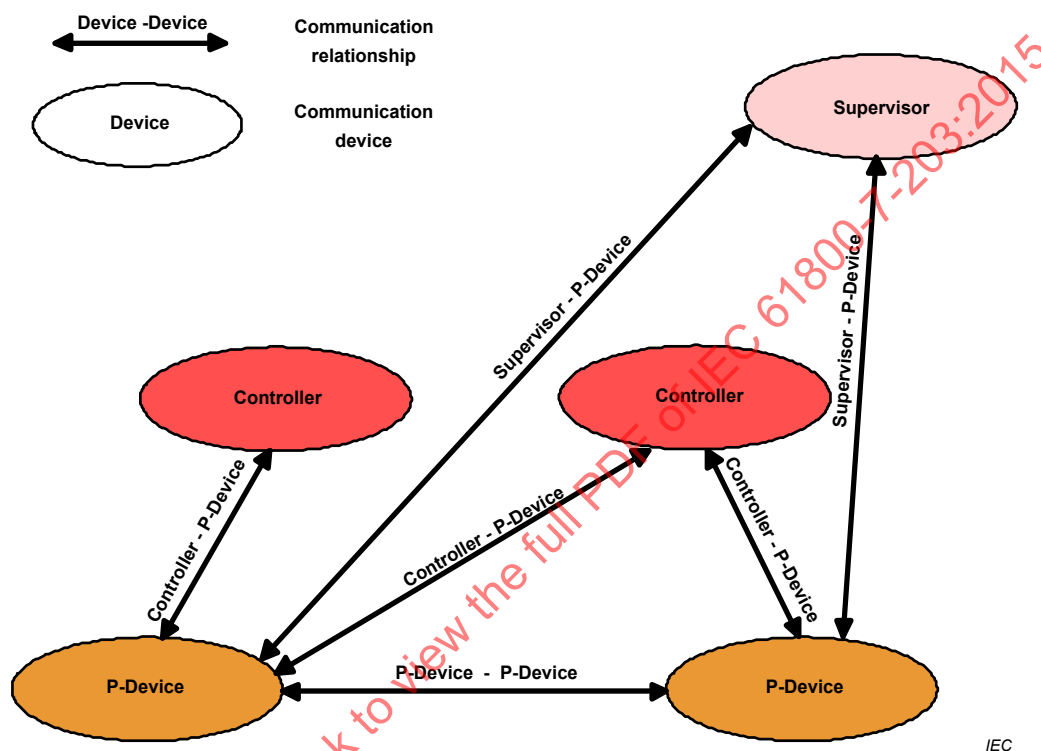


**Figure 2 – PROFIdrive Devices and there relationship**

Figure 2 shows the PROFIdrive Devices and the defined relationships between them in the context of the PROFIdrive Base Model.

### 6.1.2.3 Communication network

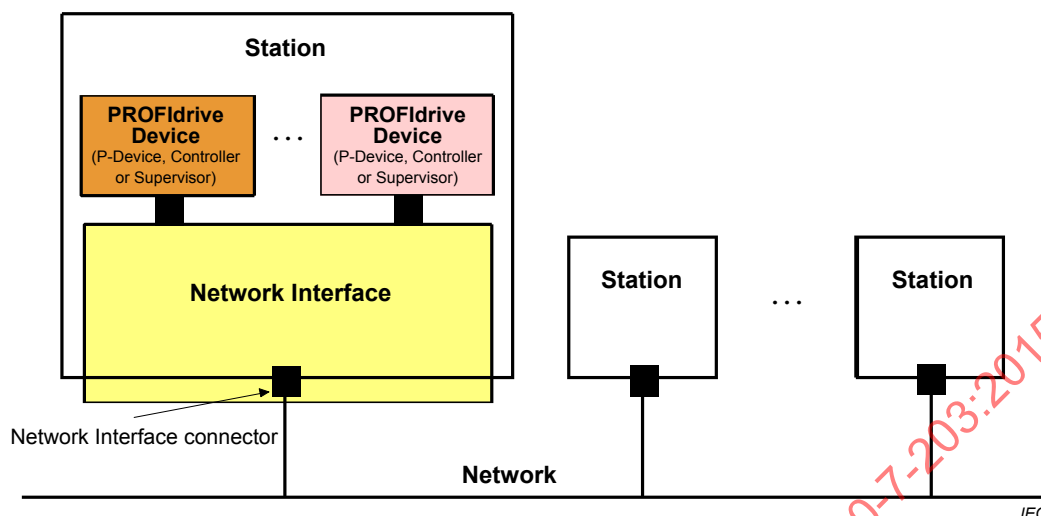


**Figure 3 – General Communication Model of a PROFIdrive automation system**

Figure 3 shows the general architecture of the automation system and the location of the PROFIdrive Devices as components of the Station. The physical model generally consists of physical Stations embedded in a communication network system. Though every Station comprises a Network Interface connector to physically connect the Station to the Network and a Network Interface functionality, which provides the communication service to the devices.

Therefore the PROFIdrive Device is precisely defined by the following address information:

- Network,
- Station (Identifier for Station inside the Network),
- Device (Identifier for Device inside the Station).

### 6.1.2.4 Functional Object

The PROFIdrive Device consists of one or more Functional Objects. The Functional Objects are logical Objects which represent a special functionality inside the automation system. Figure 4 shows the general architecture of the PROFIdrive Device containing Functional Objects.

If the Device is of P-Device type, the Functional Objects inside the P-Device are of Drive Object type (see Figure 4). The typical functionality of the Drive Object is the drive functionality itself (motor, inverter stage, closed loop current and speed control, input and output functionality). For example, one drive axis is related to a Drive Object.



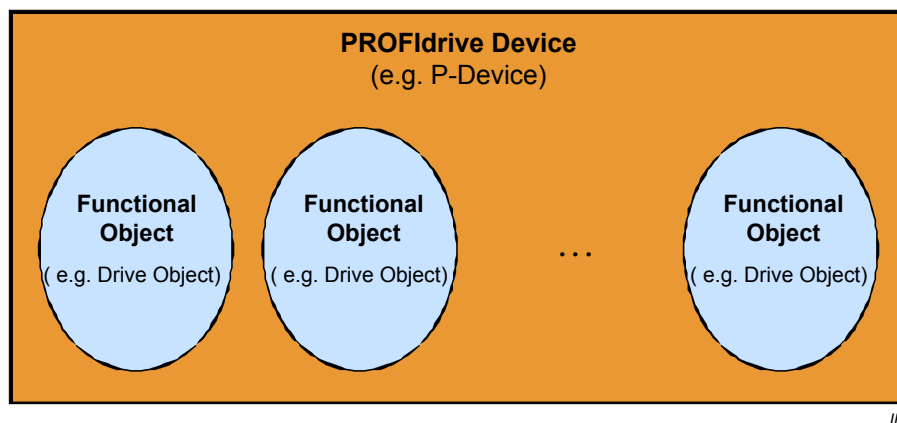


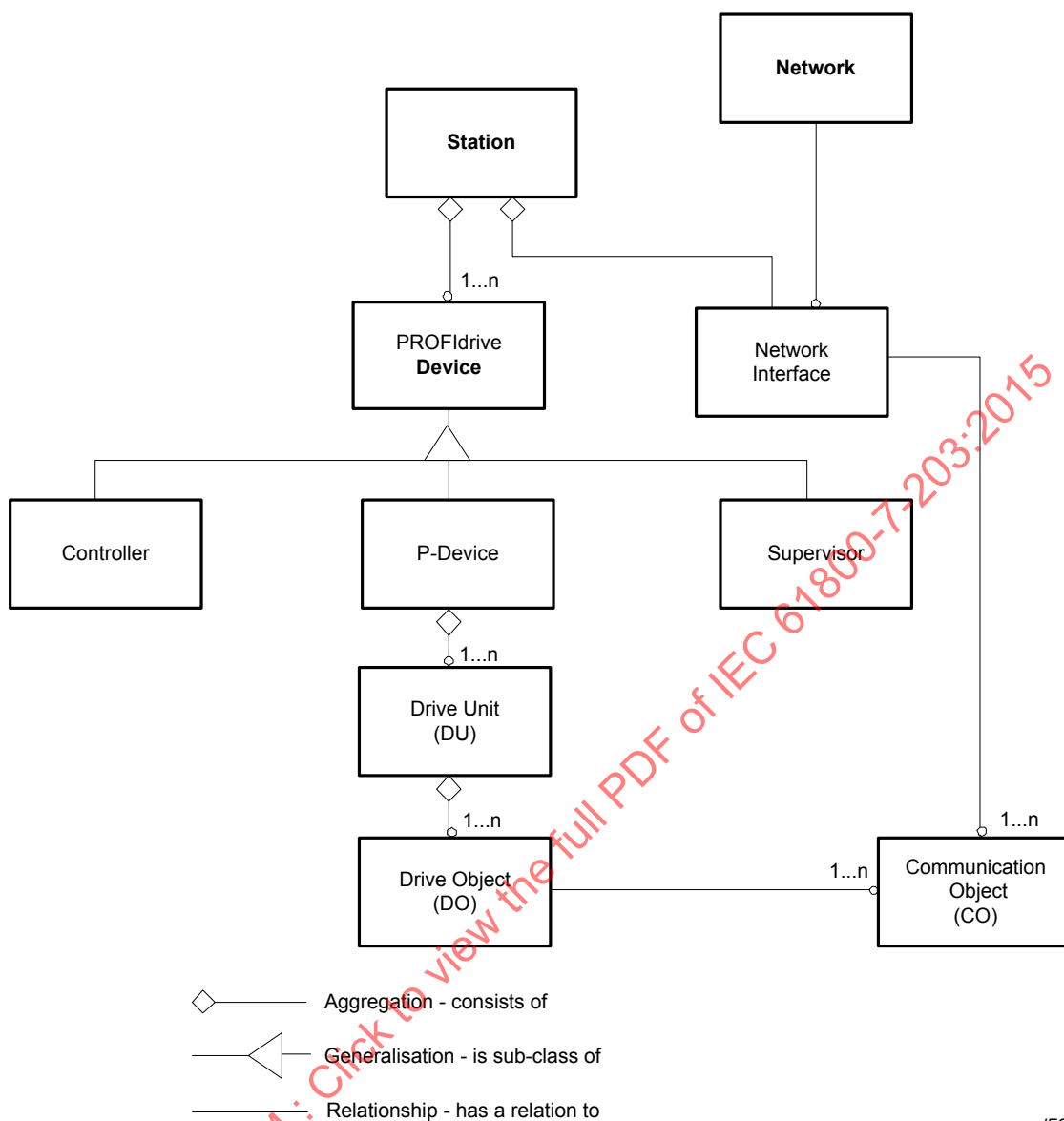
**Figure 4 – The PROFIdrive Device  
(consists of one or several Functional Objects)**

#### 6.1.2.5 Object Model

Based on the objects defined in the Base Model, the hierarchical order and dependencies between them are specified in the Object Model (see Figure 5).

Every Station consists of the Network Interface and one or more Devices. The Network Interface is related to the Network to which the Station is connected. The Devices are classified in three types, Controller, P-Device and Supervisor. If the Device is of P-Device type, the P-Device consists of one or more Drive Units (DU) which comprises one or more Drive Objects (DO). Clustering the Drive Objects in Drive Units (DU) may be used to define the affiliation of Drive Objects to one physical drive control unit (CPU) or physical cluster. The Drive Unit expresses definitely the area of validity of global parameters.

In addition, the Communication Object (CO), which has a relationship to the Network Interface and also to the Functional Object (e.g. Drive Object), is defined. The purpose of the Communication Object is to be a communication system addressable communication end point, which may be associated to a Functional Object.

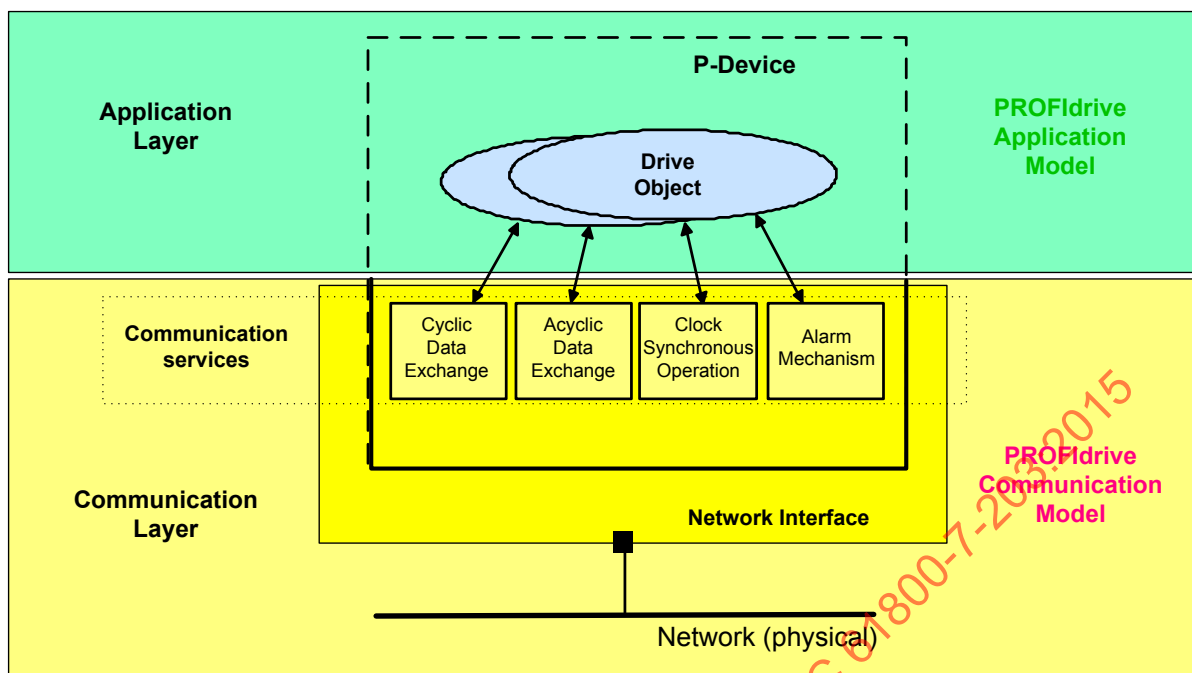


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**Figure 5 – Hierarchical order in the Object Model**

#### 6.1.2.6 Layer Model

Separation of the objects in the Base Model according to the aspects of application and communication leads to the Layer Model according to Figure 6. Here, the Application Layer only contains the functional aspects of the automation system, independent of the distribution of the functional elements among physical stations and devices. The distribution aspect is represented by the Communication Layer, which specifies the physical network components and the allocation of the Functional Objects to them.



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**Figure 6 – PROFIdrive Base Model contains the Application Layer and Communication Layer**

#### 6.1.2.7 Communication services

##### 6.1.2.7.1 General

The PROFIdrive Base Model defines the following communication services. The communication services are provided from the device and are used from the Functional Object.

The representation of data shall be in big-endian format.

##### 6.1.2.7.2 Cyclic Data Exchange

Cyclic communication means the simple transfer of IO data of predefined size in a reserved time slot. With cyclic communication, the IO data that is critical with respect to time is exchanged between the controller and device or between devices. Typical such data contains setpoint values and actual values, control- and status information. The Cyclic Data Exchange service is assigned to the “Controller – P-Device” and the “P-Device – P-Device” relationship. A Cyclic Data Exchange channel is related to a Communication Object at its end points.

##### 6.1.2.7.3 Acyclic Data Exchange

Compared to cyclic communication, data is exchanged acyclically only if necessary. Via acyclic communication, non time critical data is transferred, for example the download of firmware or parameter data. The Acyclic Data Exchange service is assigned to the “Controller – P-Device” and the “Supervisor – P-Device” relationship. An Acyclic Data Exchange channel is related to a Communication Object at its end points.

##### 6.1.2.7.4 Alarm Mechanism

With the Alarm Mechanism service, alarm information and exception situations are signalled to the controlling device in a real time manner. The service works demand-oriented to keep the exception status image of the Functional Object in the Controller up to date. With this

service, the controller is able to respond on an occurring event in the drive as fast as possible without polling the drive status information permanently. The Alarm Mechanism service is assigned to the “Controller – P-Device” relationship.

#### 6.1.2.7.5 Clock Synchronous Operation

The Clock Synchronous Operation service guaranties that tasks on different communication devices or Functional Objects start at the same time with minimum (specified) jitter (e.g. the sampling and output processes). This service also implies, that dedicated cyclic data packages are definitely transmitted until a certain moment in the communication cycle.

For drive technology, clock cycle synchronous communication is the basis for drive synchronisation. Not only message interchange on the bus system is implemented in an isochronous time base, but also the internal control algorithms – such as closed loop speed and current controllers in the drive, or the controller in the higher level automation system – are synchronised (see Figure 7).

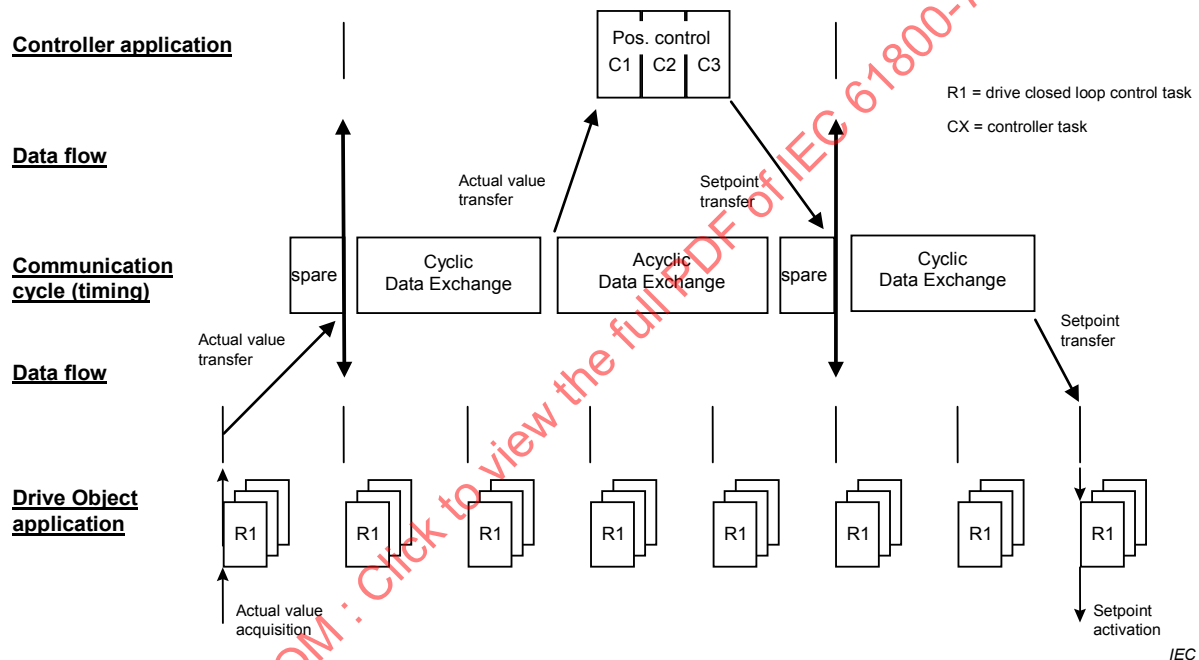


**Figure 7 – Typical use case for Clock Synchronous Operation**

The general model for the Clock Synchronous Operation service is defined according to Figure 8. The model is based on local clocks which are related to every Device supporting the Clock Synchronous Operation service. These local clocks are synchronised to one dedicated Master Clock. After the Clock Synchronous Operation mechanism is started, all Slave Clocks are synchronous to the Master Clock with a defined maximum Jitter of 1  $\mu$ s. The mechanism of start up and synchronisation of the Slave Clocks to the Master Clock are related to the communication system (part of the Communication Layer).

The device which comprises the Master Clock is defined as Clock Master. According to the application, application tasks may be triggered by the Slave Clock of the device. For example concerning an axis controller, the sampling of input values and the output of the motor current are triggered out of the Slave Clock and are therefore synchronous to all other processes related to the Clock Master.

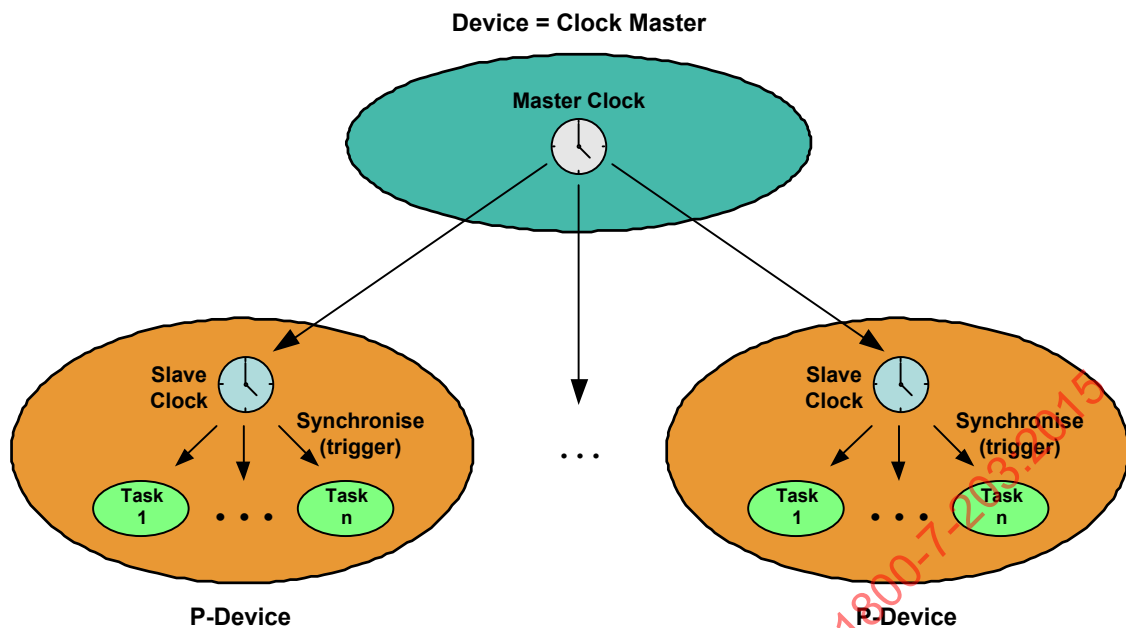


**Figure 8 – General model for Clock Synchronous Operation**

#### 6.1.2.7.6 Base Model State Machine

For the Base Model (see Figure 9) the following states, related to the communication and application run up process, are defined:

##### Offline

There is generally no communication service working.

##### Preparation

In this state, the Acyclic Data Exchange service and the Alarm Mechanism are working. This means that configuration information may be passed from the Controller to the Drive Unit and that parameter access is possible. In addition, alarms will be forwarded. There may be no Cyclic Data Exchange service or the transmitted data is not valid. The communication system tries to synchronise all Slave Clocks to the Clock Master.

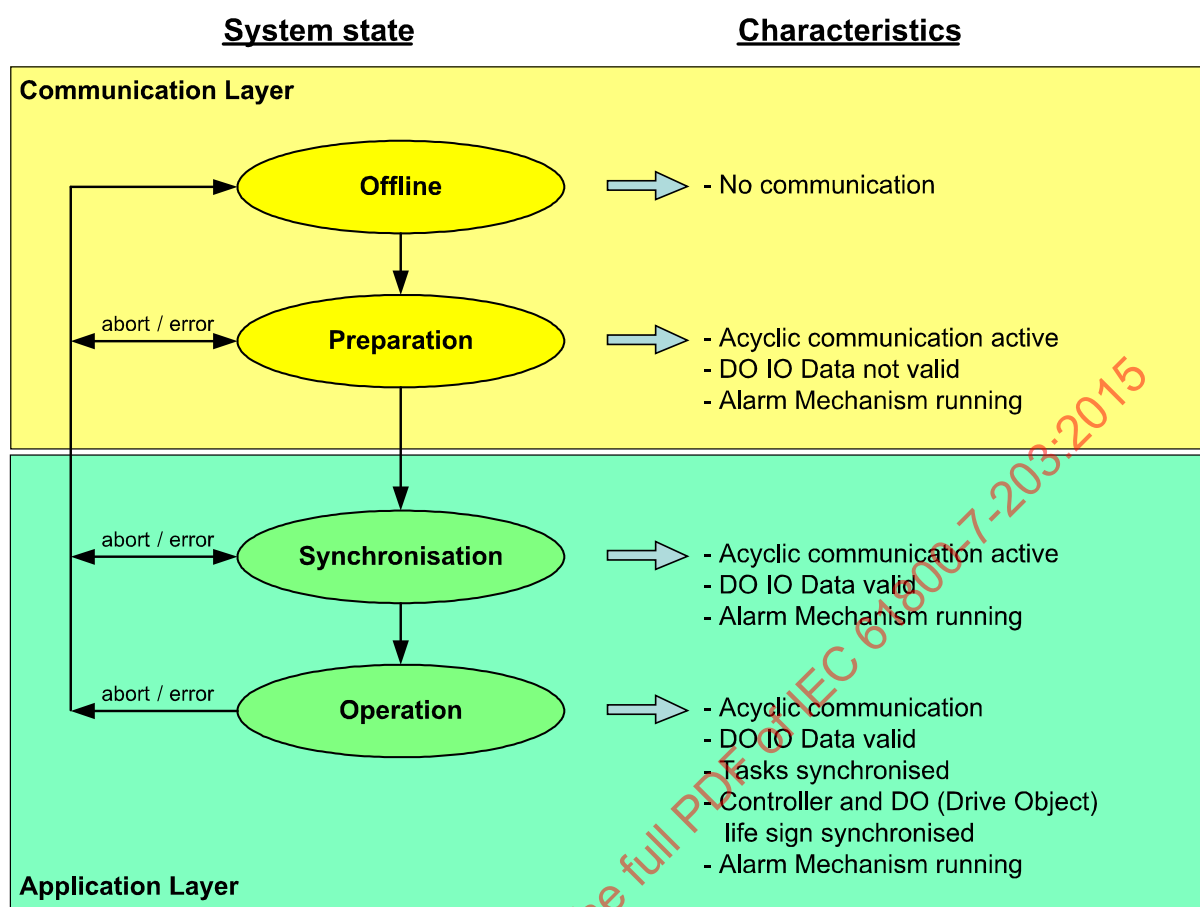
##### Synchronisation

In this state, the Acyclic Data Exchange, the Cyclic Data Exchange and the Alarm Mechanism are working and the transmitted cyclic data is valid. The application processes try to synchronise their tasks to each other (synchronise to the local Slave Clock and synchronise the data streams via the cyclic communication channels).

##### Operation

In this state, the application processes are also synchronised and the whole application is ready to operate (productive work).

If, in one of these states, exceptions occur which cause the system to lose one or more of the characteristics related to the actual state, the related devices will be forced to go back to a corresponding predecessor state, in order to proceed to switch forward to the next higher level again, if possible and allowed.



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Figure 9 – Base Model State Machine

### 6.1.3 Drive model

#### 6.1.3.1 General

Based on the P-Device device type, defined in the Base Model previously, this subclause defines the architecture of the P-Device in more detail.

#### 6.1.3.2 P-Device

This profile of drive engineering defines a PROFIdrive Device of P-Device type according to Figure 10 as a P-Device containing exactly one or multiple Drive Units (DU). The P-Device may also contain other objects which are not Drive Units. See also Figure 5.

#### 6.1.3.3 Drive Unit

This profile of drive engineering defines a PROFIdrive Drive Unit (DU) according to Figure 10 as part of a P-Device containing exactly one or multiple Drive Objects (DO). The unambiguous identification of a Drive Object within a Drive Unit is done by the Drive Object ID (DO-ID) which is assigned to every DO of a DU. The Drive Unit contains only Drive Objects. See also Figure 5.

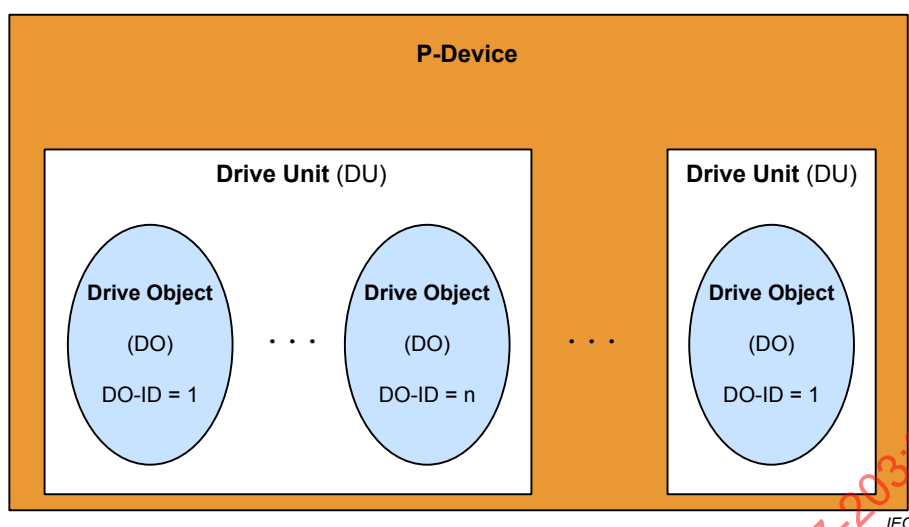


**Figure 10 – General Drive Unit model**

#### 6.1.3.4 Drive Object

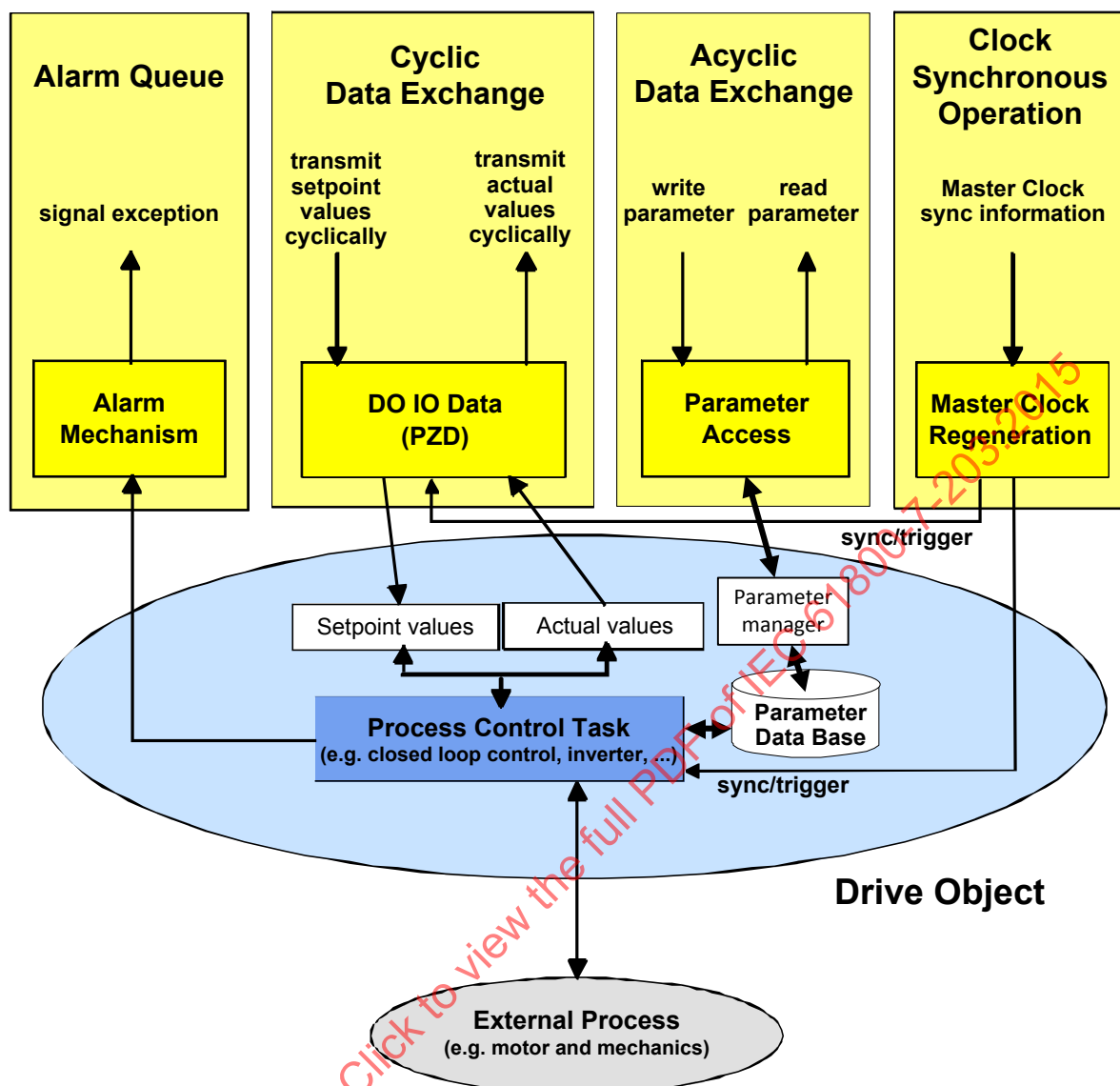
Figure 11 shows the general Drive Object (DO) architecture. The central element of the DO is the Process Control Task which is responsible for the automation functionality of the DO. Properties of the DO and the Process Control Task are represented and controlled by parameters. The parameters are administered in the Parameter Data Base. To access DO parameter, Acyclic Data Exchange service is used. For periodic transportation of setpoint values to the DO and actual values from the DO, the Cyclic Data Exchange service is used. If the DO is of Axis type (refer to 6.1.3.5), the DO comprises a General State Machine, which controls and represents the states of the Drive Process Control Task. Exceptions from the standard behaviour may occur in the Process Control Task or in the General State Machine. These exceptions may be signalled by the Alarm Mechanism to the controlling device.

The DO shall comprise as a minimum mandatory functionality:

- parameters

The DO may comprise as an optional functionality:

- Process Control Task,
- DO IO Data (setpoint value, actual values),
- General State Machine (for Axis type DO mandatory),
- support for Alarm Mechanism.



IEC

Figure 11 – General Drive Object architecture

#### 6.1.3.5 Axis type Drive Object

The DOs may be of different type. One dedicated type, which is of general importance in this drive profile is the Axis type, which is typically related to a motor (Drive Axis) and is specified in detail in 6.3.



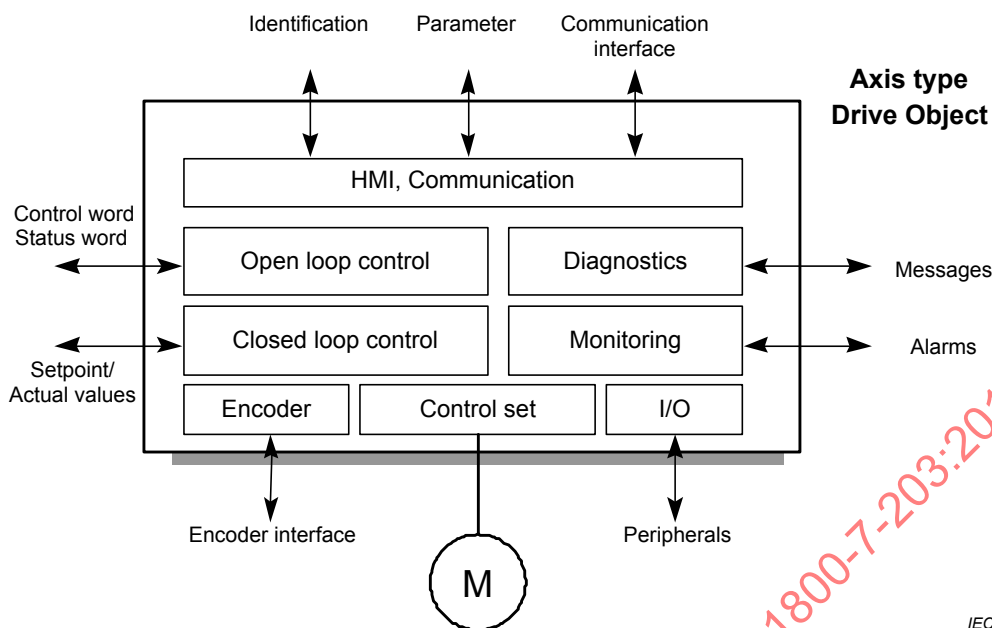


**Figure 12 – Principle functional model of an Axis type Drive Object**

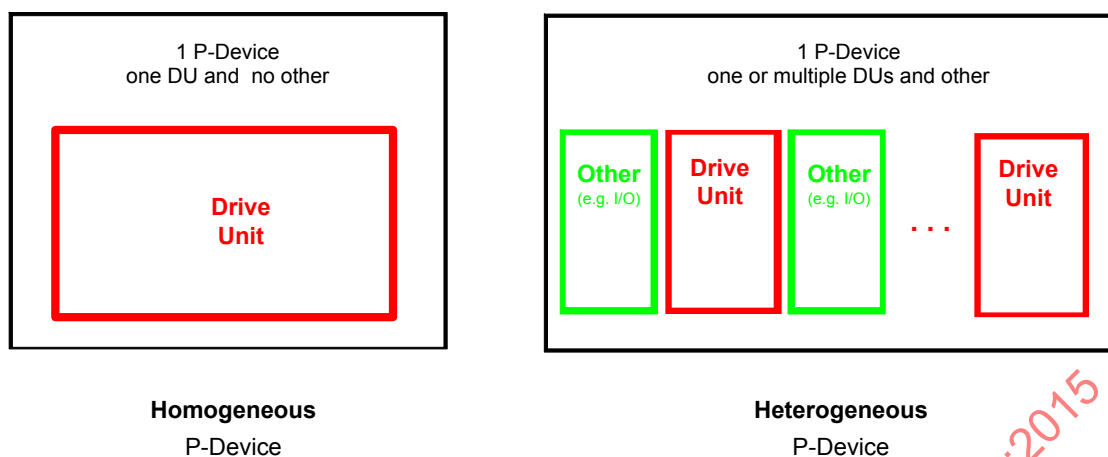
Figure 12 shows the principle functionality of an Axis type DO. The Axis DO consists of numerous function modules that work together internally, and therefore portray the intelligence of the Axis type DO.

The following logical objects are included in an Axis DO:

- objects for DO identification;
- parameters for accessing information and settings of the individual function modules;
- objects for setting the communication interface (for example, PROFIdrive Interface);
- objects for drive control (for example, control words and status words);
- objects for setpoint processing (for example, setpoint values and actual values);
- objects for diagnostics and monitoring (for example, messages, alarms, faults);
- objects for integrated sensor interface(s);
- objects for integrated peripheral functions (integrated I/O).

#### 6.1.3.6 P-Device classification

Figure 13 shows the two classes of PROFIdrive P-Devices. While the Homogeneous type is a P-Device containing only one PROFIdrive Drive Unit (and nothing else), the Heterogeneous P-Device contains at least one PROFIdrive Drive Unit and other objects of this abstraction layer which are not specified within PROFIdrive (they may belong to other application profiles).

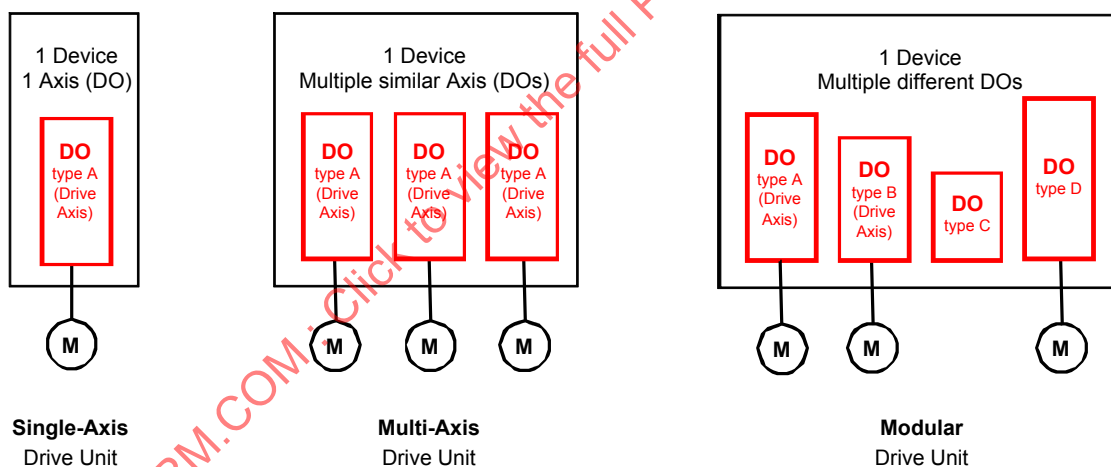


IEC

**Figure 13 – Classes of PROFIdrive P-Devices**

#### 6.1.3.7 Drive Unit classification

Figure 14 shows the three principle classes of PROFIdrive Drive Units. While the Single-Axis type is one physical device with only one Axis type DO, the Multi-Axis type consists of several similar Axis type DOs. The modular type provides the greatest flexibility and comprises one or more DOs, which may be of a different type.



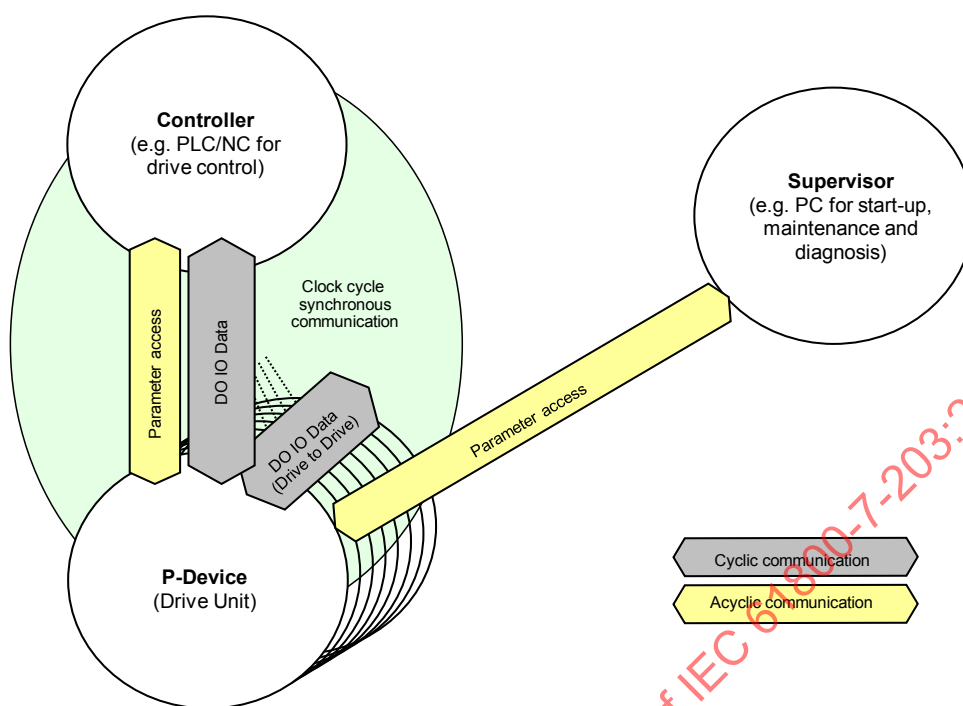
IEC

**Figure 14 – Classes of PROFIdrive Drive Units**

#### 6.1.4 P-Device communication model

Figure 15 shows the different communication channels which are available between the P-Device and the other Devices. The color shows the communication service related to this communication channel.

The Clock Synchronous Operation as well as DO IO Data transfer is available between P-Device and Controller and between P-Devices itself (Drive to Drive communication). Parameter access to the P-Device is available from all other Controller and Supervisor devices.



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**Figure 15 – Overview of the available communication services between the PROFIdrive Devices**

### 6.1.5 Application Model and Application Classes

#### 6.1.5.1 General

At present, drive applications are realised in multiple ways. Table 15 defines the different Application Classes where the drives are used. The Application Classes (AC) are typical examples from the entire spectrum of electrical drive engineering. The Application Classes include the functionality given by the application modes in IEC 61800-7-1.

The Application Model is part of the Application Layer and therefore only related to functional aspects (Functional Objects), independent on the distribution of Functional Objects among devices. Therefore the type of Application Class predefines the contents of the Functional Objects and the type of data (information) to be transported between the Functional Objects (interface). The Application Classes defined in Table 15 are assigned Profile functions in 6.3.13, which a drive manufacturer shall implement if he wishes to be compliant with the particular Application Class.

**Table 15 – Application Classes**

| No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Application Class                                                                                                  | Interface                                                                                        | Functions <sup>b</sup>                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Standard Drive                                                                                                     | n-setpoint,<br>torque-setpoint,<br>current-setpoint                                              | Cyclic IO Data interface <sup>a</sup>                                               |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Standard drive with distributed technology controller (continuous process)                                         | Technological setpoint-actual values (command variables)                                         | Cyclic IO Data interface with Drive to Drive communication <sup>a</sup>             |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Single Axis positioning drive, with local Motion Control                                                           | pos-setpoint,<br>run requests                                                                    | Cyclic IO Data interface <sup>a</sup>                                               |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Motion Control with central interpolation and speed setpoint interface<br>Optional:<br>DSC (Dynamic Servo Control) | n-setpoint<br>x-actual<br>additionally, for DSC:<br>$\Delta x$ ( $x_{err}$ ), $K_V$ ( $k_{PC}$ ) | Cyclic IO Data interface, Clock Synchronous Operation, DSC (refer to 6.3.5)         |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Motion Control with central interpolation and position setpoint interface                                          | x-setpoint                                                                                       | Cyclic IO Data interface, Clock Synchronous Operation <sup>c</sup>                  |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Motion control for clocked processes, or distributed angular synchronism                                           | Command variables,<br>motion instructions                                                        | Cyclic IO Data interface, Clock Synchronous Operation, Drive to Drive communication |
| <sup>a</sup> The cyclic interface may also be operated clock-synchronously if, for example, it is a question of synchrony of the actions in the case of several drives.<br><sup>b</sup> For all Application Classes: acyclic interface for parameters, diagnostics, identification.<br><sup>c</sup> This Application Class is not described in this edition of the Profile. The dynamic characteristics of Application Class 5 are reached with Application Class 4 with DSC. |                                                                                                                    |                                                                                                  |                                                                                     |

### 6.1.5.2 AC 1: Standard Drive

In the simplest case, the drive is controlled via a primary setpoint (for example, speed setpoint) (see Figure 16). The speed control is governed completely in the drive controller. The PLC includes all technological functions for the automation process. The field bus is merely the transmission medium between the automation system and the drive controller. The Cyclic Data Exchange communication service is used. This type of application is used primarily in the field of classical drive engineering (for example, conveyor systems). A PLC is usually used as the automation system. Clock Synchronous Operation may be used, but is typically not necessary for this Application Class.

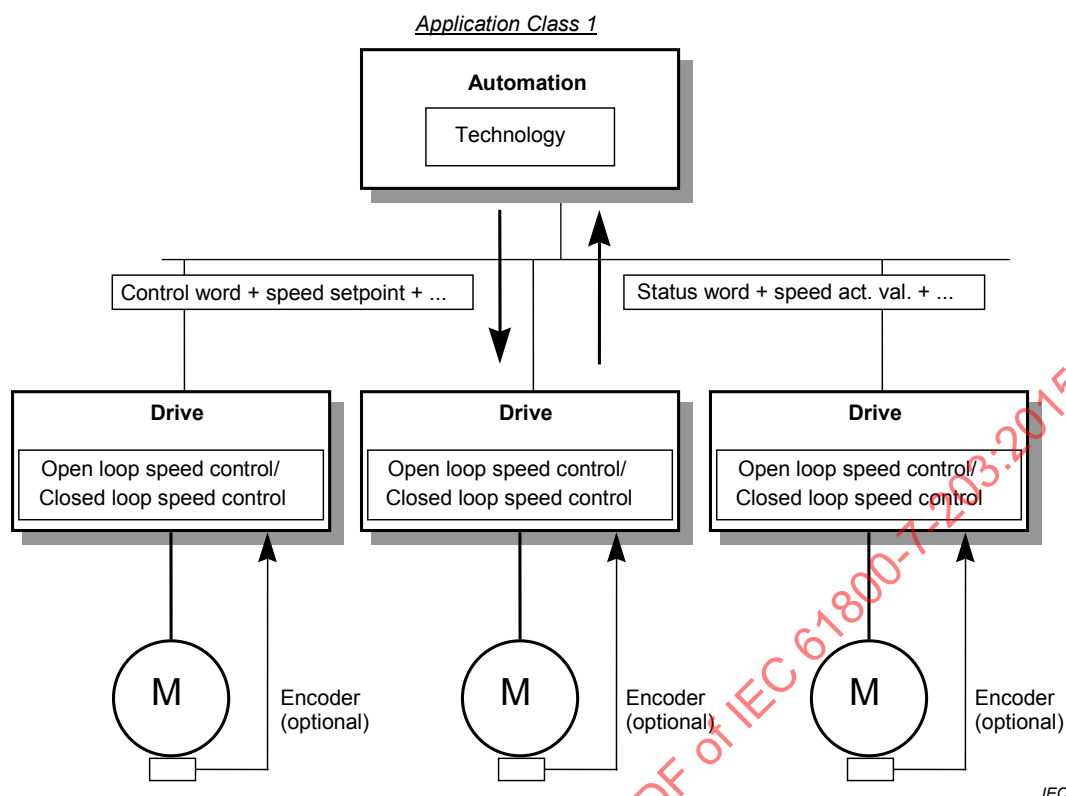


Figure 16 – Application Class 1

#### 6.1.5.3 AC 2: Standard drive with distributed technology controller

Application Class 2 represents a very flexible version for implementing drive applications (see Figure 17). In this version, the automation process is broken down into many small sub-processes.

The technology functions are no longer exclusively in the central PLC, but are also distributed in the drives. The communication interface serves as the technology interface. The data that is exchanged via the bus system between the individual automation components and drive controllers may be individually defined. This variant assumes, however, that communication is guaranteed in all directions; that is, DO IO Data transfer should be possible also between Drive Objects (Axis). To realise applications like setpoint cascades, winders, and speed synchronism Clock Synchronous Operation should be possible. The technology functions are realised in the drive.

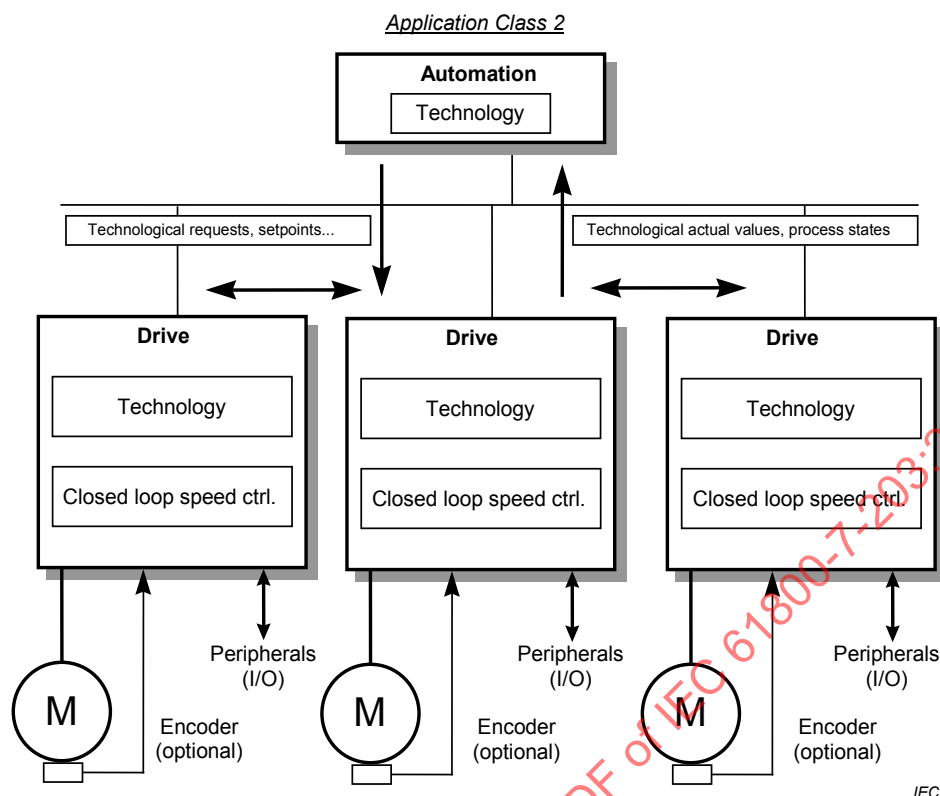


**Figure 17 – Application Class 2**

#### 6.1.5.4 AC 3: Single Axis positioning drive with local Motion Control

In Application Class 3 (see Figure 18), only the technology functions for the automation process are still in the PLC. Positioning requests are stored in the Drive. A single positioning request is started via a command from the Controller (e.g. PLC). Interpolation and position control as well as speed control are implemented directly in the drive. Since in this variant, all time-critical control algorithms are hidden in the drive controller, Clock Synchronous Operation is only necessary if complex tracking for multiple axes shall be coordinated.

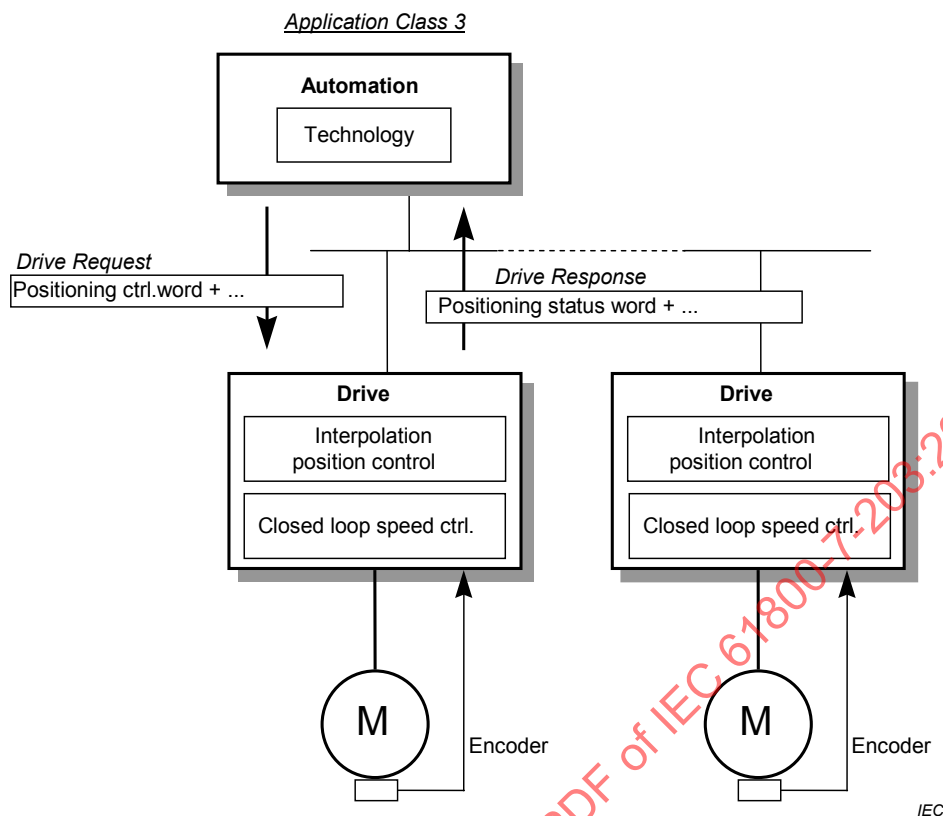
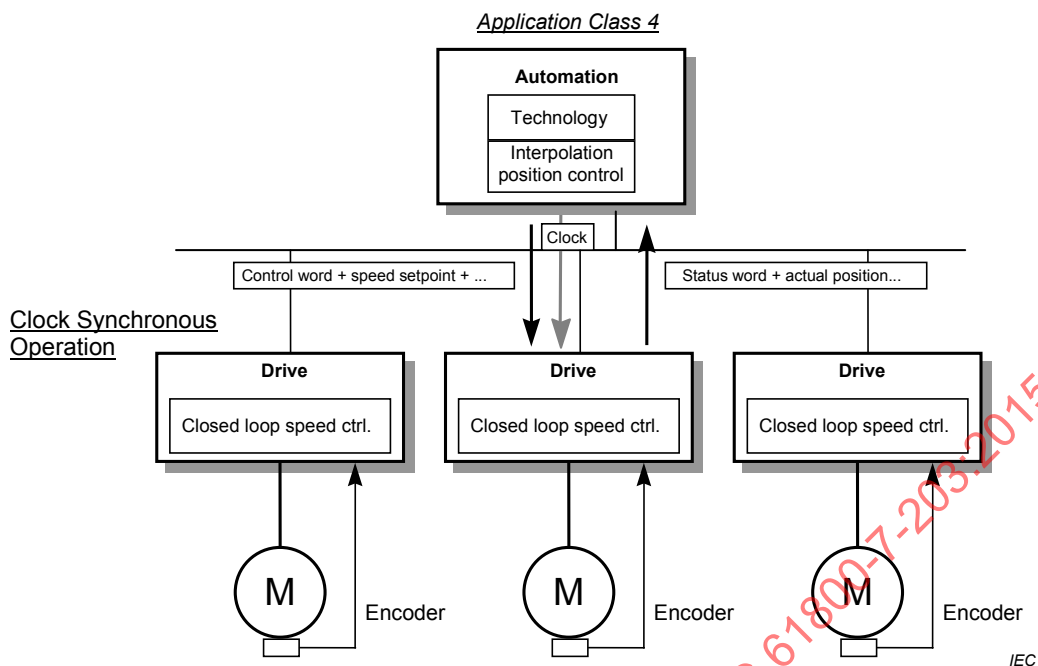


Figure 18 – Application Class 3

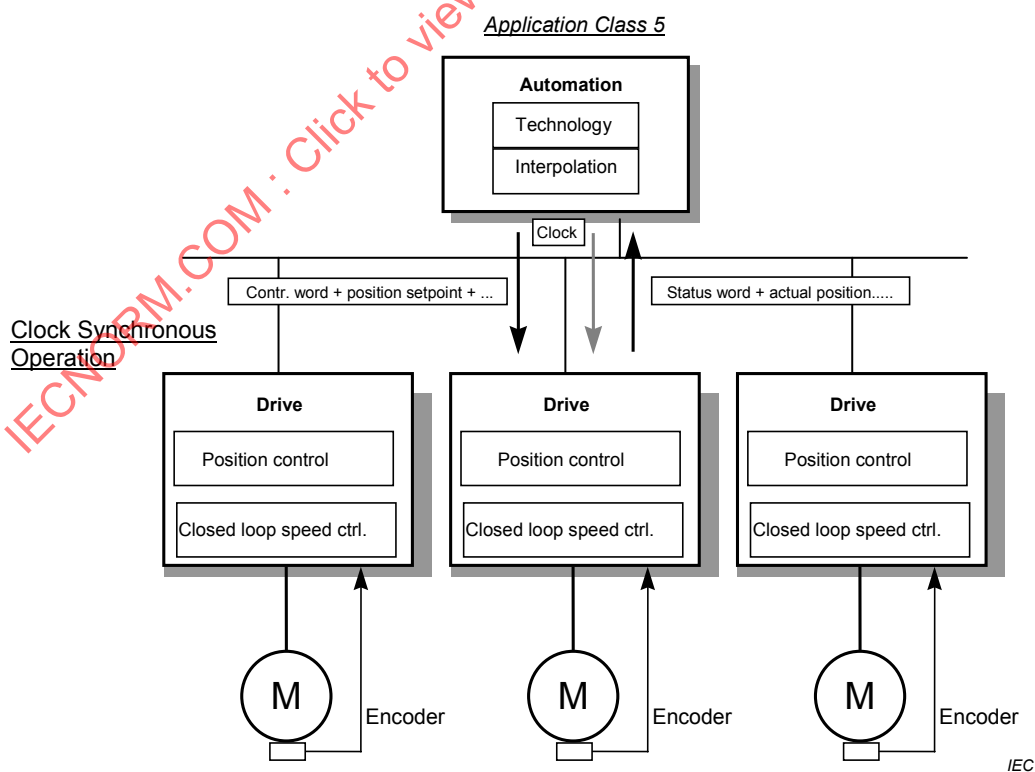
#### 6.1.5.5 AC 4: Motion Control with central interpolation and speed setpoint interface

Application Class 4 (see Figure 19) shows the position closed loop control closed via the communication system. Drives for manipulator and robotic applications often require a coordinated motion sequence of several drive systems. Motion control is primarily implemented via a central automation unit (NC). For each drive, these controllers calculate special setpoint profiles. By coordinating several drives (for example, for the XYZ axis), certain trajectories may be implemented. In addition to the required technology functions for the automation process, the automation system also includes the functions for interpolation and position control of the drive. Speed setpoint values and actual values as well as the position actual value are transferred via Cyclic Data Exchange. The drive controller essentially only includes the algorithms for closed loop speed control and actual position acquisition. Since the position is controlled via the bus system, Clock Synchronous Operation is necessary and shall be very precise. Additionally, the DSC-functionality may be used to increase the rigidity and dynamic response of the control loop.



#### 6.1.5.6 AC 5: Motion Control with central interpolation and position setpoint interface

Application Class 5 (see Figure 20) is not dealt with in this PROFIdrive profile version. The dynamic features of Application Class 5 may be achieved with Application Class 4 and DSC.





### 6.1.5.7 AC 6: Motion Control for clocked processes, or distributed angular synchronism

To realise applications like electric gearing, cam disc, angular synchronous operation, flying saw, Cyclic Data Exchange and Clock Synchronous Operation between Devices are necessary. These applications are normally realised with one master drive and several slave drives (see Figure 21). The term master drive in this context means that one drive axis provides process information (for example position actual value) to the other drives. Thereupon, the slave drives coordinate their own motion process with the process information of the master drive.

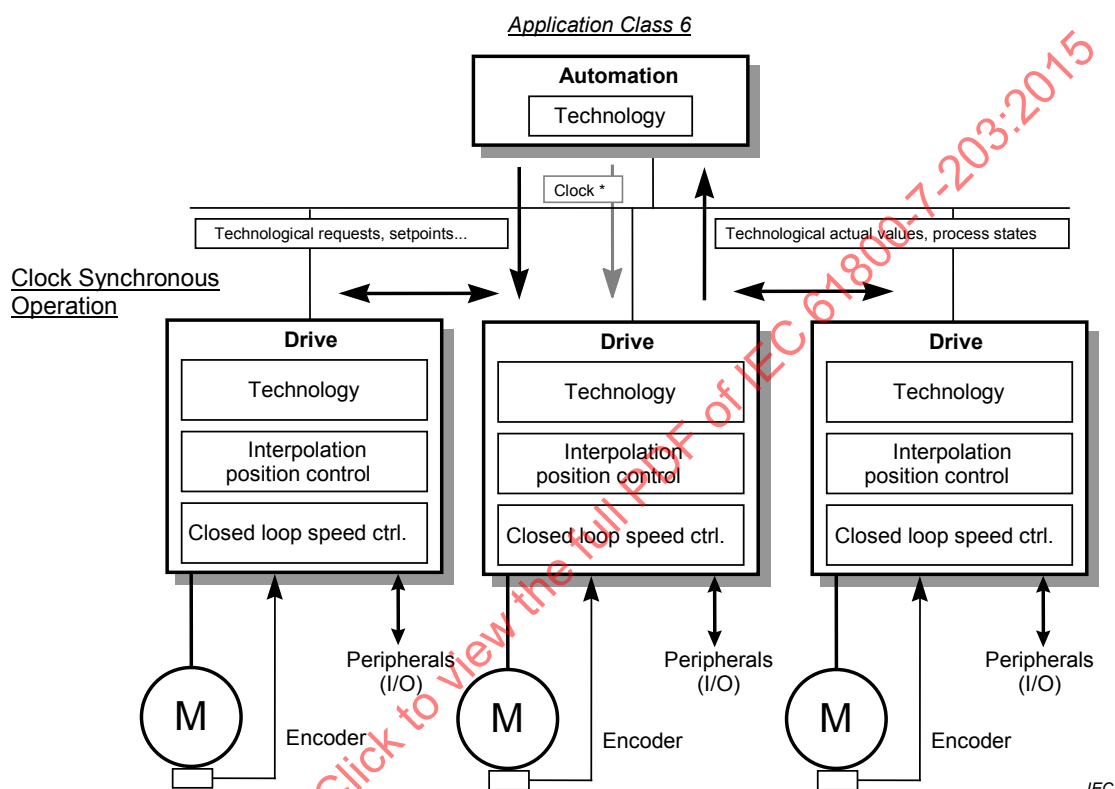


Figure 21 – Application Class 6

## 6.2 Parameter model

### 6.2.1 Parameter definition

#### 6.2.1.1 General

A parameter represents an information memory that consists of the elements defined in Table 16:

Table 16 – Parameter definition

| Element                                           | Meaning                                                                                                                 |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Parameter value (PWE)<br>(refer to 6.2.1.2)       | Includes the information variable(s)                                                                                    |
| Parameter description (PBE)<br>(refer to 6.2.1.3) | Specifies a parameter                                                                                                   |
| Text<br>(refer to 6.2.1.4)                        | Is used to support visualisation and contains a general description on the parameter function or on the parameter value |

The total of all parameters of a drive uniquely describes its behaviour or characteristics.

A parameter number is assigned to each parameter. The number range of the parameters is specified for decimal 1 to 65 535. The parameter 0 is not permitted. Profile-specific parameters are specified or reserved for the ranges decimal 900 to 999 and decimal 60 000 to 65 535 (refer to 6.4). The Profile-specific parameters shall be implemented exactly according to the definition in 6.4, even if a parameter description is implemented in the drive.

Access to the parameters (parameter value, parameter description or text) is explained in 6.2.3.

#### 6.2.1.2 Parameter value

The parameter value contains a single (simple variable) or several similar (array) information variables.

An array consists of  $n$  elements of the same data type which may be individually addressed with sub-indices from 0 to  $n-1$ .

#### 6.2.1.3 Parameter description

The parameter description contains relevant information about the respective parameter. Table 17 shows the structure of the parameter description which will be discussed in the course of this subclause.

**Table 17 – Parameter description elements**

| Subindex | Meaning                                      | Data type<br>(refer to Clause 5) |
|----------|----------------------------------------------|----------------------------------|
| 1        | Identifier (ID)                              | V2                               |
| 2        | Number of array elements or length of string | Unsigned 16                      |
| 3        | Standardisation factor                       | Floating Point                   |
| 4        | Variable attribute                           | OctetString 2                    |
| 5        | Reserved                                     | OctetString 4                    |
| 6        | Name                                         | VisibleString 16                 |
| 7        | Low limit                                    | OctetString 4                    |
| 8        | High limit                                   | OctetString 4                    |
| 9        | Reserved                                     | OctetString 2                    |
| 10       | ID extension                                 | V2                               |
| 11       | DO IO DATA reference parameter               | Unsigned 16                      |
| 12       | DO IO DATA normalisation                     | V2                               |
| 0        | Complete description                         | OctetString 46                   |

#### Identifier (subindex 1)

Additional characteristics of the parameter are stored in the ID (see Table 18).

Bit value = “0” means: “parameter does not possess this attribute”.

Bit value = “1” means: “parameter possesses this attribute”.

**Table 18 – Parameter description element "Identifier (ID)"**

| Bit    | Meaning                                                                       | Explanation                                                                                                                                                                        |
|--------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 7 | Data type numeric identifier of the parameter value (see Table 1 and Table 2) |                                                                                                                                                                                    |
| 8      | Standardisation factor and variable attribute not relevant                    | This bit is set if parameters have data types to which physical values may not be calculated, for example the data type string.                                                    |
| 9      | Parameter not writeable                                                       |                                                                                                                                                                                    |
| 10     | Additional text array available                                               |                                                                                                                                                                                    |
| 11     | Reserved                                                                      |                                                                                                                                                                                    |
| 12     | Parameter was changed with respect to the factory setting                     | This bit is set if the parameter value is unequal to the factory setting. It is reset if the parameter value is equal to the factory setting.                                      |
| 13     | Parameter value may be reset only                                             | If this bit is set, the associated parameter value is increased exclusively by internal processing, while externally, it may only be set to "0" (for example, "time differences"). |
| 14     | Array                                                                         |                                                                                                                                                                                    |
| 15     | Reserved                                                                      |                                                                                                                                                                                    |

**Number of array elements or string length (subindex 2)**

In the case of array parameters, the number of elements is entered here. In the case of parameters of the string type, the length of the string is entered here. The string parameters shall use data types OctetString or VisibleString and correspond to an array of bytes. It is not possible to form an array out of the data types OctetString or VisibleString.

**Standardisation factor (subindex 3)**

Factor that converts the (internal) value into an (external) standardised variable which, together with the unit, corresponds to the physical representation of the parameter. The standardisation factor is of the data type Floating Point.

**Variable attribute (subindex 4)**

A variable index (see Table 20 and Table 22) and a conversion index (see Table 21 and Table 23) are indicated in the variable attribute (see Table 19).

**Table 19 – Parameter description element "variable attribute"**

| Octet 1        | Octet 2                                  |
|----------------|------------------------------------------|
| variable index | conversion index<br>(Factor A, Offset B) |

The variable index represents the fixed coding of the physical variable (and therefore the base unit) of the parameter value. The variable index is of the data type Unsigned 8.

The conversion index represents the fixed coding of the conversion factor (A) and the offset (B) for a parameter value. With the conversion index, the unit may be converted into the base unit. The conversion index is of the data type Integer 8. See the following example 1.

EXAMPLE 1 variable attribute = 13/-3 (0x0DFD)

- Variable index = 13 → physical variable "speed", basic unit "metre/second"
- Conversion index = -3 → unit "millimetre/second" (factor A=0,001, offset B=0)

Further examples: External representation (by means of standardisation factor, Variable attribute)

The following applies:

- Physical value (in the unit) = transmitted value × standardisation factor × unit
- or
- Physical value (in the base unit) = (transmitted value × standardisation factor × A + B) × base unit

Coding for the variable index and the conversion index (Factor A, Offset B), see Table 20, Table 21, Table 22 and Table 23.

EXAMPLE 2

- Data Type: Integer 16
- Transmission Value: 500
- Standardisation Factor: 1,0
- Variable Index: 21 → physical variable "Electrical Voltage", base unit "Volt"
- Conversion Index: -3 → unit "Millivolt" (Factor A=0,001, Offset B=0)
  - Physical Value (in the unit) =  $500 \times 1,0 \text{ mV} = 500 \text{ mV}$
  - Physical Value (in the base unit) =  $(500 \times 1,0 \times 0,001 + 0) \text{ V} = 0,5 \text{ V}$

EXAMPLE 3

- Data Type: Unsigned16
- Transmission Value: 1 234
- Standardisation Factor: 0,01
- Variable Index: 13 → physical variable "Speed", base unit "metre/second"
- Conversion Index: 73 → unit "Kilometre/Hour" (Factor A=1 000/3 600, Offset B=0)
  - Physical Value (in the unit) =  $1\,234 \times 0,01 \text{ km/h} = 12,34 \text{ km/h}$
  - Physical Value (in the base unit) =  $(1\,234 \times 0,01 \times 1\,000/3\,600 + 0) \text{ m/s} = 3,428 \text{ m/s}$

EXAMPLE 4

- Data Type N2 → 100 % corresponds to  $2^{14}$ .
- Transmission Value: 8 043
- Standardisation Factor: 0,006 1 ( $100/2^{14}$ )
- Variable Index: 24 → physical variable "Ratio", base unit "Percent"
- Conversion Index: 0 → unit = base unit "Percent" (Factor A=1, Offset B=0)
  - Physical Value =  $8\,043 \times 0,006\,1 \% = 49,1 \%$

NOTE In the case of the data types N2, N4 or X2, X4 or optionally, Integer16, Integer32, Floating Point (normalised variables), the unit % can be converted to another physical unit by assigning a physical reference parameter (see below, Description Element DO IO Data reference parameter).

**Table 20 – Variable index and conversion index for SI units**

| Physical variable | Variable index | Unit              | Abbreviation               | Conversion index |
|-------------------|----------------|-------------------|----------------------------|------------------|
|                   | 0              | No dimensions     |                            | 0                |
| Length            | 1              | Metre             | m                          | 0                |
|                   |                | Millimetre        | mm                         | -3               |
|                   |                | Kilometre         | km                         | 3                |
|                   |                | Micrometre        | µm                         | -6               |
| Area              | 2              | Square metre      | m <sup>2</sup>             | 0                |
|                   |                | Square millimetre | mm <sup>2</sup>            | -6               |
|                   |                | Square kilometre  | km <sup>2</sup>            | 6                |
| Volume            | 3              | Cubic metre       | m <sup>3</sup>             | 0                |
|                   |                | Litre             | l                          | -3               |
| Time              | 4              | Second            | s                          | 0                |
|                   |                | Minute            | min                        | 70               |
|                   |                | Hour              | h                          | 74               |
|                   |                | Day               | d                          | 77               |
|                   |                | Millisecond       | ms                         | -3               |
|                   |                | Microsecond       | µs                         | -6               |
| Force             | 5              | Newton            | N                          | 0                |
|                   |                | Kilonewton        | kN                         | 3                |
|                   |                | Meganewton        | MN                         | 6                |
| Pressure          | 6              | Pascal            | Pa                         | 0                |
|                   |                | Kilopascal        | kPa                        | 3                |
|                   |                | Millibar          | mbar                       | 2                |
|                   |                | Bar               | bar                        | 5                |
| Mass              | 7              | Kilogram          | kg                         | 0                |
|                   |                | Gram              | g                          | -3               |
|                   |                | Milligram         | mg                         | -6               |
|                   |                | Tonne             | t                          | 3                |
| Energy, work      | 8              | Joule             | J                          | 0                |
|                   |                | Kilojoule         | kJ                         | 3                |
|                   |                | Megajoule         | MJ                         | 6                |
|                   |                | Watt hour         | Wh                         | 74               |
|                   |                | Kilowatt hour     | kWh                        | 75               |
|                   |                | Megawatt hour     | MWh                        | 76               |
| Effective power   | 9              | Watt              | W                          | 0                |
|                   |                | Kilowatt          | kW                         | 3                |
|                   |                | Megawatt          | MW                         | 6                |
|                   |                | Milliwatt         | mW                         | -3               |
| Apparent power    | 10             | Voltampere        | VA                         | 0                |
|                   |                | Kilovoltampere    | kVA                        | 3                |
|                   |                | Megavoltampere    | MVA                        | 6                |
|                   |                | Millivoltampere   | mVA                        | -3               |
| Speed             | 11             | 1/second          | s <sup>-1</sup>            | 0                |
|                   |                | 1/minute          | r/min (min <sup>-1</sup> ) | 67               |
|                   |                | 1/hour            | h <sup>-1</sup>            | 72               |
| Angle             | 12             | Radian            | rad                        | 0                |
|                   |                | Second            | "                          | 79               |
|                   |                | Minute            | '                          | 78               |
|                   |                | (Old-)degrees     | °                          | 80               |
|                   |                | New degrees (Gon) | g                          | 81               |

| Physical variable      | Variable index | Unit                            | Abbreviation        | Conversion index |
|------------------------|----------------|---------------------------------|---------------------|------------------|
| Velocity               | 13             | Metre/second                    | m/s                 | 0                |
|                        |                | Millimetre/second               | mm/s                | -3               |
|                        |                | Millimetre/minute               | mm/min              | 66               |
|                        |                | Metre/minute                    | m/min               | 67               |
|                        |                | Kilometre/minute                | km/min              | 68               |
|                        |                | Millimetre/hour                 | mm/h                | 71               |
|                        |                | Metre/hour                      | m/h                 | 72               |
|                        |                | Kilometre/hour                  | km/h                | 73               |
| Volume flow            | 14             | Cubic metre/second              | m <sup>3</sup> /s   | 0                |
|                        |                | Cubic metre/minute              | m <sup>3</sup> /min | 67               |
|                        |                | Cubic metre/hour                | m <sup>3</sup> /h   | 72               |
|                        |                | Litre/second                    | l/s                 | -3               |
|                        |                | Litre/minute                    | l/min               | 66               |
|                        |                | Litre/hour                      | l/h                 | 71               |
| Mass flow              | 15             | Kilogram/second                 | kg/s                | 0                |
|                        |                | Gram/second                     | g/s                 | -3               |
|                        |                | Tonne/second                    | t/s                 | 3                |
|                        |                | Gram/minute                     | g/min               | 66               |
|                        |                | Kilogram/minute                 | kg/min              | 67               |
|                        |                | Tonne/minute                    | t/min               | 68               |
|                        |                | Gram/hour                       | g/h                 | 71               |
|                        |                | Kilogram/hour                   | kg/h                | 72               |
|                        |                | Tonne/hour                      | t/h                 | 73               |
| Torque                 | 16             | Newton metre                    | Nm                  | 0                |
|                        |                | Kilonewton metre                | kNm                 | 3                |
|                        |                | Meganewton metre                | MNm                 | 6                |
| Temperature            | 17             | Kelvin                          | K                   | 0                |
|                        |                | Degrees Celsius                 | °C                  | 100              |
|                        |                | Degrees Fahrenheit              | °F                  | 101              |
| Temp. difference       | 18             | Kelvin                          | K                   | 0                |
| Entropy                | 19             | Joule / (Kelvin x Kilogram)     | J/(K x kg)          | 0                |
|                        |                | Kilojoule / (Kelvin x Kilogram) | kJ/(K x kg)         | 3                |
|                        |                | Megajoule / (Kelvin x Kilogram) | MJ/(K x kg)         | 6                |
| Enthalpy               | 20             | Joule/Kilogram                  | J/kg                | 0                |
|                        |                | Kilojoule/Kilogram              | kJ/kg               | 3                |
|                        |                | Megajoule/Kilogram              | MJ/kg               | 6                |
| Elec. voltage true RMS | 21             | Volt                            | V                   | 0                |
|                        |                | Kilovolt                        | kV                  | 3                |
|                        |                | Millivolt                       | mV                  | -3               |
|                        |                | Microvolt                       | μV                  | -6               |
| Elec. current          | 22             | Ampere                          | A                   | 0                |
|                        |                | Milliampere                     | mA                  | -3               |
|                        |                | Kiloampere                      | kA                  | 3                |
|                        |                | Microampere                     | μA                  | -6               |
| Elec. resistance       | 23             | Ohm                             | Ω                   | 0                |
|                        |                | Milliohm                        | mΩ                  | -3               |
|                        |                | Kiloohm                         | kΩ                  | 3                |
|                        |                | Megaohm                         | MΩ                  | 6                |
| Ratio                  | 24             | Percent                         | %                   | 0                |
| Relative humidity      | 25             | Percent                         | %                   | 0                |

| Physical variable                 | Variable index           | Unit                                | Abbreviation          | Conversion index |
|-----------------------------------|--------------------------|-------------------------------------|-----------------------|------------------|
| Absolute humidity                 | 26                       | Gram/Kilogram                       | g/kg                  | -3               |
| Relative change                   | 27                       | Percent                             | %                     | 0                |
| Frequency                         | 28                       | Hertz                               | Hz                    | 0                |
|                                   |                          | Kilohertz                           | kHz                   | 3                |
|                                   |                          | Megahertz                           | Mhz                   | 6                |
|                                   |                          | Gigahertz                           | GHz                   | 9                |
| Per-unit torque                   | 29                       | Newton metre/Ampere                 | Nm/A                  | 0                |
| Power (US)                        | 30                       | Horsepower                          | hp                    | 0                |
| Acceleration                      | 31                       | Metre/(second <sup>2</sup> )        | m/s <sup>2</sup>      | 0                |
| Jerk                              | 32                       | Metre/(second <sup>3</sup> )        | m/s <sup>3</sup>      | 0                |
| Baud rate                         | 33                       | Bit/second                          | bit/s                 | 0                |
| Angular speed                     | 34                       | Radian/second                       | rad/s                 | 0                |
|                                   |                          | Radian/minute                       | rad/min               | 67               |
|                                   |                          | Radian/hour                         | rad/h                 | 72               |
| Leadscrew pitch                   | 35                       | Millimetre/revolution               | mm/rev                | -3               |
|                                   |                          | Metre/revolution                    | m/rev                 | 0                |
| Inertia                           | 36                       | Kilogram (metre) <sup>2</sup>       | kgm <sup>2</sup>      | 0                |
| Capacity                          | 37                       | Farad                               | F                     | 0                |
|                                   |                          | Millifarad                          | mF                    | -3               |
|                                   |                          | Microfarad                          | µF                    | -6               |
|                                   |                          | Nanofarad                           | nF                    | -9               |
|                                   |                          | Picofarad                           | pF                    | -12              |
| Inductivity                       | 38                       | Henry                               | H                     | 0                |
|                                   |                          | Millihenry                          | mH                    | -3               |
| Force constant, amplification     |                          |                                     |                       |                  |
| "Kt" linear                       | 39                       | Newton/Ampere                       | N/A                   | 0                |
| "Kt" rotary                       | see: 29 Per-unit Torque  |                                     |                       |                  |
| "Kp " (rotary) speed control gain | 40                       | Newton metre/(1/minute)             | Nm/(1/min)            | 70               |
| "Kp" (linear) speed control gain  | 41                       | Newton/(metre/second)               | N/(m/s)               | 0                |
| "Kp speed adaption" (only rotary) | 42                       | (1/minute)/(Volt x Ampere x second) | (1/min)/VAs           | 67               |
| "Kv" position control gain        | 43                       | Metre/millimetre/minute             | m/mm/min (=1 000/min) | 68               |
|                                   |                          | 1/second                            | 1/s                   | 0                |
| "Kf" flux control gain            | 44                       | Ampere/Volt second                  | A/Vs                  | 0                |
| "Ki" current control gain         | See: 23 Elec. Resistance |                                     |                       |                  |
| Electric conductance              | 50                       | Siemens                             | 1S=1/Ω                | 0                |
|                                   |                          | Millisiemens                        | 1mS=1/kΩ              | -3               |
|                                   |                          | Kilosiemens                         | 1kS=1/mΩ              | 3                |
| Magnetic flux                     | 51                       | Volt second                         | 1Vs                   | 0                |
| Elec. voltage peak to peak value  | 52                       | Volt peak to peak                   | Vpp                   | 0                |
|                                   |                          | Kilovolt peak to peak               | kVpp                  | 3                |
|                                   |                          | Millivolt peak to peak              | mVpp                  | -3               |
|                                   |                          | Microvolt peak to peak              | µVpp                  | -6               |

| Physical variable             | Variable index | Unit                | Abbreviation | Conversion index |
|-------------------------------|----------------|---------------------|--------------|------------------|
| Elec. voltage effective value | 53             | Volt effective      | Veff         | 0                |
|                               |                | Kilovolt effective  | kVeff        | 3                |
|                               |                | Millivolt effective | mVeff        | -3               |
|                               |                | Microvolt effective | μVeff        | -6               |
| Elec. voltage DC value        | 54             | Volt DC value       | Vdc          | 0                |
|                               |                | Kilovolt DC value   | kVdc         | 3                |
|                               |                | Millivolt DC value  | mVdc         | -3               |
|                               |                | Microvolt DC value  | μVdc         | -6               |
| User defined                  | 254            | No dimension        |              | 0                |

Table 21 – Conversion values for the conversion index (SI units)

| Conversion index | A (conversion factor)                                      | 1/A (reciprocal conversion factor)     | B (offset) |
|------------------|------------------------------------------------------------|----------------------------------------|------------|
| 0                | 1,0 E+0                                                    | 1,0 E+0                                | 0          |
| 1                | 10 = 1,0 E+1                                               | 1,0 E-1                                | 0          |
| 2                | 100 = 1,0 E+2                                              | 1,0 E-2                                | 0          |
| 3                | 1 000 = 1,0 E+3                                            | 1,0 E-3                                | 0          |
| etc.             |                                                            |                                        |            |
|                  |                                                            |                                        |            |
| -1               | 0,1 = 1,0 E-1                                              | 1,0 E+1                                | 0          |
| -2               | 0,01 = 1,0 E-2                                             | 1,0 E+2                                | 0          |
| -3               | 0,001 = 1,0 E-3                                            | 1,0 E+3                                | 0          |
| etc.             |                                                            |                                        |            |
|                  |                                                            |                                        |            |
| 66               | $1,0 \text{ E-}3/60 = 1,667 \text{ E-}5$                   | 6,000 E+4                              | 0          |
| 67               | $1/60 = 1,667 \text{ E-}2$                                 | 6,000 E+1                              | 0          |
| 68               | $1,0 \text{ E+}3/60 = 1,667 \text{ E+}1$                   | 6,000 E -2                             | 0          |
| 69               |                                                            |                                        | 0          |
| 70               | 60                                                         | 1,667 E-2                              | 0          |
| 71               | $1,0 \text{ E-}3/3 \text{ 600} = 2,778 \text{ E-}7$        | 3,6 E+6                                | 0          |
| 72               | $1/3 \text{ 600} = 2,778 \text{ E-}4$                      | 3,6 E+3                                | 0          |
| 73               | $1,0 \text{ E+}3/3 \text{ 600} = 2,778 \text{ E-}1$        | 3,6                                    | 0          |
| 74               | 3 600                                                      | $1/3 \text{ 600} = 2,778 \text{ E-}4$  | 0          |
| 75               | $3 \text{ 600} \times 1,0 \text{ E+}3 = 3,600 \text{ E+}6$ | 2,778 E-7                              | 0          |
| 76               | $3 \text{ 600} \times 1,0 \text{ E+}6 = 3,600 \text{ E+}9$ | 2,778 E-10                             | 0          |
| 77               | 86 400                                                     | $1/86 \text{ 400} = 1,157 \text{ E-}5$ | 0          |
| 78               | $\pi/10 \text{ 800} = 2,909 \text{ E-}4$                   | 3,438 E+3                              | 0          |
| 79               | $\pi/648 \text{ 000} = 4,848 \text{ E-}6$                  | 2,063 E+5                              | 0          |
| 80               | $\pi/180 = 1,745 \text{ E-}2$                              | 5,730 E+1                              | 0          |
| 81               | $\pi/200 = 1,571 \text{ E-}2$                              | 6,366 E+1                              | 0          |
|                  |                                                            |                                        |            |
| 100              | 1                                                          | 1                                      | +273,15    |
| 101              | $5/9 = 0,555 \text{ 6}$                                    | 1,8                                    | +459,67    |



**Table 22 – Variable index and conversion index for US units**

| Physical variable | Variable index | Unit                                                                                                                                                                      | Abbreviation                                                        | Conversion index                   |
|-------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------|
| US Length         | 100            | Thousandth of an inch<br>Inch (= 0,025 4 m)<br>Foot (= 0,304 8 m)<br>Yard (= 0,914 4 m)<br>Mile (= 1 609,3 m)<br>1 ft = 12 in<br>1 yd = 3 ft = 36 in<br>1 mile = 1 760 yd | mil<br>in<br>ft<br>yd<br>mile                                       | -3<br>0<br>-70<br>-71<br>-72       |
| US Area           | 101            | Square inch<br>Square foot<br>Square yard                                                                                                                                 | in <sup>2</sup><br>ft <sup>2</sup><br>yd <sup>2</sup>               | 0<br>-73<br>-74                    |
| US Volume 1       | 102            | Cubic inch<br>Cubic foot<br>Cubic yard                                                                                                                                    | in <sup>3</sup><br>ft <sup>3</sup><br>yd <sup>3</sup>               | 0<br>-76<br>-77                    |
| US Volume 2       | 103            | Gallon<br>(= 3,785 4 E-9 m <sup>3</sup> )                                                                                                                                 | gal                                                                 | 0                                  |
| US Velocity       | 104            | Inch/second<br>Inch/minute<br>Foot/second<br>Foot/minute<br>Mile/hour                                                                                                     | in/s, IPS<br>in/min, IPM<br>ft/s, FPS<br>ft/min, FPM<br>mile/h, MPH | 0<br>67<br>-70<br>-80<br>-81       |
| US Acceleration   | 105            | Inch/(seconds <sup>2</sup> )<br>Foot/(seconds <sup>2</sup> )                                                                                                              | in/s <sup>2</sup><br>ft/s <sup>2</sup>                              | 0<br>-70                           |
| US Jerk           | 106            | Inch/(seconds <sup>3</sup> )<br>Foot/(seconds <sup>3</sup> )                                                                                                              | in/s <sup>3</sup><br>ft/s <sup>3</sup>                              | 0<br>-70                           |
| US Volume Flow 1  | 107            | Cubic inch/second<br>Cubic inch/minute<br>Cubic inch/hour                                                                                                                 | in <sup>3</sup> /s<br>in <sup>3</sup> /min<br>in <sup>3</sup> /h    | 0<br>67<br>72                      |
| US Volume Flow 2  | 108            | Gallon/second<br>Gallon/minute<br>Gallon/hour                                                                                                                             | gal/s, GPS<br>gal/min, GPM<br>gal/h, GPH                            | 0<br>67<br>72                      |
| US Mass           | 109            | Ounce<br>Pound ( = 0,453 6 kg)<br>1 lb = 16 oz                                                                                                                            | oz<br>lb                                                            | -90<br>0                           |
| US Mass flow      | 110            | Ounce/second<br>Ounce/minute<br>Ounce/hour<br>Pound/second<br>Pound/minute<br>Pound/hour                                                                                  | oz/s<br>oz/min<br>oz/h<br>lb/s<br>lb/min<br>lb/h                    | -90<br>-91<br>-92<br>0<br>67<br>72 |
| US Inertia        | 111            | Ounce inch squared<br>Pound inch squared<br>Pound feet squared                                                                                                            | oz in <sup>2</sup><br>lb in <sup>2</sup><br>lb ft <sup>2</sup>      | -90<br>0<br>-73                    |
| US Force          | 112            | Pound force<br>( = 4,448 22 N)                                                                                                                                            | lb f                                                                | 0                                  |
| US Torque         | 113            | Ounce inch<br>Pound force inch<br>Pound force foot                                                                                                                        | oz in<br>lb f in, INLB<br>lb f ft, FTLB                             | -90<br>0<br>-70                    |

| Physical variable  | Variable index | Unit                                                                    | Abbreviation                      | Conversion index |
|--------------------|----------------|-------------------------------------------------------------------------|-----------------------------------|------------------|
| US Pressure        | 114            | Pound per square inch<br>( = 6 894,8 Pa)                                | psi (lb/in <sup>2</sup> )         | 0                |
| US "Kt" linear     | 115            | Pound force/Ampere                                                      | lb f/A                            | 0                |
| US "Kt" rotary     | 116            | Ounce inch/ampere<br>Pound force inch/ampere<br>Pound force foot/ampere | oz in/A<br>lb f in/A<br>lb f ft/A | -90<br>0<br>-70  |
| US "Kp"            | 117            | Pound force inch second                                                 | lb f in s                         | 0                |
| US "Kv"            | same as SI     | Inch/minute/thousandth of an inch                                       | in/min/mil<br>(=1 000/min)        | 68               |
| US leadscrew pitch | 118            | Inch/revolution                                                         | in/rev                            | 0                |

**Table 23 – Conversion values for the conversion index (US units)**

| Conversion index | A<br>(conversion factor) | B<br>(offset) |
|------------------|--------------------------|---------------|
| -70              | 12                       | 0             |
| -71              | 36                       | 0             |
| -72              | 63 360                   | 0             |
| -73              | 144                      | 0             |
| -74              | 1 296                    | 0             |
| -75              | --                       | --            |
| -76              | 1 728                    | 0             |
| -77              | 46 656                   | 0             |
|                  |                          |               |
| -80              | 12/60 = 0,2              | 0             |
| -81              | 63 360/3 600 = 176       | 0             |
|                  |                          |               |
| -90              | 1/16 = 6,250 E-2         | 0             |
| -91              | 1/960 = 1,042 E-3        | 0             |
| -92              | 1/57 600 = 1,736 E-5     | 0             |

#### **Name (subindex 6)**

"Name" describes the symbolic name of the parameter. The name is of the data type VisibleString with a length of 16 bytes.

#### **Low/high limit (subindices 7 and 8)**

"Low/high limit" defines the valid value range of the parameter value.

The drive rejects an attempt to assign a value outside of the parameter's value range. The low and the high limit are of the same data type as the parameter value, but the length of the description elements is always 4 bytes (file format: right justified, big endian). For parameters whose data types permit no value range (for example, VisibleString), the contents of these description elements are of no importance.

**ID extension (subindex 10)**

The ID extension is reserved.

**IO Data reference parameter/IO Data normalisation (subindices 11 and 12)**

Parameter values may also be transmitted as IO Data (refer to 6.3.4.4). If normalised variables (data types N2, N4 or X2, X4 or optional Integer16, Integer32, Floating Point) are transmitted, the following is necessary for calculating the physical value: the physical reference value (IO Data reference value), and the bit (refer to IO Data normalisation) to which the physical reference value refers. For a calculation example, refer to 6.3.4.5.

For parameters of the data type X2, X4, the description elements “IO Data reference parameter” and “IO Data normalisation” shall be available.

For parameters of the data type N2, N4, the description elements “IO Data reference parameter” shall be available, and the description element “IO Data normalisation” is optional as it is defined by the data type.

If parameters of data type Integer8, Integer16, Integer32, Unsigned8, Unsigned16, Unsigned32 or Floating Point are transmitted as normalised IO Data (with unit “%”) the description elements “IO Data reference parameter” and “IO Data normalisation” shall be available (see Table 24). If they are transmitted as non-normalised, these description elements shall not be available.

In the case of all other data types, these description elements are not relevant.

**Table 24 – Parameter description elements  
“IO Data reference value/IO Data normalisation”**

| Description element                                                                                                                                                                                                                     | Content     |                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------|
| IO Data reference parameter                                                                                                                                                                                                             | 0           | No reference value available <sup>b</sup>                     |
|                                                                                                                                                                                                                                         | 1 to 65 535 | Parameter number of the reference value <sup>c</sup>          |
| IO Data normalisation                                                                                                                                                                                                                   | Bit 0 to 5  | Normalisation bit 0 to 31 <sup>a</sup> (32 to 63 is reserved) |
|                                                                                                                                                                                                                                         | Bit 6 to 14 | reserved                                                      |
|                                                                                                                                                                                                                                         | Bit 15      | Normalisation valid                                           |
| <sup>a</sup> For the parameters with data type N2, N4, the coding of the normalisation bit is fixed (14 and 30). For the normalised parameters with data type Floating Point, the coding of the normalisation bit is not relevant (=0). |             |                                                               |
| <sup>b</sup> The combination “no reference value exists”/ “normalisation valid” is permissible.                                                                                                                                         |             |                                                               |
| <sup>c</sup> Parameters that are used for reference values are not to be normalised.                                                                                                                                                    |             |                                                               |

**Complete description (subindex 0)**

The “complete description” includes a total field of 46 bytes (corresponding to the complete parameter description structure). This length is the constant for each parameter (regardless of the data type, etc.). If the complete parameter description is read out with one access, the description elements IO Data reference parameter and IO Data normalisation shall be included.

**6.2.1.4 Text**

Text from a text array may be assigned to a parameter as an additional explanation or description. An indexed text line has a length of 16 bytes (see Table 25).

**Table 25 – Text array for parameter description**

| Subindex text array | Text                       |
|---------------------|----------------------------|
| 0                   | Text 0 (16 bytes)          |
| 1                   | Text 1 (16 bytes)          |
| 2 – n               | Text 2 – n (16 bytes each) |

The existence of a text array is marked within the parameter description (ID: additional text array available). The text is stored in the object type “array” of the data type “VisibleString 16” assigned to the parameter. Text arrays may be assigned to parameters of the object type “array” (with any data type), or to parameters of the object type “simple variable” (with data type “Unsigned8/16/32”, “Boolean”, or “V2”). The individual texts of a text array are assigned to the array elements for parameters of the type “array”, and assigned to the values for parameters of the type “simple variable”.

#### **Array parameter – text array**

Subindex text array == Subindex array parameter

#### **Unsigned8/16/32 – text array**

Subindex text array == parameter value (see Table 26)

$0 \leq \text{Parameter value} \leq 65\,535$

#### **Boolean – text array**

Number of texts = 2

**Table 26 – Text array for the data type Boolean**

| Subindex text array | Parameter value |
|---------------------|-----------------|
| 0                   | "false"         |
| 1                   | "true"          |

#### **V2 – text array**

Number of texts = 32

To each bit of the bit sequence, two texts are assigned, one each to the bit value “0” and “1” (see Table 27).

Subindex Text Array == Bit position  $\times$  2 + Bit Value

$0 \text{ (LSB)} \leq \text{Bit position} \leq 15 \text{ (MSB)}, 0 \leq \text{Bit Value} \leq 1;$

**Table 27 – Text array for data type V2 (bit sequence)**

| Subindex text array | Parameter value |
|---------------------|-----------------|
| 0                   | ----- 0         |
| 1                   | ----- 1         |
| 2                   | ----- 0 -       |
| 3                   | ----- 1 -       |
| 4                   | ----- 0 --      |
| :                   | :               |
| 30                  | 0 -----         |
| 31                  | 1 -----         |

### 6.2.2 Global and local parameters

As defined in 6.1.3 and 6.3.4.4, a Drive Unit consists of the drive device itself and one or several Drive Objects (DO). The drive axes are related to Axis type DOs.

For Multi-Axis and Modular Drive Units, each DO has a dedicated parameter number space.

Two types of parameters with different ranges of values are defined in the profile:

#### Global parameter

Global parameters are related to the complete device (for example communication interface related parameters). If addressing different DOs of a Drive Unit, a global parameter will always specify the same value.

#### DO/axis-specific parameters

These parameters are related to the Drive Object. The DO/axis-specific parameters may have different values in every Axis DO (for example parameter 967 "control word1").

The subdivision of the parameters into global and DO/axis-specific parameters is shown in 6.4.

Figure 22 shows an example with global parameter 918 "node address" and the axis-specific parameter 944 "fault message counter" for a Multi-Axis or Modular Drive Unit. A Single-Axis Drive Unit is similar to the Multi-Axis Drive Unit, but only the DO1 is present.

| Multi-Axis / Modular Drive Unit |       |                  |       |                  |       |                  |       |
|---------------------------------|-------|------------------|-------|------------------|-------|------------------|-------|
| DO 1 (e.g. Axis)                |       | DO 2 (e.g. Axis) |       | DO 3 (e.g. Axis) |       | DO n (e.g. Axis) |       |
| PNU                             | Value | PNU              | Value | PNU              | Value | PNU              | Value |
| 1                               | ...   | 1                | ...   | 1                | ...   | 1                | ...   |
| 2                               | ...   | 2                | ...   | 2                | ...   | 2                | ...   |
| 91<br>8                         | 3     | 91<br>8          | 3     | 91<br>8          | 3     | 91<br>8          | 3     |
| 94<br>4                         | 12    | 94<br>4          | 3     | 94<br>4          | 7     | 94<br>4          | 4     |
|                                 |       | ...              | ...   | ...              | ...   | ...              | ...   |
|                                 |       | ...              | ...   | ...              | ...   | ...              | ...   |

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**Figure 22 – Example overview of global and local parameters of a Multi-Axis/Modular Drive Unit**

The value range of the DO-ID numbers range from 0 to 254. With the DO-ID 0 the drive device itself may be addressed (device representative, no axis) and the global parameters may be read. The assignment of the drive axis numbers to the DOs is device-specific and may be read out of parameter P978 "list of module IDs" (refer to 6.3.4.4).

The addressing is described in 6.2.3.

### 6.2.3 Base Mode Parameter Access

#### 6.2.3.1 General

In this subclause, the access to parameters via the "Base Mode" is defined. A request language will be defined for the access. The requests and the replies are transmitted acyclically by use of the "Acyclic Data Exchange" mechanism of the Communication System.

The Base Mode Parameter Access exists because of compatibility reasons due to former PROFIdrive profile and every drive shall be able to handle the Base Mode Parameter Access (mandatory).

#### 6.2.3.2 General characteristics

The Base Mode Parameter Access shows the following characteristics.

- 16-bit wide address each for parameter number and subindex.
- Transmission of complete arrays or parts of them, or the entire parameter description.
- Transmission of different parameters in one access (multi-parameter requests). The device should post the maximum number of parameter accesses in one parameter request in the optional parameter P974.
- Always just one parameter request is being processed at a time (no pipelining).
- A parameter request/parameter response shall fit in a data block (240 bytes default.) The requests/replies are not split-up over several data blocks. The maximum length of the data blocks may be different from 240 bytes depending on Device characteristics or bus

configuration. With PROFIBUS the maximum block size is limited to 240 byte, with Profinet the maximum block size is limited to  $2^{32} - 65$  byte data length. The device shall post the maximum length of the request/response block in parameter P974 if the size is different from the default size of 240 byte.

- No spontaneous messages will be transmitted.
- For optimised simultaneous access to different parameters (for example, operator interface screen contents), “multi-parameter” requests will be defined.
- There are no cyclic parameter requests.
- After run-up, the profile-specific parameters shall be at least readable in every state.

#### **6.2.3.3 DO addressing modes**

The Base Mode Parameter Access is defined with two different DO address modes according to the following definition.

- Base Mode Parameter Access – Local: In this address mode, only the local parameters of the DO are accessible, to which the CO, where the parameter access point is attached, is related. Access of all global parameters is also possible. The DO-ID in the parameter request header is of no significance.
- Base Mode Parameter Access – Global: In this address mode, all parameters of the Drive Unit are accessible, to which the CO, where the parameter access point is attached, is related. The DO-ID in the parameter request is used for accessing of local parameters inside the Drive Unit. For access of global parameters, the DO-ID 0 may also be used. This address mode serves for compatibility reasons (PROFIBUS) and should not be used by new PROFINET IO Controller and Supervisor application processes.

#### **6.2.3.4 Parameter requests and parameter responses**

A parameter request consists of three segments:

##### **Request header**

ID for the request and number of parameters which are accessed. Multi-Axis and Modular drives, Addressing of one DO.

##### **Parameter address**

Addressing of a parameter. If several parameters are accessed, there are correspondingly many parameter addresses. The parameter address appears only in the request, not in the response.

##### **Parameter value**

Per addressed parameter, there is a segment for the parameter values. Depending on the request ID, parameter values appear only in either the request or in the reply.

Words and double words:

The following telegram contents are displayed in words (a word or 2 bytes per line). Words or double words will have the most significant byte being transmitted first (big endian) (see Figure 23).

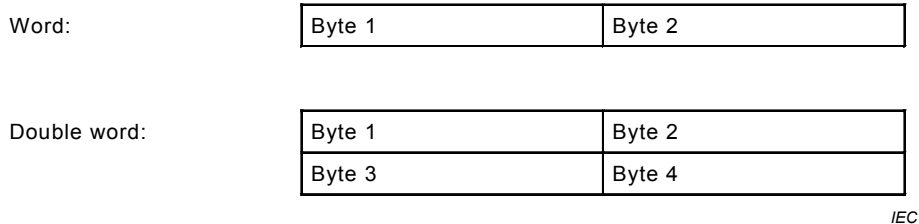


**Figure 23 – Byte order for Words and Double words**

According to the Base Mode Parameter Access, the structure of the parameter request and parameter response is shown in Table 28, or respectively, in Table 29.

**Table 28 – Base mode parameter request**

| Block definition                                                               | Byte n                 | Byte n+1              | n                                    |
|--------------------------------------------------------------------------------|------------------------|-----------------------|--------------------------------------|
| Request header                                                                 | Request reference      | Request ID            | 0                                    |
|                                                                                | Axis-No./DO-ID         | No. of parameters = i | 2                                    |
| 1 <sup>st</sup> Parameter address                                              | Attribute              | No. of elements       | 4                                    |
|                                                                                | Parameter number (PNU) |                       |                                      |
|                                                                                | Subindex               |                       |                                      |
| i <sup>th</sup> Parameter address                                              | ...                    |                       | 4 + 6 × (i-1)                        |
| 1 <sup>st</sup> Parameter value(s)<br>(only for request<br>"Change parameter") | Format                 | No. of values         | 4 + 6 × i                            |
|                                                                                | Values                 |                       |                                      |
|                                                                                | ...                    |                       |                                      |
|                                                                                |                        |                       |                                      |
| i <sup>th</sup> Parameter values                                               | ...                    |                       |                                      |
|                                                                                |                        |                       | 4 + 6 × i + ... + (Format_n × Qty_n) |

**Table 29 – Base mode parameter response**

| Block definition                                                        | Byte n                  | Byte n+1              | n                           |
|-------------------------------------------------------------------------|-------------------------|-----------------------|-----------------------------|
| Response header                                                         | Request ref. mirrored   | Response ID           | 0                           |
|                                                                         | Axis-No./DO-ID mirrored | No. of parameters = i | 2                           |
| 1 <sup>st</sup> Parameter value(s)<br>(only after request<br>"Request") | Format                  | No. of values         | 4                           |
|                                                                         | Values or Error values  |                       |                             |
|                                                                         | ...                     |                       |                             |
|                                                                         |                         |                       |                             |
| i <sup>th</sup> Parameter values                                        | ...                     |                       |                             |
|                                                                         |                         |                       | 4 +... + (Format_n × Qty_n) |

Meaning of the fields:

#### Request Header

- Request reference



Unique identification of the request/response pair for the master. The master changes the request reference with each new request (for example, modulo 255). The slave mirrors the request reference in the response without checking.

- Request ID

two IDs are defined:

- Request parameter
- Change parameter

A parameter change may be stored either in volatile or non-volatile RAM according to the device. A changed parameter that is stored in volatile RAM may first be stored in ROM with parameter P971. The differentiation Value/Description/Text is added to the address as an attribute. The differentiation Word/Double Word is added to the parameter values as a format. For the differentiation Single/Array Parameter, refer to “No. of elements” in the parameter address.

- Response ID

Mirroring of the request ID with supplement information whether the request was executed positively or negatively.

- Request parameter positive
- Request parameter negative (it was not possible to execute the request, entirely or partially)
- Change parameter positive
- Change parameter negative (it was not possible to execute the request, entirely or partially)

If the response is negative, error numbers are entered per partial response instead of values.

- Axis-No./DO-ID

For Base Mode Parameter Access – Local: irrelevant; In the parameter response, the DO-ID out of the request is mirrored.

For Base Mode Parameter Access – Global: DO addressing information used for multi-axis or modular drives. This enables various axes/DOs to be able to be accessed each with a dedicated parameter number space in the drive via the same PAP. See also 6.2.3.3.

- No. of parameters

In the case of multi-parameter requests, specifying the number of the following Parameter Address and/or Parameter Value areas. For single requests the No. of parameters = 1.

Default value range 1 to 39. The value range may be reduced or extended, which shall be indicated by P974.

Notice, that for a multi-parameter request the PROFIdrive Drive Unit shall arrange the parameter value areas in the response message in the same order as in the corresponding multi-parameter request message.

## Parameter Address

- Attribute

Type of object which is being accessed. Value range:

- Value
- Description
- Text

- Number of elements

Number of array elements that are accessed or length of string which is accessed.

Default value range 0, 1 to 234. The value range may be reduced or extended which shall be indicated by P974.

Special case Number of elements = 0: If values are accessed: recommended for non-indexed parameters (see also Table 30 for details).

- Parameter number (PNU)

Addresses the parameter that is being accessed. Value range: 1 to 65 535.

- Subindex

Addresses the first array element of the parameter or the beginning of a string access or the text array, or the description element that is being accessed. Value range: 0 to 65 534.

### Parameter Value

- Format

Format and number specify the location in the telegram to which subsequent values are assigned.

Value range:

- Zero (without values as positive partial response to a change request)
- Data type
- Error (as negative partial response)
- Instead of a data type, the following are possible:
  - Byte (for description and texts)
  - Word
  - Double word

- Number of values

Number of the following values or number of the following data type elements (number of octets in case of OctetString). In case of write request of OctetString, the correct length shall be supplied otherwise the drive shall respond with error 0x18, "number of values are not consistent" (see Table 32).

- Values

The values of the parameter

If the values consist of an odd number of bytes, a zero byte is appended in order to secure the word structure of the telegrams.

In the case of a positive partial response, the parameter value contains the following:

- Format = (Data Type or Byte, Word, Double Word)
- Number of values
- the values

In the case of a negative partial response, the parameter value contains the following:

- Format = error
- No. of values = 1
- Value = error value = error number

In the case of a negative response, the parameter value may contain the following:

- Format = error
- No. of values = 2
- Value 1 = Error value 1: error number
- Value 2 = Error value 2: subindex of the first array element where the error occurs
- (Purpose: after a faulty write access to an array, not all values shall be repeated)

In the case of a positive partial response without values, the parameter value contains the following:

- Format = zero
- Number of values = 0
- (no values)

Not all combinations consisting of attribute, number of elements, and subindex are permitted (refer to Table 30).

A parameter which is not indexed in the profile may be realised with indices in the Drive Unit, if the response to a Parameter Access is profile-specific.

**Table 30 – Permissible combinations consisting of attribute, number of elements and subindex**

| Attribute                                                                                                                                                                    | No. of elements    | Subindex | Related data                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------|------------------------------------------------------------------------------------------------------------------|
| Value (single parameter)                                                                                                                                                     | 0                  | 0        | The value (recommended)                                                                                          |
|                                                                                                                                                                              | 1                  | 0        | The value (for compatibility, do not use for request)                                                            |
| Value (array parameter)                                                                                                                                                      | 0                  | 0        | One value, under subindex 0                                                                                      |
|                                                                                                                                                                              | 1                  | 0 – n    | One value, under subindex                                                                                        |
|                                                                                                                                                                              | 2 – n <sup>a</sup> | 0 – n    | Several values, starting with subindex                                                                           |
| Value (string parameter)                                                                                                                                                     | 0                  | 0        | The entire string (if the response exceeds the block size, the string is cut at the end to match the block size) |
|                                                                                                                                                                              | 1                  | 0 – n    | One character, under subindex                                                                                    |
|                                                                                                                                                                              | 2 – n <sup>a</sup> | 0 – n    | Several characters, starting with subindex                                                                       |
| Description                                                                                                                                                                  | 0 (irrelevant)     | 0        | The entire description                                                                                           |
|                                                                                                                                                                              | 1                  | 1 – 12   | One description element                                                                                          |
| Text (from text array)                                                                                                                                                       | 1                  | 0 – n    | One text (16bytes), under subindex                                                                               |
|                                                                                                                                                                              | 2 – n              | 0 – n    | Several texts, starting with subindex                                                                            |
| <sup>a</sup> If the number of elements available in the device does not match with the number of elements which are requested or shall be changed, an error shall be output. |                    |          |                                                                                                                  |

### 6.2.3.5 Coding

The coding is given in Table 31.

**Table 31 – Coding of the fields in parameter request/parameter response of Base Mode Parameter Access**

| Field             | Data type | Values                                                                                                                                                                                                                                                                                              | Comment                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Request reference | Unsigned8 | 0x00 reserved<br>0x01 – 0xFF                                                                                                                                                                                                                                                                        | The slave shall mirror the Request reference without checking. Value 0 should not be used by the master.                                                                                                                                                                                                                                                                                                              |
| Request ID        | Unsigned8 | 0x00 reserved (illegal)<br>0x01 Request parameter<br>0x02 Change parameter<br><br>0x03 – 0x3F reserved<br>0x40 – 0x7F manufacturer-specific<br>0x80 – 0xFF not applicable (illegal)                                                                                                                 | Request ID = 0 and Request ID out of value range from 0x80 to 0xFF always is an illegal Request ID and shall be answered with "service not supported" (Response ID = 0x21)                                                                                                                                                                                                                                            |
| Response ID       | Unsigned8 | 0x00 reserved<br>0x01 Request parameter(+)<br>0x02 Change parameter(+)<br><br>0x03 – 0x3F reserved<br>0x40 – 0x7F manufacturer-specific<br><br>0x80 service not supported<br>0x81 Request parameter(-)<br>0x82 Change parameter(-)<br><br>0x83 – 0xBF reserved<br>0xC0 – 0xFF manufacturer-specific |                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Axis/DO-ID        | Unsigned8 | 0x00 Device-Representative<br>0x01 – 0xFE DO-ID-Number 1 – 254<br>0xFF reserved                                                                                                                                                                                                                     | Zero is not a DO but the access to the Drive Unit representative.                                                                                                                                                                                                                                                                                                                                                     |
| No. of parameters | Unsigned8 | 0x00 reserved<br>0x01 – 0xFF Quantity 1 to 255                                                                                                                                                                                                                                                      | For PROFIBUS devices the maximum number of parameters for a multi parameter access is limited to 39.<br>For PROFINET devices the maximum number of parameters is 255.<br>There may be additional limitations through the communication system (maximum length of data record) or device parameter manager. If there is no parameter 974 implemented the default maximum number of parameters is 39. See also 6.3.9.4. |
| Attribute         | Unsigned8 | 0x00 reserved<br>0x10 Value<br>0x20 Description<br>0x30 Text<br><br>0x40 – 0x70 reserved<br>0x80 – 0xF0 manufacturer-specific                                                                                                                                                                       | The four least significant bits are reserved for (future) expansion of "No. of elements" to 12 bits.                                                                                                                                                                                                                                                                                                                  |
| No. of elements   | Unsigned8 | 0x00 Special Function<br>0x01 – 0xEA Quantity 1 to 234<br>0xEB – 0xFF reserved                                                                                                                                                                                                                      | Limitation because of compatibility to former profile versions (PROFIBUS 240 Bytes maximum Datablock size).<br>There may be additional limitations through the communication system (maximum length of data record) or device parameter manager. If there is no parameter 974 implemented the default maximum number of elements is 234. See also 6.3.9.4.                                                            |

| Field            | Data type  | Values                                                                                                                                                                                                             | Comment                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Parameter number | Unsigned16 | 0x0000 reserved<br>0x0001 – Number 1 to 65 535<br>0xFFFF                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                            |
| Subindex         | Unsigned16 | 0x0000 – Number 0 to 65 534<br>0xFFFE                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                            |
| Format           | Unsigned8  | 0x00 reserved<br>0x01 – 0x39 Data types<br>0x39 – 0x3F reserved<br>0x40 Zero<br>0x41 Byte<br>0x42 Word<br>0x43 Double word<br>0x44 Error<br>0x45 – 0x70 reserved<br>0x71 – 0x7C Data types<br>0x7D – 0xFF reserved | Every Device shall at least support the basic data types Byte, Word and Double Word (mandatory).<br>Write requests by the Controller preferably use the "correct" standard and profile specific data types (refer to Clause 5). As substitute, Byte, Word or Double Word are also possible. The Controller shall be able to interpret all values/data types. For details see also 6.2.3.6. |
| No. of values    | Unsigned8  | 0x00 – 0xEA Quantity 0 to 234<br>0xEB – 0xFF reserved                                                                                                                                                              | Limitation because of compatibility to former profile versions (PROFIBUS 240 Bytes maximum Datablock size). There may be additional limitations through the communication system (maximum length of data record) or device parameter manager. If there is no parameter 974 implemented the default maximum number of values is 234. See also 6.3.9.4.                                      |
| Error number     | Unsigned16 | 0x0000 – Error numbers<br>0x00FF (see Table 32)                                                                                                                                                                    | The more significant byte is reserved.                                                                                                                                                                                                                                                                                                                                                     |

The device shall output an error, if reserved values are accessed (not Request reference).

**Table 32 – Error numbers in Base Mode parameter responses**

| Error No.<br>= Error<br>value1 | Meaning                                               | Used at                                                                                                                                                                                                                | Additional info<br>= Error value 2 |
|--------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| 0x00                           | Impermissible parameter number                        | Access to unavailable parameter <sup>a</sup>                                                                                                                                                                           | 0                                  |
| 0x01                           | Parameter value cannot be changed                     | Change access to a parameter value that cannot be changed                                                                                                                                                              | Subindex                           |
| 0x02                           | Low or high limit exceeded                            | Change access with value outside the value limits                                                                                                                                                                      | Subindex                           |
| 0x03                           | Faulty subindex                                       | Access to unavailable subindex of array or string parameter. Shall not be used for single parameters <sup>a</sup>                                                                                                      | Subindex                           |
| 0x04                           | No array                                              | Access with subindex to non-indexed parameter <sup>a</sup>                                                                                                                                                             | 0                                  |
| 0x05                           | Incorrect data type                                   | Change access with value that does not match the data type of the parameter                                                                                                                                            | 0                                  |
| 0x06                           | Setting not permitted (may only be reset)             | Change access with value unequal to 0 where this is not permitted                                                                                                                                                      | Subindex                           |
| 0x07                           | Description element cannot be changed                 | Change access to a description element that cannot be changed                                                                                                                                                          | Subindex                           |
| 0x08                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x09                           | No description data available                         | Access to unavailable description <sup>a</sup> (parameter value is available)                                                                                                                                          | 0                                  |
| 0x0A                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x0B                           | No operation priority                                 | Change access without rights to change parameters                                                                                                                                                                      | 0                                  |
| 0x0C                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x0D                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x0E                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x0F                           | No text array available                               | Access to text array that is not available <sup>a</sup> (parameter value is available)                                                                                                                                 | 0                                  |
| 0x10                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x11                           | Request cannot be executed because of operating state | Access is temporarily not possible for reasons that are not specified in detail                                                                                                                                        | 0                                  |
| 0x12                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x13                           | reserved                                              | Compatibility reasons                                                                                                                                                                                                  | -                                  |
| 0x14                           | Value impermissible                                   | Change access with a value that is within the value limits, but is not permissible for other long-term reasons (parameter with defined single values)                                                                  | Subindex                           |
| 0x15                           | Response too long                                     | The length of the current response exceeds the maximum transmittable length of the response transport block. In case of a multi parameter request, the response block was shortened by omitting of parameter requests. | 0                                  |
| 0x16                           | Parameter address impermissible                       | Illegal value (reserved) or value which is not supported for the attribute, illegal or not supported number of elements, illegal parameter number or illegal subindex or a combination <sup>a</sup>                    | 0                                  |
| 0x17                           | Illegal format                                        | Write request: Illegal format or format of the parameter data which is not supported                                                                                                                                   | 0                                  |
| 0x18                           | Number of values are not consistent                   | Write request: Number of the values of the parameter data do not match the number of elements in the parameter address                                                                                                 | 0                                  |

| Error No.<br>= Error<br>value1                                                                                                                                                                                                                                                           | Meaning                                  | Used at                                                                                                                                                                                  | Additional info<br>= Error value 2 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| 0x19                                                                                                                                                                                                                                                                                     | Axis/DO nonexistent                      | Access to an Axis/DO which does not exist                                                                                                                                                | 0                                  |
| 0x1A – 0x1F                                                                                                                                                                                                                                                                              | reserved                                 | -                                                                                                                                                                                        | -                                  |
| 0x20                                                                                                                                                                                                                                                                                     | Parameter text element cannot be changed | Change access to a parameter text element that cannot be changed                                                                                                                         | Subindex                           |
| 0x21                                                                                                                                                                                                                                                                                     | Service not supported                    | Illegal or unknown Request ID (Response ID = 0x80)                                                                                                                                       | -                                  |
| 0x22                                                                                                                                                                                                                                                                                     | Too much parameter requests              | Multi parameter request: The response block does not contain all parameter responses because of maximum number of supported parameter requests per multi parameter request was exceeded. | -                                  |
| 0x23                                                                                                                                                                                                                                                                                     | Multi parameter access not supported     | Device parameter manager does not support multi parameter requests. Request is discarded.                                                                                                | -                                  |
| 0x24 – 0x64                                                                                                                                                                                                                                                                              | reserved                                 | -                                                                                                                                                                                        | -                                  |
| 0x65 – 0xFF                                                                                                                                                                                                                                                                              | Manufacturer-specific                    | -                                                                                                                                                                                        | -                                  |
| <sup>a</sup> In case of multiple errors in the Parameter address, the evaluation of the Parameter address shall be in the order of Attribute, No. of elements, Parameter number and Subindex. Notification of error in Error value1 shall be according to the first error in this order. |                                          |                                                                                                                                                                                          |                                    |

#### 6.2.3.6 Support of data types in Base Mode Parameter Access

For new developments in general all PROFIdrive Controller and PROFIdrive devices should support the standard and profile specific data types according to the definition in Clause 5.

For compatibility reasons, every PROFIdrive Drive Unit shall support Base Mode parameter write requests also with the basic data types Byte, Word and Double Word according to the definition in Table 31 (mandatory).

The PROFIdrive Drive Unit shall behave in the following manner.

- In case of a parameter read request, it shall signal the corresponding matching data type in the read response (e.g. Integer16).
- In case of a parameter write request, it shall check the data type and signal an error if parameter data types do not match. For example, if the request is with basic data type Word and the parameter drive internal representation is with standard data type Integer16, the data types match and the Drive Unit shall accept the request.

If the PROFIdrive Drive Unit does not support any other data types than basic data types Byte, Word and Double Word, it shall behave in the following manner.

- It rejects the parameter write request with an error response if data types do not match.

For compatibility reasons, every PROFIdrive Controller shall be able to also interpret Base Mode parameter responses containing the basic data types Byte, Word and Double Word (mandatory).

The PROFIdrive Controller shall behave in the following manner:

- In case of a parameter write request, it should signal the corresponding matching data type in the write request (e.g. Integer16).
- If the device is ancient and answers the parameter read request with a response using basic data types Byte, Word and Double Word, the controller should accept the response and be able to handle the value.

The error numbers 0x00 – 0x13 are taken from PROFIdrive Profile, Version 2. Values that cannot be assigned are reserved for future use.

### 6.2.3.7 Handling of multi parameter requests

Support of multi parameter access feature for the Base Mode Parameter Access is an optional functionality. Multi parameter access capability helps to reduce transfer time for startup or Parameter Data Base loading use cases significantly.

If a multi parameter request contains more parameter requests than supported by the device parameter manager, the parameter manager shall process as much parameter requests than possible. The response block contains the results of all processed parameter request and should finish with an error block with error code 0x22 at the end. For compatibility reasons it is also possible to omit the error block with error code 0x22.

If the processing of a multi parameter request shows that the size of the response exceeds the maximum block size of the response block, the parameter manager shall process as much parameter requests as fit into the response block. The response block contains the results of all processed parameter request and should be closed with an error block with error code 0x15. For compatibility reasons it is also possible to omit the error block with error code 0x15.

If an error with error number 0x05, 0x16, 0x17 or 0x18 occurs while processing a multi parameter change value request, all further parameter requests in the multi parameter request shall be aborted.

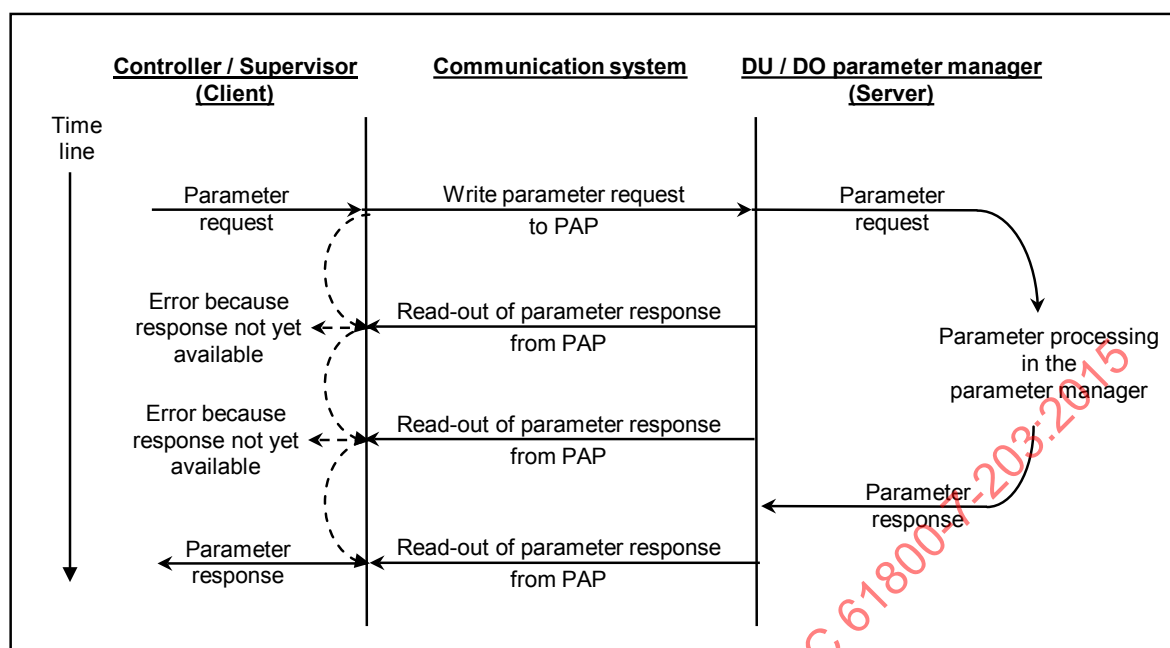
### 6.2.3.8 Data flow for Base Mode Parameter Access

The transfer of the Base Mode Parameter Access request to the DO/DU parameter manager is done by writing the request data structure onto the Parameter Access Point (PAP) data record. When the write operation finishes, the parameter manager state machine is triggered according to Figure 24 and Table 33.

The transfer of the Base Mode Parameter Access response from the DO/DU parameter manager back to the client is done by reading the response data structure out of the Parameter Access Point (PAP) data record. The response to the read access is dependent on the internal state of the parameter manager according to Figure 24 and Table 33.

Note, that the data flow according to Figure 24 and the related state machine defined in Table 33 is valid for exactly one connection. If several connections have been set up, then the appropriate number of state machines shall be available and every connection is assigned a separate state machine.





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Figure 24 – Data flow for Base Mode Parameter Access

Table 33 – General state machine for the parameter manager processing

| Event<br>(Communication)      |                  | State (parameter manager)        |                                  |                                  |                                                     |
|-------------------------------|------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------------------------|
|                               |                  | Connection disconnected          | Idle                             | Request being processed          | Response available                                  |
| Connection being established  | Action           |                                  | Reset processing                 |                                  |                                                     |
|                               | Subsequent state | Idle                             | Idle                             |                                  |                                                     |
| Connection being disconnected | Action           | (ignore)                         | Reset processing                 |                                  |                                                     |
|                               | Subsequent state | -                                | Connection disconnected          |                                  |                                                     |
| Write.req                     | Action           | (protocol error)<br>Write.res(-) | Start processing<br>Write.res(+) | Write.res(-)<br>"state conflict" | Reject response<br>Start processing<br>Write.res(+) |
|                               | Subsequent state | -                                | Request being processed          | -                                | Request being processed                             |
| Read.req                      | Action           | (protocol error)<br>Read.res(-)  | Read.res(-)<br>"state conflict"  |                                  | Read.res(+)                                         |
|                               | Subsequent state | -                                | -                                |                                  | Idle                                                |
| Processing completed          | Action           | Reject                           | Reject                           |                                  | (internal error)<br>reject                          |
|                               | Subsequent state | -                                | -                                | Response available               | -                                                   |

The columns of this table specify the state. The rows explain an event. Every row is subdivided into two fields. One describes the action and the other the subsequent state.

### 6.2.3.9 Telegram sequences for Parameter Access

#### 6.2.3.9.1 General

The Telegram sequences are given in Table 34 to Table 69.

#### 6.2.3.9.2 Sequence 1: Request parameter value, single

**Table 34 – Sequence 1: Parameter request**

| Block definition  | Byte n                    | Byte n+1                          | n  |
|-------------------|---------------------------|-----------------------------------|----|
| Request header    | Request reference         | Request ID =<br>Request parameter | 0  |
|                   | DO-ID = 0                 | No. of parameters = 1             | 2  |
| Parameter address | Attribute = Value         | No. of elements = 0               | 4  |
|                   | Parameter number          |                                   |    |
|                   | Subindex = 0 (irrelevant) |                                   |    |
|                   |                           |                                   | 10 |

**Table 35 – Sequence 1: Parameter response positive with data of data type Word**

| Block definition | Byte n                | Byte n+1                               | n |
|------------------|-----------------------|----------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2 |
| Parameter value  | Format = Word         | No. of values = 1                      | 4 |
|                  | Value                 |                                        | 6 |
|                  |                       |                                        | 8 |

**Table 36 – Sequence 1: Parameter response positive with data of data type Double word**

| Block definition | Byte n                | Byte n+1                               | n  |
|------------------|-----------------------|----------------------------------------|----|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0  |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2  |
| Parameter value  | Format = Double word  | No. of values = 1                      | 4  |
|                  | Value                 |                                        | 6  |
|                  |                       |                                        | 10 |

**Table 37 – Sequence 1: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                               | n |
|------------------|-----------------------|----------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2 |
| Parameter value  | Format = Error        | No. of values = 1                      | 4 |
|                  | Error value           |                                        | 6 |
|                  |                       |                                        | 8 |

**6.2.3.9.3 Sequence 2: Change parameter value, single****Table 38 – Sequence 2: Parameter request**

| Block definition  | Byte n                    | Byte n+1                         | n  |
|-------------------|---------------------------|----------------------------------|----|
| Request header    | Request reference         | Request ID =<br>Change parameter | 0  |
|                   | DO-ID = 0                 | No. of parameters = 1            | 2  |
| Parameter address | Attribute = Value         | No. of elements = 0              | 4  |
|                   | Parameter number          |                                  |    |
|                   | Subindex = 0 (irrelevant) |                                  |    |
| Parameter value   | Format = Word             | No. of values = 1                | 10 |
|                   | Value                     |                                  | 12 |
|                   |                           |                                  | 14 |

**Table 39 – Sequence 2: Parameter response, positive**

| Block definition | Byte n                | Byte n+1                              | n |
|------------------|-----------------------|---------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Change parameter (+) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                 | 2 |
|                  |                       |                                       | 4 |

**Table 40 – Sequence 2: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                              | n |
|------------------|-----------------------|---------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Change parameter (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                 | 2 |
| Parameter value  | Format = Error        | No. of values = 1                     | 4 |
|                  | Error value           |                                       | 6 |
|                  |                       |                                       | 8 |

#### 6.2.3.9.4 Sequence 3: Request parameter value, several array elements

**Table 41 – Sequence 3: Parameter request**

| Block definition  | Byte n            | Byte n+1                          | n  |
|-------------------|-------------------|-----------------------------------|----|
| Request header    | Request reference | Request ID =<br>Request parameter | 0  |
|                   | DO-ID = 0         | No. of parameters = 1             | 2  |
| Parameter address | Attribute = Value | No. of elements = 5               | 4  |
|                   | Parameter number  |                                   |    |
|                   | Subindex = 0      |                                   |    |
|                   |                   |                                   | 10 |

**Table 42 – Sequence 3: Parameter response, positive**

| Block definition | Byte n                | Byte n+1                               | n  |
|------------------|-----------------------|----------------------------------------|----|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0  |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2  |
| Parameter value  | Format = Word         | No. of values = 5                      | 4  |
|                  | Value 1               |                                        | 6  |
|                  | Value 2               |                                        |    |
|                  | Value 3               |                                        |    |
|                  | Value 4               |                                        |    |
|                  | Value 5               |                                        |    |
|                  |                       |                                        | 16 |

**Table 43 – Sequence 3: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                               | n |
|------------------|-----------------------|----------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2 |
| Parameter value  | Format = Error        | No. of values = 1                      | 4 |
|                  | Error value           |                                        | 6 |
|                  |                       |                                        | 8 |

**6.2.3.9.5 Sequence 4: Change parameter value, several array elements****Table 44 – Sequence 4: Parameter request**

| Block definition  | Byte n            | Byte n+1                         | n  |
|-------------------|-------------------|----------------------------------|----|
| Request header    | Request reference | Request ID =<br>Change parameter | 0  |
|                   | DO-ID = 0         | No. of parameters = 1            | 2  |
| Parameter address | Attribute = Value | No. of elements = 5              | 4  |
|                   | Parameter number  |                                  |    |
|                   | Subindex = 125    |                                  |    |
| Parameter value   | Format = Word     | No. of values = 5                | 10 |
|                   | Value 1           |                                  | 12 |
|                   | Value 2           |                                  |    |
|                   | Value 3           |                                  |    |
|                   | Value 4           |                                  |    |
|                   | Value 5           |                                  |    |
|                   |                   |                                  | 22 |

**Table 45 – Sequence 4: Parameter response, positive**

| Block definition | Byte n                | Byte n+1                              | n |
|------------------|-----------------------|---------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Change parameter (+) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                 | 2 |
|                  |                       |                                       | 4 |

**Table 46 – Sequence 4: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                              | n |
|------------------|-----------------------|---------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Change parameter (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                 | 2 |
| Parameter value  | Format = Error        | No. of values = 1                     | 4 |
|                  | Error value           |                                       | 6 |
|                  |                       |                                       | 8 |

**6.2.3.9.6 Sequence 5: Change parameter value, several array elements, Format Byte**

**Table 47 – Sequence 5: Parameter request**

| Block definition  | Byte n            | Byte n+1                         | n  |
|-------------------|-------------------|----------------------------------|----|
| Request header    | Request reference | Request ID =<br>Change parameter | 0  |
|                   | DO-ID = 0         | No. of parameters = 1            | 2  |
| Parameter address | Attribute = Value | No. of elements = 7              | 4  |
|                   | Parameter number  |                                  |    |
|                   | Subindex = 110    |                                  |    |
| Parameter value   | Format = Byte     | No. of values = 7                | 10 |
|                   | Value 1           | Value 2                          | 12 |
|                   | Value 3           | Value 4                          |    |
|                   | Value 5           | Value 6                          |    |
|                   | Value 7           | Dummy byte                       | 18 |

**Table 48 – Sequence 5: Parameter response, positive**

| Block definition | Byte n                | Byte n+1                              | n |
|------------------|-----------------------|---------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Change parameter (+) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                 | 2 |
|                  |                       |                                       | 4 |

**Table 49 – Sequence 5: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                              | n |
|------------------|-----------------------|---------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Change parameter (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                 | 2 |
| Parameter value  | Format = Error        | No. of values = 1                     | 4 |
|                  | Error value           |                                       | 6 |
|                  |                       |                                       | 8 |

**6.2.3.9.7 Sequence 6: Request parameter value, multi-parameter****Table 50 – Sequence 6: Parameter request**

| Block definition      | Byte n            | Byte n+1                          | n  |
|-----------------------|-------------------|-----------------------------------|----|
| Request header        | Request reference | Request ID =<br>Request parameter | 0  |
|                       | DO-ID = 0         | No. of parameters = 3             | 2  |
| 1st Parameter address | Attribute = Value | No. of elements = 1               | 4  |
|                       | Parameter number  |                                   |    |
|                       | Subindex = 7      |                                   |    |
| 2nd Parameter address | Attribute = Value | No. of elements = 100             | 10 |
|                       | Parameter number  |                                   |    |
|                       | Subindex = 0      |                                   |    |
| 3rd Parameter address | Attribute = Value | No. of elements = 2               | 16 |
|                       | Parameter number  |                                   |    |
|                       | Subindex = 13     |                                   |    |
|                       |                   |                                   | 22 |

**Table 51 – Sequence 6: Parameter response (+): all partial accesses OK**

| Block definition       | Byte n                | Byte n+1                               | n   |
|------------------------|-----------------------|----------------------------------------|-----|
| Response header        | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0   |
|                        | DO-ID mirrored        | No. of parameters = 3                  | 2   |
| 1st Parameter value(s) | Format = Word         | No. of values = 1                      | 4   |
|                        | Value                 |                                        | 6   |
| 2nd Parameter value(s) | Format = Word         | No. of values = 100                    | 8   |
|                        | Value 1               |                                        | 10  |
|                        | Value 2               |                                        |     |
|                        | ...                   |                                        |     |
|                        | Value 100             |                                        |     |
| 3rd Parameter value(s) | Format = Double word  | No. of values = 2                      | 210 |
|                        | Value 1               |                                        | 212 |
|                        |                       |                                        |     |
|                        | Value 2               |                                        |     |
|                        |                       |                                        | 220 |

**Table 52 – Sequence 6: Parameter response (-): first and third partial access OK, second partial access erroneous**

| Block definition       | Byte n                | Byte n+1                            | n  |
|------------------------|-----------------------|-------------------------------------|----|
| Response header        | Request ref. mirrored | Response ID = Request parameter (-) | 0  |
|                        | DO-ID mirrored        | No. of parameters = 3               | 2  |
| 1st Parameter value(s) | Format = Word         | No. of values = 1                   | 4  |
|                        | Value                 |                                     | 6  |
| 2nd Parameter value(s) | Format = Error        | No. of values = 1                   | 8  |
|                        | Error value           |                                     | 10 |
| 3rd Parameter value(s) | Format = Double word  | No. of values = 2                   | 12 |
|                        | Value 1               |                                     | 14 |
|                        |                       |                                     |    |
|                        | Value 2               |                                     |    |
|                        |                       |                                     | 22 |

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**6.2.3.9.8 Sequence 7: Change parameter value, multi-parameter****Table 53 – Sequence 7: Parameter request**

| Block definition       | Byte n               | Byte n+1                         | n   |
|------------------------|----------------------|----------------------------------|-----|
| Request header         | Request reference    | Request ID =<br>Change parameter | 0   |
|                        | DO-ID = 0            | No. of parameters = 3            | 2   |
| 1st Parameter address  | Attribute = Value    | No. of elements = 1              | 4   |
|                        | Parameter number     |                                  |     |
|                        | Subindex = 7         |                                  |     |
| 2nd Parameter address  | Attribute = Value    | No. of elements = 100            | 10  |
|                        | Parameter number     |                                  |     |
|                        | Subindex = 0         |                                  |     |
| 3rd Parameter address  | Attribute = Value    | No. of elements = 2              | 16  |
|                        | Parameter number     |                                  |     |
|                        | Subindex = 13        |                                  |     |
| 1st Parameter value(s) | Format = Word        | No. of values = 1                | 22  |
|                        | Value                |                                  | 24  |
| 2nd Parameter value(s) | Format = Word        | No. of values = 100              | 26  |
|                        | Value 1              |                                  | 28  |
|                        | Value 2              |                                  |     |
|                        | ...                  |                                  |     |
|                        | Value 100            |                                  |     |
| 3rd Parameter value(s) | Format = Double word | No. of values = 2                | 228 |
|                        | Value 1              |                                  | 230 |
|                        |                      |                                  |     |
|                        | Value 2              |                                  |     |
|                        |                      |                                  | 238 |

**Table 54 – Sequence 7: Parameter response (+): all partial accesses OK**

| Block definition | Byte n                | Byte n+1                              | n |
|------------------|-----------------------|---------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Change parameter (+) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 3                 | 2 |
|                  |                       |                                       | 4 |

**Table 55 – Sequence 7: Parameter response (-):  
first and third partial access OK, second partial access erroneous**

| Block definition       | Byte n                | Byte n+1                              | n  |
|------------------------|-----------------------|---------------------------------------|----|
| Response header        | Request ref. mirrored | Response ID =<br>Change parameter (-) | 0  |
|                        | DO-ID mirrored        | No. of parameters = 3                 | 2  |
| 1st Parameter value(s) | Format = Zero         | No. of values = 0                     | 4  |
| 2nd Parameter value(s) | Format = Error        | No. of values = 2                     | 6  |
|                        | Error value           |                                       | 8  |
|                        | Erroneous subindex    |                                       | 10 |
| 3rd Parameter value(s) | Format = Zero         | No. of values = 0                     | 12 |
|                        |                       |                                       | 14 |

#### 6.2.3.9.9 Sequence 8: Request description, single

**Table 56 – Sequence 8: Parameter request**

| Block definition  | Byte n                  | Byte n+1                          | n  |
|-------------------|-------------------------|-----------------------------------|----|
| Request header    | Request reference       | Request ID =<br>Request parameter | 0  |
|                   | DO-ID = 0               | No. of parameters = 1             | 2  |
| Parameter address | Attribute = Description | No. of elements = 1               | 4  |
|                   | Parameter number        |                                   |    |
|                   | Subindex = n            |                                   |    |
|                   |                         |                                   | 10 |

**Table 57 – Sequence 8: Parameter response positive with data  
of the data type word (for example ID)**

| Block definition | Byte n                | Byte n+1                               | n |
|------------------|-----------------------|----------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2 |
| Parameter value  | Format = Word         | No. of values = 1                      | 4 |
|                  | Value                 |                                        | 6 |
|                  |                       |                                        | 8 |

**Table 58 – Sequence 8: Parameter response positive with text**

| Block definition | Byte n                | Byte n+1                               | n   |
|------------------|-----------------------|----------------------------------------|-----|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0   |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2   |
| Parameter value  | Format = Byte         | No. of values = 16                     | 4   |
|                  | Byte 1                | Byte 2                                 | 6   |
|                  | ...                   | ...                                    | ... |
|                  | Byte 15               | Byte 16                                | ... |
|                  |                       |                                        | 22  |

**Table 59 – Sequence 8: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                               | n |
|------------------|-----------------------|----------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2 |
| Parameter value  | Format = Error        | No. of values = 1                      | 4 |
|                  | Error value           |                                        | 6 |
|                  |                       |                                        | 8 |

**6.2.3.9.10 Sequence 9: Request description, complete****Table 60 – Sequence 9: Parameter request**

| Block definition  | Byte n                  | Byte n+1                            | n  |
|-------------------|-------------------------|-------------------------------------|----|
| Request header    | Request reference       | Request ID =<br>Request parameter   | 0  |
|                   | DO-ID = 0               | No. of parameters = 1               | 2  |
| Parameter address | Attribute = Description | No. of elements = 0<br>(irrelevant) | 4  |
|                   | Parameter number        |                                     |    |
|                   | Subindex = 0 (!)        |                                     |    |
|                   |                         |                                     | 10 |

**Table 61 – Sequence 9: Parameter response, positive**

| Block definition | Byte n                | Byte n+1                               | n               |
|------------------|-----------------------|----------------------------------------|-----------------|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0               |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2               |
| Parameter value  | Format = Byte         | No. of values = (Bytes)                | 4               |
|                  | ID                    |                                        | 6               |
|                  | (etc.)                |                                        |                 |
|                  | ...                   | ...                                    |                 |
|                  |                       |                                        |                 |
|                  | ...                   | ...                                    |                 |
|                  |                       |                                        | 6 + Description |

**Table 62 – Sequence 9: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                               | n |
|------------------|-----------------------|----------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2 |
| Parameter value  | Format = Error        | No. of values = 1                      | 4 |
|                  | Error value           |                                        | 6 |
|                  |                       |                                        | 8 |

#### 6.2.3.9.11 Sequence 10: Request text, single

**Table 63 – Sequence 10: Parameter request**

| Block definition  | Byte n            | Byte n+1                          | n  |
|-------------------|-------------------|-----------------------------------|----|
| Request header    | Request reference | Request ID =<br>Request parameter | 0  |
|                   | DO-ID = 0         | No. of parameters = 1             | 2  |
| Parameter address | Attribute = Text  | No. of elements = 1               | 4  |
|                   | Parameter number  |                                   |    |
|                   | Subindex = n      |                                   |    |
|                   |                   |                                   | 10 |

**Table 64 – Sequence 10: Parameter response, positive**

| Block definition | Byte n                | Byte n+1                               | n   |
|------------------|-----------------------|----------------------------------------|-----|
| Response header  | Request ref. mirrored | Response ID =<br>Request parameter (+) | 0   |
|                  | DO-ID mirrored        | No. of parameters = 1                  | 2   |
| Parameter value  | Format = Byte         | No. of values = 16                     | 4   |
|                  | Byte 1                | Byte 2                                 | 6   |
|                  | ...                   | ...                                    | ... |
|                  | Byte 15               | Byte 16                                | ... |
|                  |                       |                                        | 22  |

**Table 65 – Sequence 10: Parameter response, negative**

| Block definition | Byte n                | Byte n+1                                 | n |
|------------------|-----------------------|------------------------------------------|---|
| Response header  | Request ref. mirrored | Response ID =<br>Request description (-) | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1                    | 2 |
| Parameter value  | Format = Error        | No. of values = 1                        | 4 |
|                  | Error value           |                                          | 6 |
|                  |                       |                                          | 8 |

**6.2.3.9.12 Sequence 11: Request parameter, multi-parameter, various attributes****Table 66 – Sequence 11: Request of values, description and text in one request**

| Block definition      | Byte n                  | Byte n+1                          | n  |
|-----------------------|-------------------------|-----------------------------------|----|
| Request header        | Request reference       | Request ID =<br>Request parameter | 0  |
|                       | DO-ID = 0               | No. of parameters = 3             | 2  |
| 1st Parameter address | Attribute = Value       | No. of elements = 3               | 4  |
|                       | Parameter number        |                                   |    |
|                       | Subindex = 0            |                                   |    |
| 2nd Parameter address | Attribute = Description | No. of elements = 0               | 10 |
|                       | Parameter number        |                                   |    |
|                       | Subindex = 0            |                                   |    |
| 3rd Parameter address | Attribute = Text        | No. of elements = 3               | 16 |
|                       | Parameter number        |                                   |    |
|                       | Subindex = 0            |                                   |    |
|                       |                         |                                   | 22 |

**Table 67 – Sequence 11: Parameter response (+): all partial accesses OK**

| Block definition                               | Byte n                | Byte n+1                            | n                |
|------------------------------------------------|-----------------------|-------------------------------------|------------------|
| Response header                                | Request ref. mirrored | Response ID = Request parameter (+) | 0                |
|                                                | DO-ID mirrored        | No. of parameters = 3               | 2                |
| 1st Parameter values<br>(three values)         | Format = Word         | No. of values = 3                   | 4                |
|                                                | Value 1               |                                     |                  |
|                                                | Value 2               |                                     |                  |
|                                                | Value 3               |                                     |                  |
| 2nd Parameter values<br>(complete description) | Format = Byte         | No. of values = (Bytes)             | 12               |
|                                                | ID                    |                                     |                  |
|                                                | (etc.)                |                                     |                  |
|                                                | ...                   |                                     |                  |
|                                                |                       |                                     |                  |
| 3rd Parameter values<br>(three texts)          | Format = Byte         | No. of values = 48                  | 12 + Description |
|                                                | Byte 1                | Byte 2                              |                  |
|                                                | ...                   | ...                                 |                  |
|                                                | Byte 47               | Byte 48                             |                  |
|                                                |                       |                                     | 62 + Description |

#### 6.2.3.9.13 Sequence 12: Request parameter, multi-parameter, faulty request header

**Table 68 – Sequence 12: Request of values, header with illegal Request ID**

| Block definition      | Byte n                  | Byte n+1              | n  |
|-----------------------|-------------------------|-----------------------|----|
| Request header        | Request reference       | Request ID = 0        | 0  |
|                       | DO-ID = 0               | No. of parameters = 3 | 2  |
| 1st Parameter address | Attribute = Value       | No. of elements = 3   | 4  |
|                       | Parameter number        |                       |    |
|                       | Subindex = 0            |                       |    |
| 2nd Parameter address | Attribute = Description | No. of elements = 0   | 10 |
|                       | Parameter number        |                       |    |
|                       | Subindex = 0            |                       |    |
| 3rd Parameter address | Attribute = Text        | No. of elements = 3   | 16 |
|                       | Parameter number        |                       |    |
|                       | Subindex = 0            |                       |    |
|                       |                         |                       | 22 |

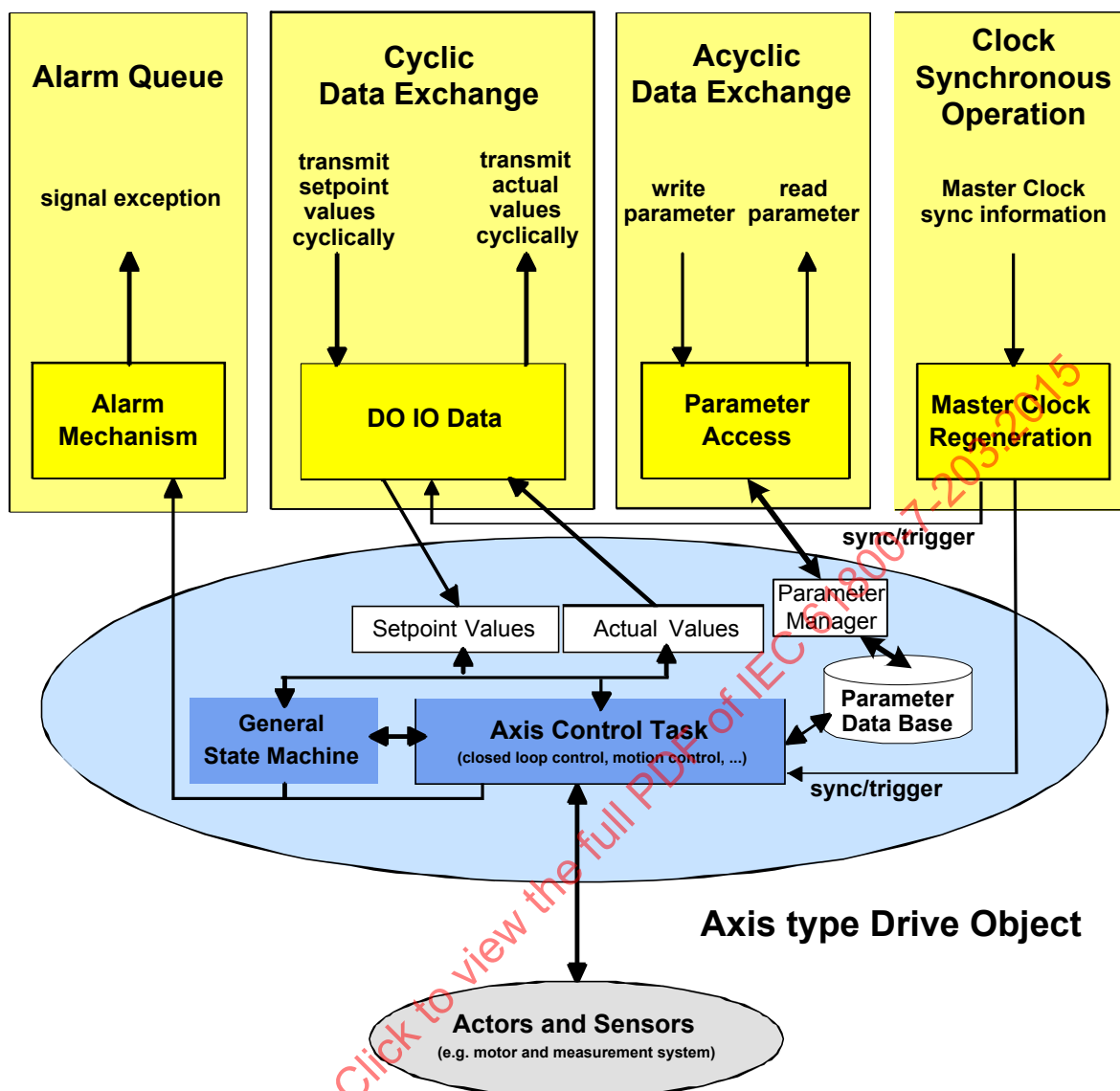
**Table 69 – Sequence 12: Parameter response (-): service not supported**

| Block definition | Byte n                | Byte n+1              | n |
|------------------|-----------------------|-----------------------|---|
| Response header  | Request ref. mirrored | Response ID = 0x80    | 0 |
|                  | DO-ID mirrored        | No. of parameters = 1 | 2 |
| Parameter value  | Format = Error        | No. of values = 1     | 4 |
|                  | Error value = 0x21    |                       | 6 |
|                  |                       |                       | 8 |

### 6.3 Drive control application process

#### 6.3.1 General Axis type Drive Object architecture

Figure 25 shows the functional elements of the Axis type Drive Object (DO). The central element of the Axis type DO is the Axis Control Task which is responsible for the control of the related Axis. Properties of the DO and the Axis Control Task are represented and controlled by parameters. The parameters are administered in the Parameter Data Base. To access DO parameters, the Acyclic Data Exchange service is used in interaction with the parameter manager. The parameter manager receives parameter requests, performs the access to the Parameter Data Base and answers to the parameter request with a related parameter response. For periodic transportation of setpoint values to the Axis and actual values from the Axis DO, the Cyclic Data Exchange service is used. The Axis type DO comprises the General State Machine, which controls and represents the states of the Axis Control Task. Exception situations out of the Axis Control Task and the General State Machine may be signalled by the Alarm Mechanism to the controlling device. For Clock Synchronous Operation of several DOs (Axis), the Clock Synchronous Operation service shall be used to trigger the relevant control tasks.



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**Figure 25 – General functional elements of the PROFIdrive Axis type DO**

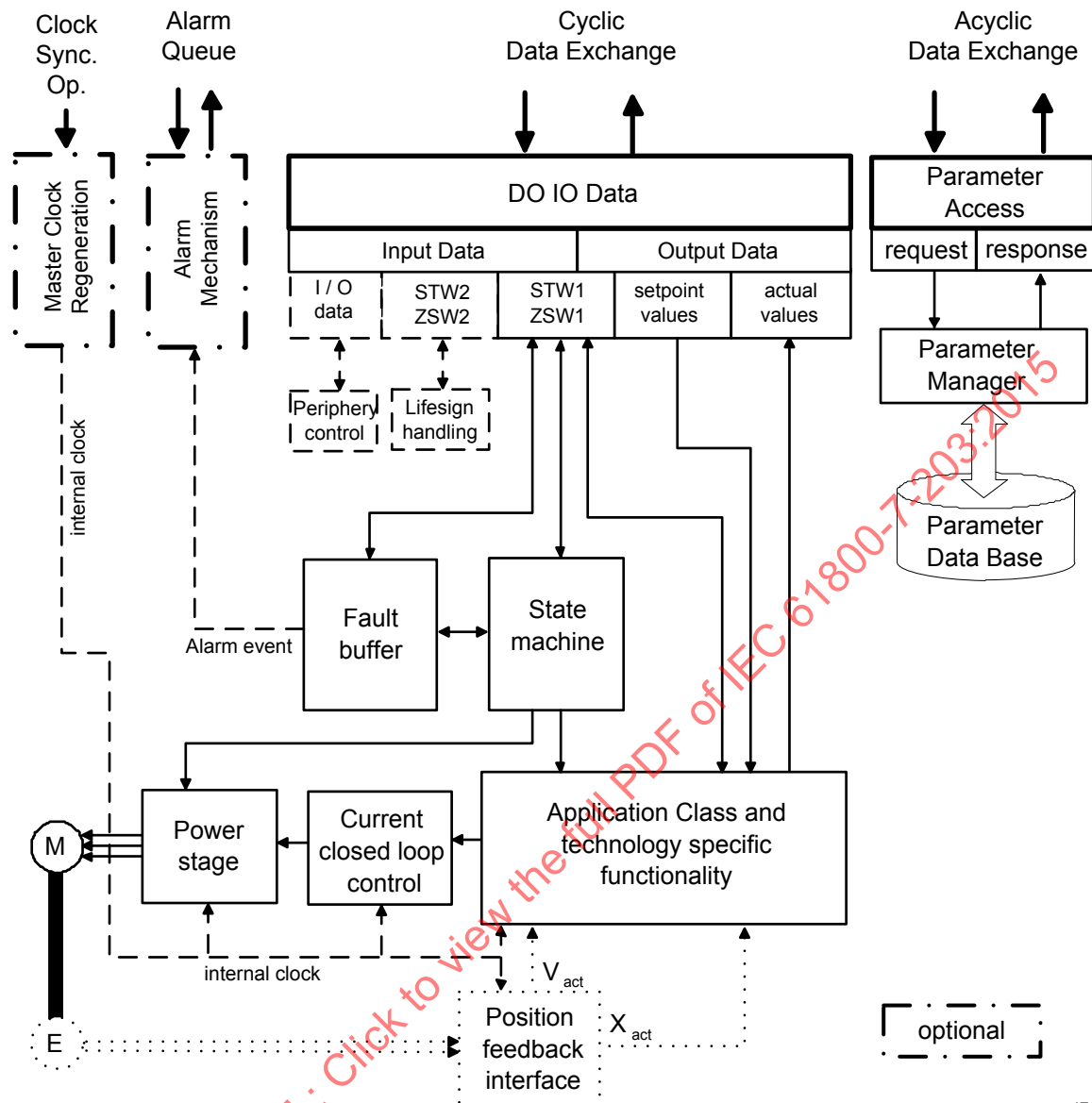
The Axis type DO shall comprise the following mandatory functionalities:

- Parameters,
- Axis Control Task,
- General State Machine,
- DO IO Data (setpoint values and actual values).

The Axis type DO may comprise as optional functionalities:

- support of Alarm Mechanism,
- Clock Synchronous Operation of Axis Control Task.





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**Figure 26 – Functional block diagram of the PROFIdrive Axis type DO**

Figure 26 shows the more detailed functional architecture of the Axis type DO. The Axis Control Task is subdivided into the following elements:

- fault buffer,
- position feedback interface,
- power stage,
- current closed loop control,
- life sign handling,
- peripheral control,
- Application Class and technology specific functionality.

Depending on the level of the drive interface, the PROFIdrive Axis may operate in different control modes. These general control modes are related to one or more of the PROFIdrive Application Classes. For more details on the control modes, refer to 6.3.3.

### 6.3.2 Control and status words

#### 6.3.2.1 General

To improve the exchange of devices of different manufacturers in a control application, it is strongly recommend to use the device-specific bits only for the control of manufacturer-specific functions. The device-specific bits shall not be necessary for the operation of a device in the speed control mode and in the positioning mode (default of the device-specific bits = 0).

#### 6.3.2.2 Control word 1 (STW1)

The structure of the control word 1 is shown in Table 70.

**Table 70 – Overview on the assignment of the bits of control word 1**

| Bit      | Significance                                       |                                                           |
|----------|----------------------------------------------------|-----------------------------------------------------------|
|          | Speed control mode                                 | Positioning mode                                          |
| 0        | ON/OFF                                             |                                                           |
| 1        | No Coast Stop/Coast Stop (no OFF2/OFF 2)           |                                                           |
| 2        | No Quick Stop/Quick Stop (no OFF3/OFF 3)           |                                                           |
| 3        | Enable Operation/Disable Operation                 |                                                           |
| 4        | Enable Ramp Generator /<br>Reset Ramp Generator    | Do Not Reject Traversing Task /<br>Reject Traversing Task |
| 5        | Unfreeze Ramp Generator /<br>Freeze Ramp Generator | No Intermediate Stop /<br>Intermediate Stop               |
| 6        | Enable Setpoint/Disable Setpoint                   | Activate Traversing Task<br>(0 -> 1)                      |
| 7        | Fault Acknowledge (0 -> 1)                         |                                                           |
| 8        | Jog 1 ON <sup>a</sup> /Jog 1 OFF <sup>a</sup>      |                                                           |
| 9        | Jog 2 ON <sup>a</sup> /Jog 2 OFF <sup>a</sup>      |                                                           |
| 10       | Control By PLC/No Control By PLC                   |                                                           |
| 11       | Device-specific                                    | Start Homing Procedure/Stop Homing Procedure              |
| 12 to 15 | Device-specific                                    |                                                           |

The significance for bit value = 1 is to the left of the slash; bit value = 0 to the right.

NOTE Using the closed-loop speed controlled mode in Application Class 4 with or without DSC (positioning with central interpolation and positioning control), the STW1 bit 4 and 6 ("Enable/Reset Ramp Generator" and "Enable/Disable Setpoint") keep their effectiveness; STW1 bit 5 ("Unfreeze/Freeze Ramp Generator") can be with or without effect. If STW1 bit 5 is without effect, this is indicated by parameter PNU930 = 3.

<sup>a</sup> Optional.

Table 71 lists the common control bits, Table 72 and Table 73 lists the control bits where speed control (AC 4) and positioning modes (AC 3) differ.

**Table 71 – Detailed assignment of the common control word 1 bits (STW1) for speed control/positioning**

| Bit      | Value | Significance                  | Comments                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|-------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | 1     | ON                            | "Switched on" condition; voltage at the power converter, i.e. the main contact is closed (if present).                                                                                                                                                                                                                                                                                                 |
|          | 0     | OFF<br>(OFF 1)                | Power-down (the drive returns to the "Ready For Switching On" condition); the drive is ramped-down along the ramp (RFG) or along the current limit or along the voltage limit of the d.c. link; if standstill is detected, the voltage is isolated; the main contact is opened (if present). During deceleration, bit 1 of ZSW1 is still set.<br>An OFF command is interruptible.                      |
| 1        | 1     | No Coast Stop<br>(no OFF 2)   | All "Coast Stop (OFF2)" commands are withdrawn.                                                                                                                                                                                                                                                                                                                                                        |
|          | 0     | Coast Stop<br>(OFF 2)         | Voltage is isolated.<br>The main contact is then opened (if present) and the drive goes into the "Switching On Inhibited" condition; the motor coasts down to a standstill.                                                                                                                                                                                                                            |
| 2        | 1     | No Quick Stop<br>(no OFF 3)   | All "Quick Stop (OFF3)" commands are withdrawn.                                                                                                                                                                                                                                                                                                                                                        |
|          | 0     | Quick Stop<br>(OFF 3)         | Quick stop; if required, withdraw the operating enable, the drive is decelerated as fast as possible, for example along the current limit or at the voltage limit of the d.c. link, at $n/f = 0$ ; if the rectifier pulses are disabled, the voltage is isolated (the contact is opened) and the drive goes into the "Switching On Inhibited" condition.<br>A Quick Stop command is not interruptible. |
| 3        | 1     | Enable Operation              | Enable electronics and pulses<br>The drive then runs-up to the setpoint.                                                                                                                                                                                                                                                                                                                               |
|          | 0     | Disable Operation             | The drive coasts down to a standstill (ramp-function generator to 0 or tracking) and goes into the "Switched on" condition (refer to control word 1, bit 0).                                                                                                                                                                                                                                           |
| 7        | 1     | Fault Acknowledge<br>(0 -> 1) | The group signal is acknowledged with a positive edge; the drive reaction to a fault depends on the type of fault. If the fault reaction has isolated the voltage, the drive then goes into the "Switching On Inhibited" condition.                                                                                                                                                                    |
|          | 0     | No significance               |                                                                                                                                                                                                                                                                                                                                                                                                        |
| 10       | 1     | Control By PLC                | Control via interface, DO IO Data valid (refer to 6.3.11).                                                                                                                                                                                                                                                                                                                                             |
|          | 0     | No Control By PLC             | DO IO Data not valid; expect Sign-Of-Life. In the case of loss of the control priority bit, the reaction is device-specific.<br><br>Possible reactions:<br>1) speed control: "old" Process data is kept,<br>2) positioning: DO IO Data are set to 0.                                                                                                                                                   |
| 12 to 15 |       | device-specific               | Definition not specified.                                                                                                                                                                                                                                                                                                                                                                              |

**Table 72 – Detailed assignment of the special control word 1 bits (STW1) for speed control mode**

| Bit                    | Value | Significance            | Comments                                                                                                                                                                                                |
|------------------------|-------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                      | 1     | Enable Ramp Generator   |                                                                                                                                                                                                         |
|                        | 0     | Reset Ramp Generator    | Output of the RFG is set to 0. The main contact remains closed, the converter is not isolated from the line, the drive decelerates along the current limit or along the voltage limit of the d.c. link. |
| 5                      | 1     | Unfreeze Ramp Generator |                                                                                                                                                                                                         |
|                        | 0     | Freeze Ramp Generator   | Freeze the actual setpoint entered by the ramp-function generator. If Application Class 4 is used, Bit 5 may be without effect. No relevance of STW1 bit 5 is indicated by parameter PNU930 = 3.        |
| 6                      | 1     | Enable Setpoint         | The value selected at the input of the RFG is switched-in.                                                                                                                                              |
|                        | 0     | Disable Setpoint        | The value selected at the input of the RFG is set to 0.                                                                                                                                                 |
| 8                      | 1     | Jog 1 ON <sup>a</sup>   | Prerequisite: Operation is enabled, drive is in standstill and STW1 bit 4, 5, 6 = 0. The drive runs up along the ramp of RFG to jogging setpoint 1.                                                     |
|                        | 0     | Jog 1 OFF <sup>a</sup>  | Drive brakes along the ramp of RFG, if "Jog 1" was previously ON, and goes into "Operation Enabled" when drive comes to a standstill.                                                                   |
| 9                      | 1     | Jog 2 ON <sup>a</sup>   | Prerequisite: Operation is enabled, drive is in standstill and STW1 bit 4, 5, 6 = 0. The drive runs up along the ramp of RFG to jogging setpoint 2.                                                     |
|                        | 0     | Jog 2 OFF <sup>a</sup>  | Drive brakes along the ramp of RFG, if "Jog 2" was previously ON, and goes into "Operation Enabled" when drive comes to a standstill.                                                                   |
| 11                     |       | device-specific         | Significance not specified.                                                                                                                                                                             |
| <sup>a</sup> Optional. |       |                         |                                                                                                                                                                                                         |

**Table 73 – Detailed assignment of the special control word 1 bits (STW1) for the positioning mode**

| Bit                    | Value | Significance                      | Comments                                                                                                                                                                                                                              |
|------------------------|-------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                      | 1     | Do Not Reject Traversing Task     | A Traversing Task is activated using the positive signal edge at bit 6.                                                                                                                                                               |
|                        | 0     | Reject Traversing Task            | The drive brakes from an active Traversing Task with maximum acceleration to $n=0$ and remains stationary with the holding torque. The current Traversing Task is rejected.                                                           |
| 5                      | 1     | No Intermediate Stop              | This shall be continually set when executing a Traversing Task.                                                                                                                                                                       |
|                        | 0     | Intermediate Stop                 | Drive brakes from an active Traversing Task to $n = 0$ along a ramp, and remains stationary with the holding torque. The Traversing Task is not rejected. The Traversing Task is continued when bit 5 of control word 1 changes to 1. |
| 6                      |       | Activate Traversing Task (0 -> 1) | The positive signal edge enables a Traversing Task or a new MDI-setpoint.                                                                                                                                                             |
| 8                      | 1     | Jog 1 ON <sup>a</sup>             | Prerequisite: Operation is enabled and no positioning procedure is active. The drive is in variable-speed mode with jogging setpoint 1.                                                                                               |
|                        | 0     | Jog 1 OFF <sup>a</sup>            |                                                                                                                                                                                                                                       |
| 9                      | 1     | Jog 2 ON <sup>a</sup>             | Like Bit 8 with jogging setpoint 2.                                                                                                                                                                                                   |
|                        | 0     | Jog 2 OFF <sup>a</sup>            |                                                                                                                                                                                                                                       |
| 11                     | 1     | Start Homing Procedure            | Homing Procedure is started with a change from 0 to 1. Bit 11 in the status word is set to 0 with the start of the Homing Procedure. Prerequisite: Operation is enabled.                                                              |
|                        | 0     | Stop Homing Procedure             | Homing Procedure in progress is aborted, the drive stops along a ramp.                                                                                                                                                                |
| <sup>a</sup> Optional. |       |                                   |                                                                                                                                                                                                                                       |

### 6.3.2.3 Control word 2 (STW2)

The structure of the control word 2 is shown in Table 74.

**Table 74 – Overview on the assignment of the bits of control word 2**

| Bit                                                                                                                                                                                                                      | Significance                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| 0 to 11                                                                                                                                                                                                                  | Device-specific                      |
| 12 to 15                                                                                                                                                                                                                 | Controller Sign-Of-Life <sup>a</sup> |
| <sup>a</sup> If a clock cycle synchronous application is not implemented, i.e. bits 12 to 15 of control word 2 are not required to transfer the controller Sign-Of-Life, the complete control word 2 may be freely used. |                                      |

### 6.3.2.4 Encoder control word 2 (STW2\_ENC)

The Encoder control word 2 is specially dedicated to telegrams for Encoder DOs and combines control functionality out of STW1 with the Controller Sign-Of-Life out of STW2. The structure of the Encoder control word 2 is shown in Table 75.

**Table 75 – Overview on the assignment of the bits of Encoder control word 2**

| Bit                                                                                         | Significance                     |
|---------------------------------------------------------------------------------------------|----------------------------------|
| 0 to 6                                                                                      | Device-specific                  |
| 7                                                                                           | Fault Acknowledge (0 -> 1)       |
| 8 to 9                                                                                      | Device-specific                  |
| 10                                                                                          | Control By PLC/No Control By PLC |
| 11                                                                                          | Device-specific                  |
| 12 to 15                                                                                    | Controller Sign-Of-Life          |
| The significance for bit value = 1 is to the left of the slash; bit value = 0 to the right. |                                  |

**6.3.2.5 Status word 1 (ZSW1)**

The structure of the status word 1 is shown in Table 76.

**Table 76 – Overview on the assignment of the bits of status word 1**

| Bit      | Significance                                                               |                                                                                    |
|----------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|          | Speed control mode                                                         | Positioning mode                                                                   |
| 0        | Ready To Switch On /Not Ready To Switch On                                 |                                                                                    |
| 1        | Ready To Operate/Not Ready To Operate                                      |                                                                                    |
| 2        | Operation Enabled (drive follows setpoint)/Operation Disabled              |                                                                                    |
| 3        | Fault Present/No Fault                                                     |                                                                                    |
| 4        | Coast Stop Not Activated/Coast Stop Activated (No OFF2/OFF2)               |                                                                                    |
| 5        | Quick Stop Not Activated/Quick Stop Activated (No OFF3/OFF3)               |                                                                                    |
| 6        | Switching On Inhibited/Switching On Not Inhibited                          |                                                                                    |
| 7        | Warning Present/No Warning                                                 |                                                                                    |
| 8        | Speed Error Within Tolerance Range /<br>Speed Error Out Of Tolerance Range | Following Error Within Tolerance Range /<br>Following Error Out Of Tolerance Range |
| 9        | Control Requested/No Control Requested                                     |                                                                                    |
| 10       | f Or n Reached Or Exceeded /<br>f Or n Not Reached                         | Target Position Reached /<br>Not At Target Position                                |
| 11       | Device-specific                                                            | Home Position Set/Home Position Not Yet Set                                        |
| 12       | Device-specific                                                            | Traversing Task Acknowledgement<br>(0 -> 1)                                        |
| 13       | Device-specific                                                            | Drive Stopped/Drive Moving                                                         |
| 14 to 15 | Device-specific                                                            |                                                                                    |

The significance for bit value = 1 is left of the slash; bit value = 0 to the right.

The common status bits are shown in Table 77 and the status bits which differ for the speed control (AC 4) and positioning (AC 3) in Table 78 and Table 79.

**Table 77 – Detailed assignment of the common status word 1 bits (ZSW1)  
for the speed control /positioning mode**

| Bit      | Value | Significance                           | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|-------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | 1     | Ready To Switch On                     | Power supply is switched on, electronics initialised, main contactor, if available, has switched off, pulses are inhibited.                                                                                                                                                                                                                                                                                                                                                                    |
|          | 0     | Not Ready To Switch On                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1        | 1     | Ready To Operate                       | Refer to control word 1, bit 0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|          | 0     | Not Ready To Operate                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2        | 1     | Operation Enabled                      | Drive follows setpoint. This means that the electronic and pulses are enabled (Refer to control word 1, bit 3), the closed loop control is active and controls the motor and the output of the setpoint channel is the input for the closed loop control.                                                                                                                                                                                                                                      |
|          | 0     | Operation Disabled                     | Either the pulses are disabled or the drive does not follow the output value of the setpoint channel.                                                                                                                                                                                                                                                                                                                                                                                          |
| 3        | 1     | Fault Present                          | Unacknowledged faults or currently not acknowledgeable faults (fault messages) are present (in the fault buffer). The fault reaction is fault-specific and device-specific. The acknowledging of a fault may only be successful if the fault cause has disappeared or has been removed before. If the fault has isolated the voltage, the drive goes into the "Switching On Inhibited" condition, otherwise the drive returns to operation. The related fault numbers are in the fault buffer. |
|          | 0     | No Fault                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 4        | 1     | Coast Stop Not Activated<br>(No OFF 2) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|          | 0     | Coast Stop Activated<br>(OFF 2)        | "Coast Stop (OFF 2)" command is present.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 5        | 1     | Quick Stop Not Activated<br>(No OFF 3) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|          | 0     | Quick Stop Activated<br>(OFF 3)        | "Quick Stop (OFF 3)" command is present.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 6        | 1     | Switching On Inhibited                 | The drive goes only again in the "Switched On" condition with "No Coast Stop AND No Quick Stop" followed by "ON". This means that the "Switching On Inhibited" bit is only set back to zero if the OFF command is set after "No Coast Stop AND No Quick Stop".                                                                                                                                                                                                                                 |
|          | 0     | Switching On Not Inhibit               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 7        | 1     | Warning Present                        | Warning information present in the service/maintenance parameter; no acknowledgement.                                                                                                                                                                                                                                                                                                                                                                                                          |
|          | 0     | No Warning                             | There is no warning or the warning has disappeared again.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 9        | 1     | Control Requested                      | The automation system is requested to assume control (refer to 6.3.11).                                                                                                                                                                                                                                                                                                                                                                                                                        |
|          | 0     | No Control Requested                   | Control by the automation system is not possible, only possible at the device or by another interface.                                                                                                                                                                                                                                                                                                                                                                                         |
| 14 to 15 | -     | device-specific                        | Significance not specified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Table 78 – Detailed assignment of the special status word 1 bits (ZSW1) for the speed control mode**

| Bit      | Value | Significance                       | Comments                                                                                                                                                                                                              |
|----------|-------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8        | 1     | Speed Error Within Tolerance Range | Actual value is within a tolerance band; dynamic violations are permissible for $t < t_{\max}$ , for example<br><br>$n = n_{\text{set}} \pm$ ,<br>$f = f_{\text{set}} \pm$ , etc.,<br>$t_{\max}$ may be parameterised |
|          | 0     | Speed Error Out Of Tolerance Range |                                                                                                                                                                                                                       |
| 10       | 1     | f Or n Reached Or Exceeded         | Actual value $\geq$ comparison value (setpoint) which may be set via the parameter number.                                                                                                                            |
|          | 0     | f Or n Not Reached                 |                                                                                                                                                                                                                       |
| 11 to 13 | -     | device-specific                    | Significance not specified.                                                                                                                                                                                           |

**Table 79 – Detailed assignment of the special status word 1 bits (ZSW1) for the positioning mode**

| Bit | Value | Significance                            | Comments                                                                                                                                                                           |
|-----|-------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8   | 1     | Following Error Within Tolerance Range  | The dynamic comparison of the setpoint position with the actual position value is located with the defined following error window.                                                 |
|     | 0     | Following Error Out Of Tolerance Range  |                                                                                                                                                                                    |
| 10  | 1     | Target Position Reached                 | The position actual value is located at the end of a Traversing Task in the positioning window.                                                                                    |
|     | 0     | Not At Target Position                  |                                                                                                                                                                                    |
| 11  | 1     | Home Position Set                       | Homing Procedure was executed and Home Position is valid.                                                                                                                          |
|     | 0     | Home Position Not Yet Set               | No valid Home Position available.                                                                                                                                                  |
| 12  | Edge  | Traversing Task Acknowledgment (0 -> 1) | Using the positive edge, it is acknowledged that a new traversing task or MDI-setpoint was accepted.<br>If the DO General State Machine is not in state S4, bit 12 is set to zero. |
| 13  | 1     | Drive Stopped                           | Signals that a Traversing Task has been completed or standstill for intermediate stop and stop.                                                                                    |
|     | 0     | Drive Moving                            | Traversing Task is executed $n < > 0$ .                                                                                                                                            |

#### 6.3.2.6 Status word 2 (ZSW2)

The structure of the status word 2 is shown in Table 80.

**Table 80 – Overview on the assignment of the bits of status word 2**

| Bit                                                                                                                                                                                                                 | Significance                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 0 to 11                                                                                                                                                                                                             | Device-specific              |
| 12 to 15                                                                                                                                                                                                            | DO Sign-Of-Life <sup>a</sup> |
| <sup>a</sup> If a clock cycle synchronous application is not implemented, i.e. bits 12 to 15 of status word 2 are not required to transfer the DO Sign-Of-Life, then the complete status word 2 may be freely used. |                              |



### 6.3.2.7 Encoder status word 2 (ZSW2\_ENC)

The Encoder status word 2 is specially dedicated to telegrams for Encoder DOs and combines status functionality out of ZSW1 with the DO Sign-Of-Life out of ZSW2. The structure of the Encoder status word 2 is shown in Table 81.

**Table 81 – Overview on the assignment of the bits of Encoder status word 2**

| Bit                                                                                        | Significance                           |
|--------------------------------------------------------------------------------------------|----------------------------------------|
| 0 to 2                                                                                     | Device-specific                        |
| 3                                                                                          | Fault Present/No Fault                 |
| 4 to 8                                                                                     | Device-specific                        |
| 9                                                                                          | Control Requested/No Control Requested |
| 10 to 11                                                                                   | Device-specific                        |
| 12 to 15                                                                                   | DO Sign-Of-Life                        |
| The significance for bit value = 1 is to the left of the slash; bit value = 0 to the right |                                        |

### 6.3.2.8 Status bit "Pulses Enabled/Disabled"

The controller may get the information, if the DO has disabled the pulses, out of the status bit "Pulses Enabled".

This bit is optional. The manufacturer may use a device-specific bit of the status word 1 or 2 or, possibly, a bit in a manufacturer-specific status word.

In new developments, it is recommended to use bit 11 of status word 2 for "Pulses Enabled".

The evaluation of status word bit "Pulses Enabled" is optional (refer to 6.4).

To identify the usage and the position of the bit "Pulses Enabled", a profile parameter P924 "Status word bit Pulses Enabled" is defined with the structure in Table 82.

**Table 82 – Structure of Parameter 924 "Status word bit Pulses Enabled"**

| Subindex | Meaning       | Comments                                                                                                                                                                                                 |
|----------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | signal number | Status word 1 (ZSW1), status word 2 (ZSW2) or manufacturer-specific status word. If there is no status bit "Pulses Enabled" in the current DO IO Data, the signal number 0 shall be posted in PNU924[0]. |
| 1        | bit position  | 0 to 15                                                                                                                                                                                                  |

If the parameter P924 is implemented in the drive, the drive supports the evaluation of "Pulses Enabled".

## 6.3.3 Operating modes and State Machine

### 6.3.3.1 General

For applications with Drive Axis, a differentiation may be made according to the six PROFIdrive Application Classes with the associated levels of drive interfaces (refer to 6.1.5). According to the different interface levels, the following Operation Modes are defined within this profile:

- Speed control mode

The Application Classes 1 and 4 may be combined in the speed control mode.

NOTE The operating mode speed control can be realised with different types of control modes, for example, v/f control, frequency control, voltage control and closed-loop speed control.

- Positioning mode

The Application Class 3 is emulated under the positioning mode.

- Operating mode for the process technology

The operating mode for the integration of drives in process technology applications according to the VIK<sup>15</sup>-NAMUR<sup>16</sup> recommendation is generally based on the Application Class 1. For a detailed description of this mode, refer to 6.5.

- Manufacturer-specific modes

The Application Classes with distributed technology cannot be assigned to an operating mode defined by the profile, as the interface of the higher-level open loop control to the technology is exclusively application-specific. The operating mode interface to the speed control and the positioning feedback control is displaced inwards between the technology and axis controller.

In addition to the operating modes defined by the profile and the associated state diagrams, operating modes may be defined manufacturer-specific, whereby bits 0 to 3, 7 and 10 of control word 1 and bits 0 to 7 and 9 of status word 1 shall be used corresponding to the specified operating modes in the profile.

- Operating mode changeover

A steady-state operating mode setting may be realised via parameter 930.

A dynamic changeover is implemented manufacturer-specific using the device-specific defined control word bits.

### 6.3.3.2 General state diagram

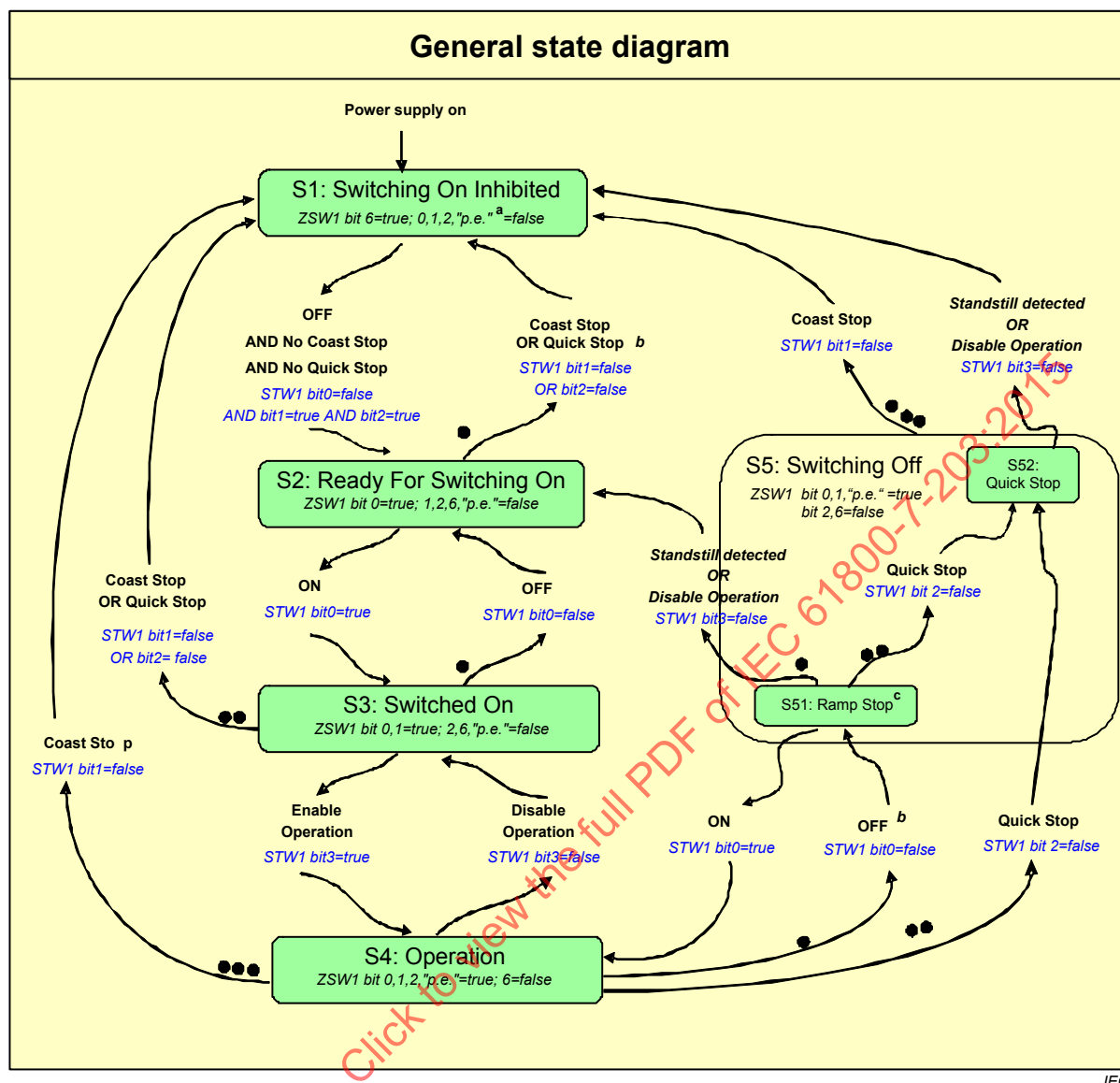
#### State diagram

State diagrams are defined for the operating modes.

In order to simplify the diagram, the states, common for all operating modes (also manufacturer-specific), are combined in the general state diagram (see Figure 27) with only the supplementary states of the individual modes being shown in dedicated diagrams. This state diagram corresponds with the function block “state machine” in the general Drive Object block diagram (see Figure 26).

<sup>15</sup> VIK = Association of the Industrial Customers and Industrial Power Producers.

<sup>16</sup> NAMUR = Standards Working Group for Instrumentation and Control in the Chemical Industry.



<sup>a</sup> "p.e." = "Pulses Enabled" optional (refer to 6.3.2.7).

<sup>b</sup> The internal condition "fault with ramp stop" also activates this transition.

<sup>c</sup> Deceleration rate in ramp stop is switched to maximum if STW1 bit 4 = false in speed control mode.

NOTE 1 STW1 bit x,y =: These control word bits are set by the control.

NOTE 2 ZSW1 bit x,y = These status word bits indicate the current state.

NOTE 3 **Standstill detected** is an internal result of a stop operation.

**Figure 27 – General state diagram for all operating modes**

Information on the general state diagram.

- The green blocks represent states, the arrows represent transitions.
- From several states, several transitions are possible. In order to achieve standard device behaviour, the transitions are specified with assigned priorities in the particular state diagrams in 6.3.3. Points are used to identify the priority level. The more points that a transition has, the higher its priority is. Accordingly, a transition without points has the lowest priority.
- In the general state diagram, internal conditions of the drive are not shown. Internal signals may have an influence on the transitions.

All transitions in this general state machine may only be initiated by a controller, if it has the control priority. The following conditions shall be fulfilled to give the controller the control priority (refer also to 6.3.11):

- the PROFIBUS or PROFINET interface between this controller and the DO has the control priority (P928);
- ZSW1 Bit 9 is set by the DO;
- STW1 Bit 10 is set by the controller.

Internal conditions of the drive or control priority of another interface may cause transitions which are independent of this controller.

The bits defined for the positioning mode are only relevant, if the drive is in the state S4 "Operation".

Note that the priority of the Stop-Reactions is in the order of Ramp Stop, Quick Stop and Coast Stop, where Coast Stop is the highest and Ramp Stop the lowest priority. The effect and priority of the Stop-Reactions is independent from the origin (general state machine, speed setpoint channel STW1 bits 4, 6 or Stop-Reactions caused by faults). This means that any higher priority Stop-Reaction overwrites all lower priority Stop-Reaction. For example, if the axis is switched off by STW1 bit 0 = 0 and remains in S5 Ramp Stop, a concurrent setting of STW1 bit 4 = 0 drives the axis to a Ramp Stop with maximum deceleration rate.

In addition, all Stop-Reactions caused by faults (Fault with Ramp Stop, Fault with Quick Stop, Fault with Coast Stop) force the general state machine to switch to state S1 (Switching On Inhibited) or S2 (Ready For Switching On).

### **6.3.3.3 Speed control mode**

#### **6.3.3.3.1 General**

The speed control mode comprises the speed setpoint interfaces used in the Application Classes 1 and 4. Generally both interfaces use STW1/ZSW1 and the speed setpoint input to control the drive. The differences between the speed setpoint interface in Application Class 1 and Application Class 4 are the different feedback values (Output Data) and the different functionality of the speed setpoint channel.

Notice that all Stop-Reactions out of the state machine (Coast Stop, Quick Stop and Ramp Stop) have a higher priority than the control functions of the speed setpoint channel.

#### **6.3.3.3.2 Speed control mode for Application Class 1**

Speed control in Application Class 1 typically is represented by the lack of a position feedback interface and the open loop control of the speed (or torque) via the PROFIdrive Interface. Figure 28 shows the typical functionality of an Application Class 1 PROFIdrive Drive Object. Clock Synchronous Operation is optional, but generally not necessary.

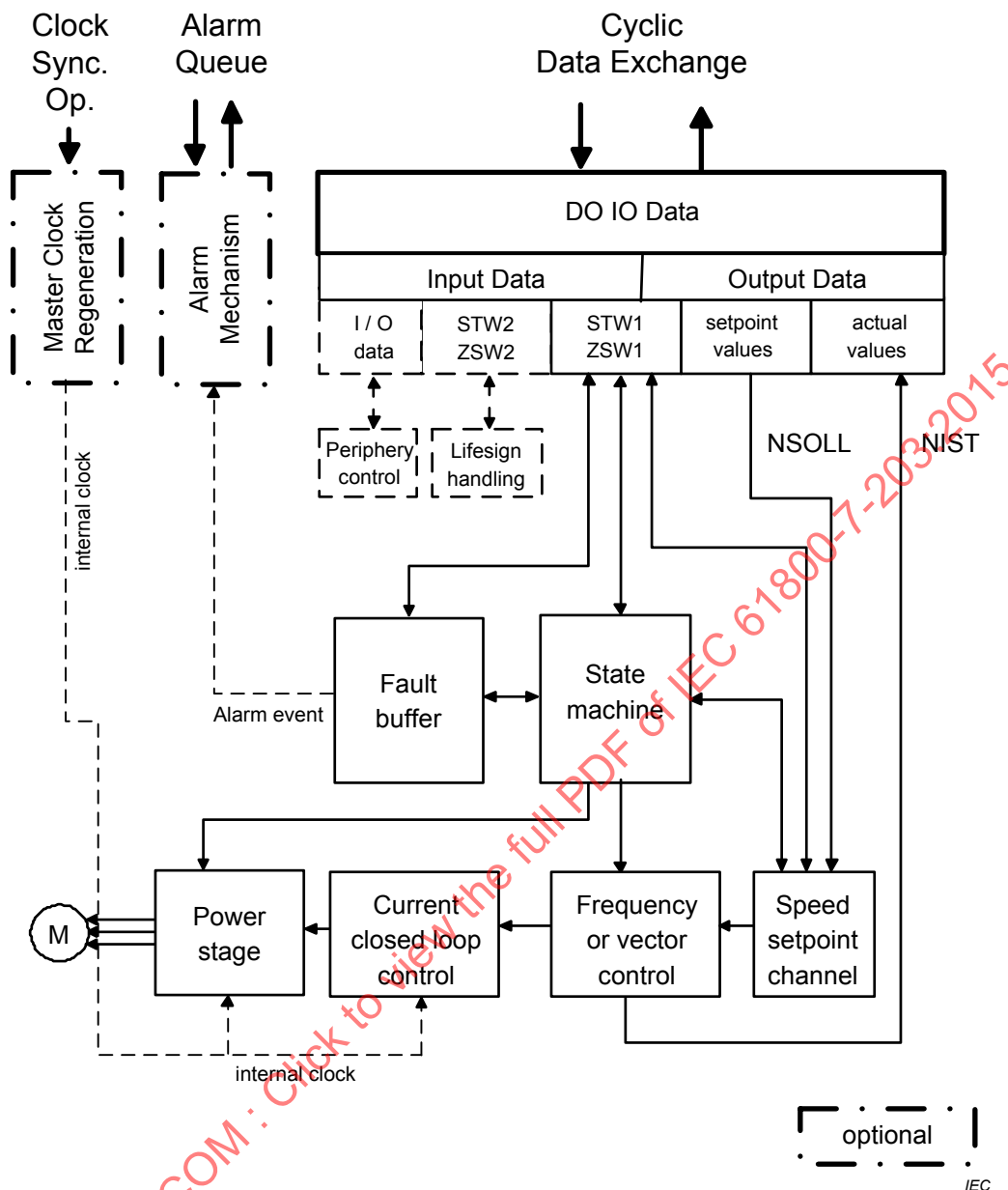


**Figure 28 – General functionality of a PROFIdrive Axis DO with Application Class 1 functionality**

Figure 29 shows the typical functionality of the speed setpoint channel block in Application Class 1 and the effect of the STW1 control bits on the speed setpoint channel. The jog mode functionality is optional.

If the DO supports parameter PNU930 (operating mode) than the drive shows the functionality of the speed setpoint channel and the support of the bits 4, 5, 6 in STW1 according to Figure 29 by answering a parameter read request on PNU930 with value = 1 (this is also the default if the DO does not support PNU930).

The Ramp Function Generator (RFG) is set to zero output if STW1 bit 4 is set to zero. If the RFG is activated by STW1 bit 4 = 1, the RFG output starts with setpoint value zero or the RFG output setpoint value may be synchronised to the actual value of the axis speed (vendor specific).

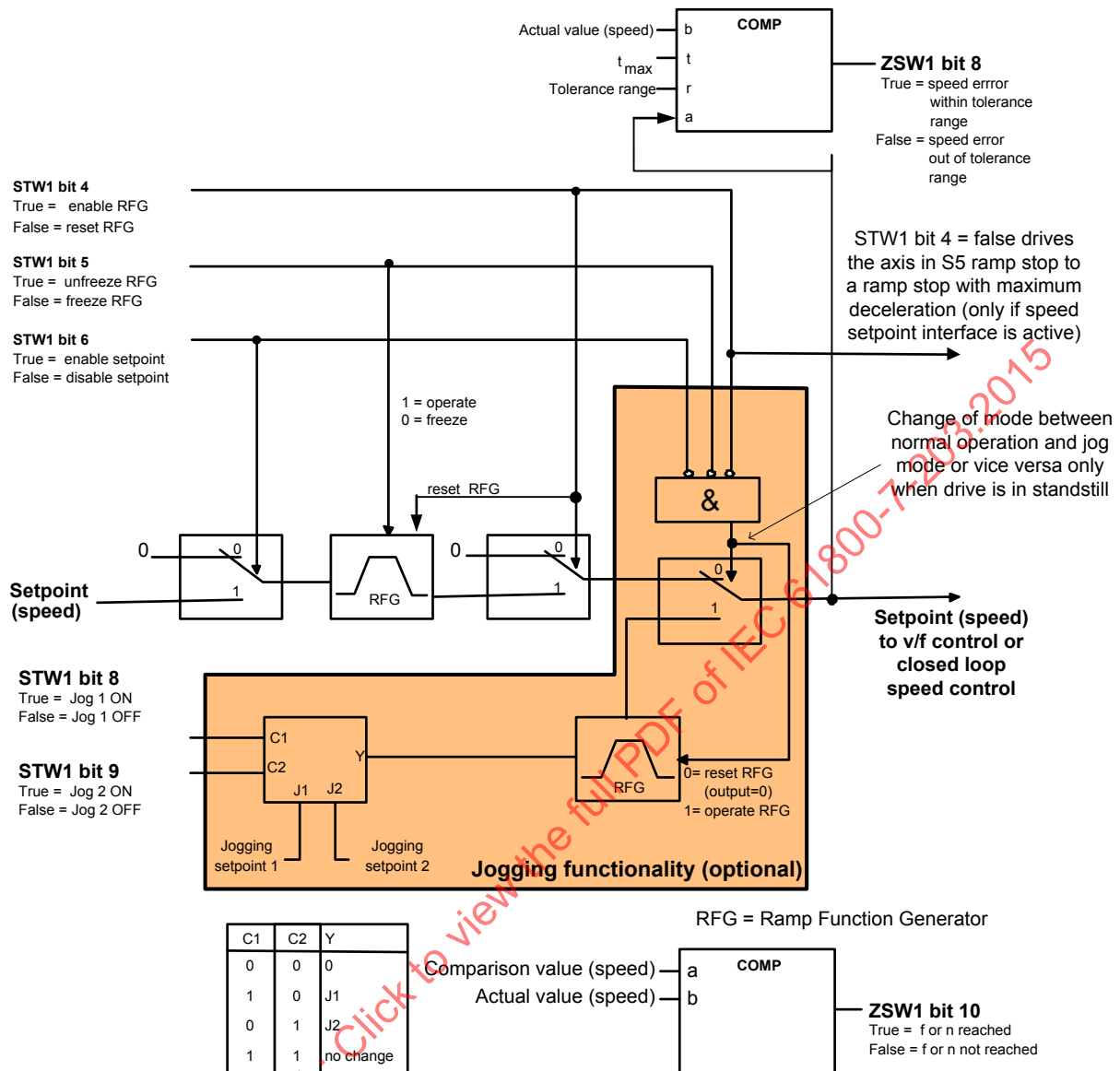


Figure 29 – Speed setpoint channel for use in Application Class 1 and 4

### 6.3.3.3.3 Speed control mode for Application Class 4

Speed control in Application Class 4 typically is used for positioning by use of servo drives with central interpolation. Therefore the position closed loop control located on the control is closed via the PROFIdrive Interface. For this Application Class, the Position Feedback Interface and the Clock Synchronous Operation is necessary. Optionally, a second Position Feedback Interface and additional DSC functionality may be applied. Figure 30 shows the typical functionality of an Application Class 4 PROFIdrive Axis DO.

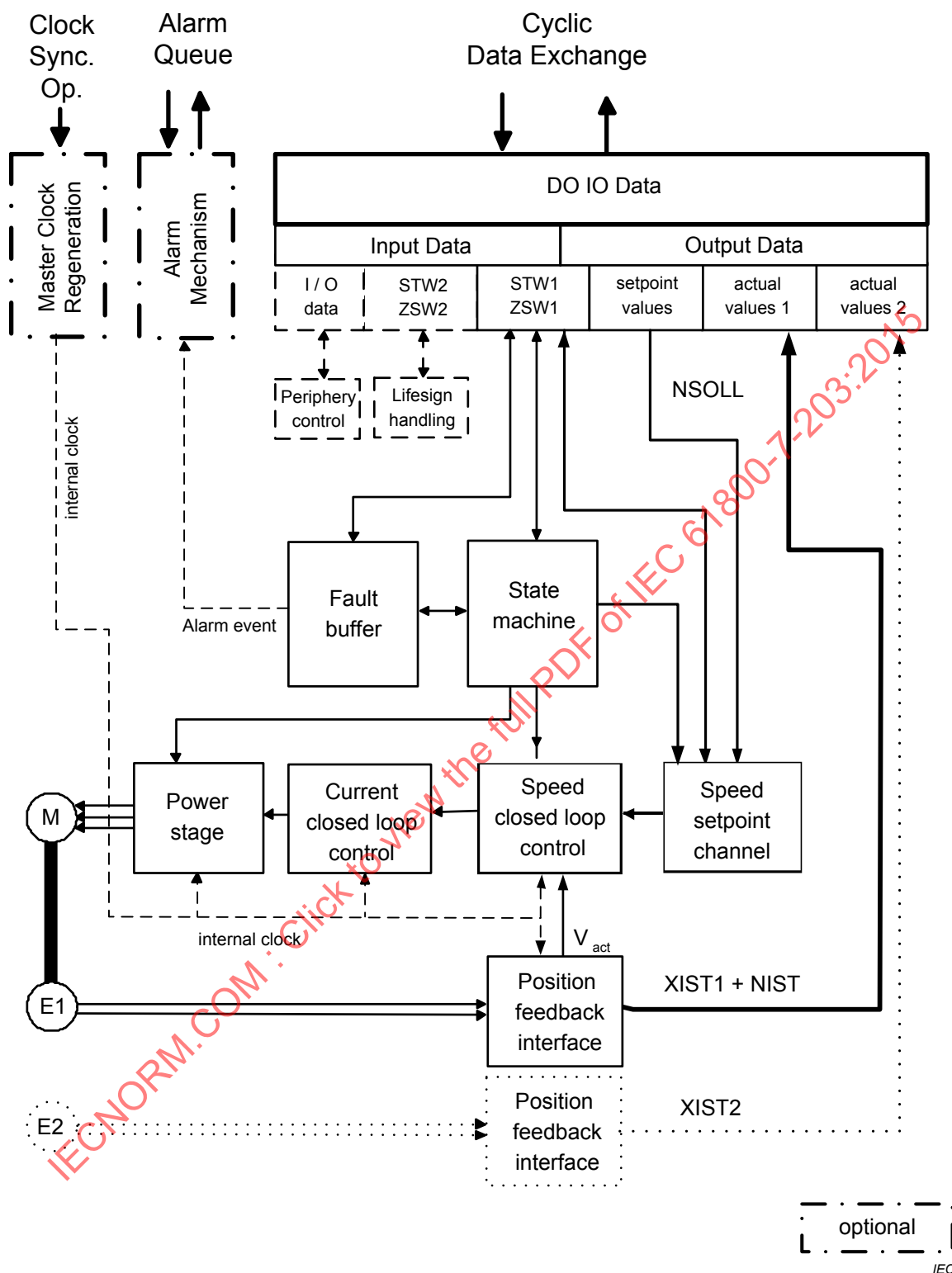
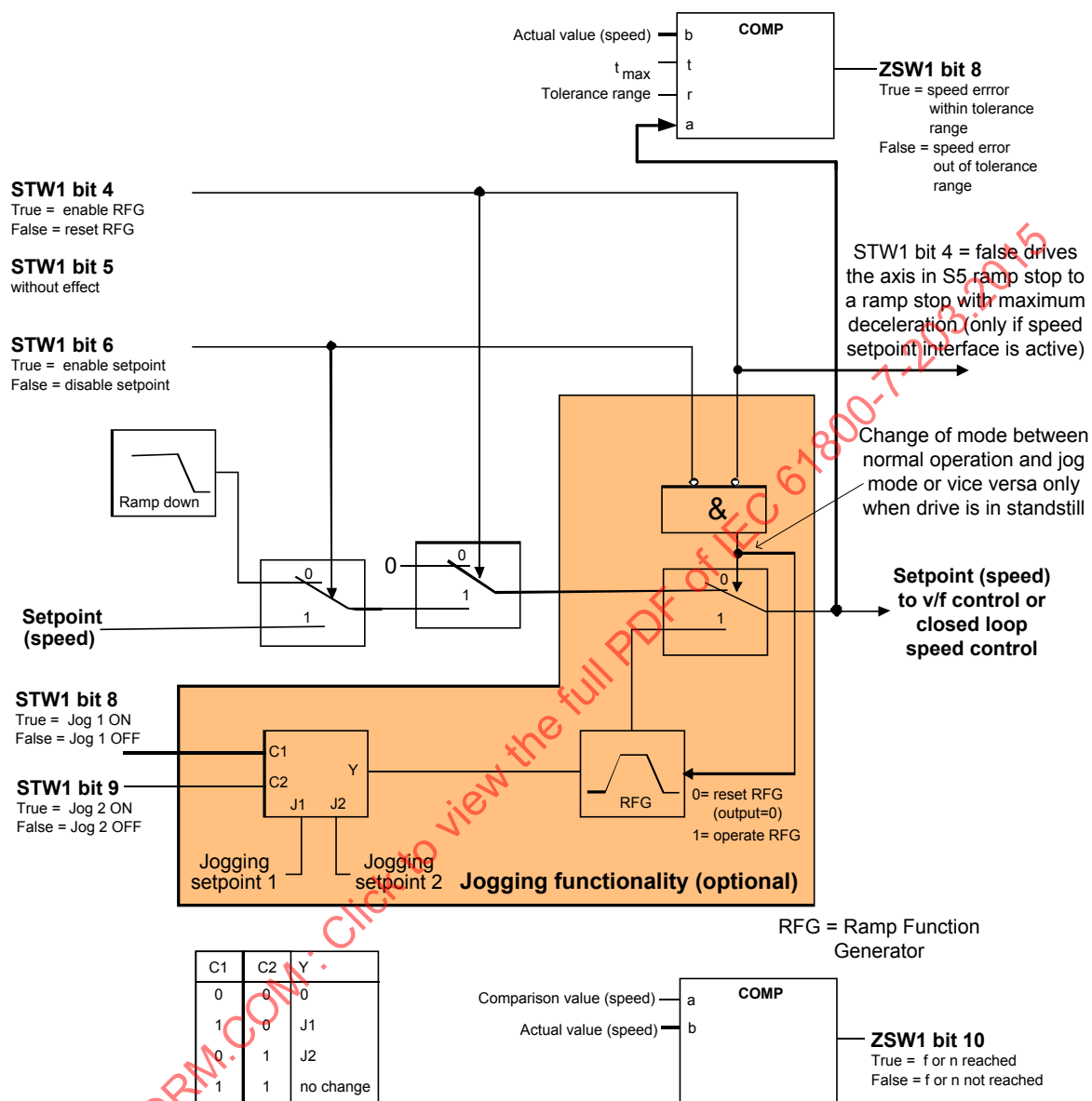


**Figure 30 – General functionality of a PROFIdrive Axis DO with Application Class 4 functionality**

In Application Class 4, there is typically no need for a Ramp Function Generator (RFG) in the speed setpoint channel. Therefore, a more simple speed setpoint channel without RFG functionality may be used (optional). Figure 31 shows the functionality of this reduced speed setpoint channel block for use in Application Class 4 and the effect of the STW1 control bits on the speed setpoint channel. With this speed setpoint channel, STW1 bit 5 has no effect. The jog mode functionality is optional.

If the DO supports parameter PNU930 (operating mode) than the DO posts the functionality of the reduced speed setpoint channel by answering a parameter read request on PNU930 with a value = 3 (if the DO supports a reduced speed setpoint channel, PNU930 is mandatory).



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Figure 31 – Reduced speed setpoint channel for use in Application Class 4 (optional)

#### 6.3.3.3.4 Jogging functionality in speed control mode

The jogging functionality is optional. Prerequisite for the jog mode is that the drive is already switched to state S4 “operation”. Switching of mode between normal operation and jog mode (drive follows selected jogging setpoint) is only possible when the drive is at a standstill. To enter the jog mode (drive shows effect on the jog bits (STW1, bits 8 and 9)), the standard setpoint channel shall be completely deactivated (STW1, bit 4 = 0, bit 5 = 0, bit 6 = 0; bit 5 has no effect in case of a “Reduced Speed setpoint channel”). Leaving the jog mode and switching back to normal operation first requires that the drive comes to a standstill in the jog mode (STW1, Bits 8, 9 = 0). STW1 bits 4, 5, 6 need not force the drive to leave the jog mode if the drive is not already at a standstill. If in jog mode, the speed setpoint from “jogging setpoint 1” is activated (STW1 bit 8 = 1) and afterward also “jogging setpoint 2” (STW1 bit 9 = 1) is activated, then the drive still keeps the former setpoint value “jogging setpoint 1”. If both



jog bits are activated at the same time (from STW1 bit 8 = bit 9 = 0 to STW1 bit 8 = bit 9 = 1 with the next DP-cycle), then the jogging setpoint value is zero.

### 6.3.3.4 Positioning mode

#### 6.3.3.4.1 General

In “positioning mode”, which refers to the Application Class 3, the speed setpoint channel function block is replaced by the “motion control” function block (see Figure 32). The motion control block comprises the functionality of a position closed loop control and an interpolator for single axis point to point movement and optional homing and jogging functionality. In positioning mode, the bits in the STW1/ZSW1 which, in speed control mode are dedicated to the speed setpoint channel, are used to control the motion control operation (refer to 6.3.2). In addition, the general state machine/diagram according to Figure 27 is expanded in the positioning mode according to Figure 35.

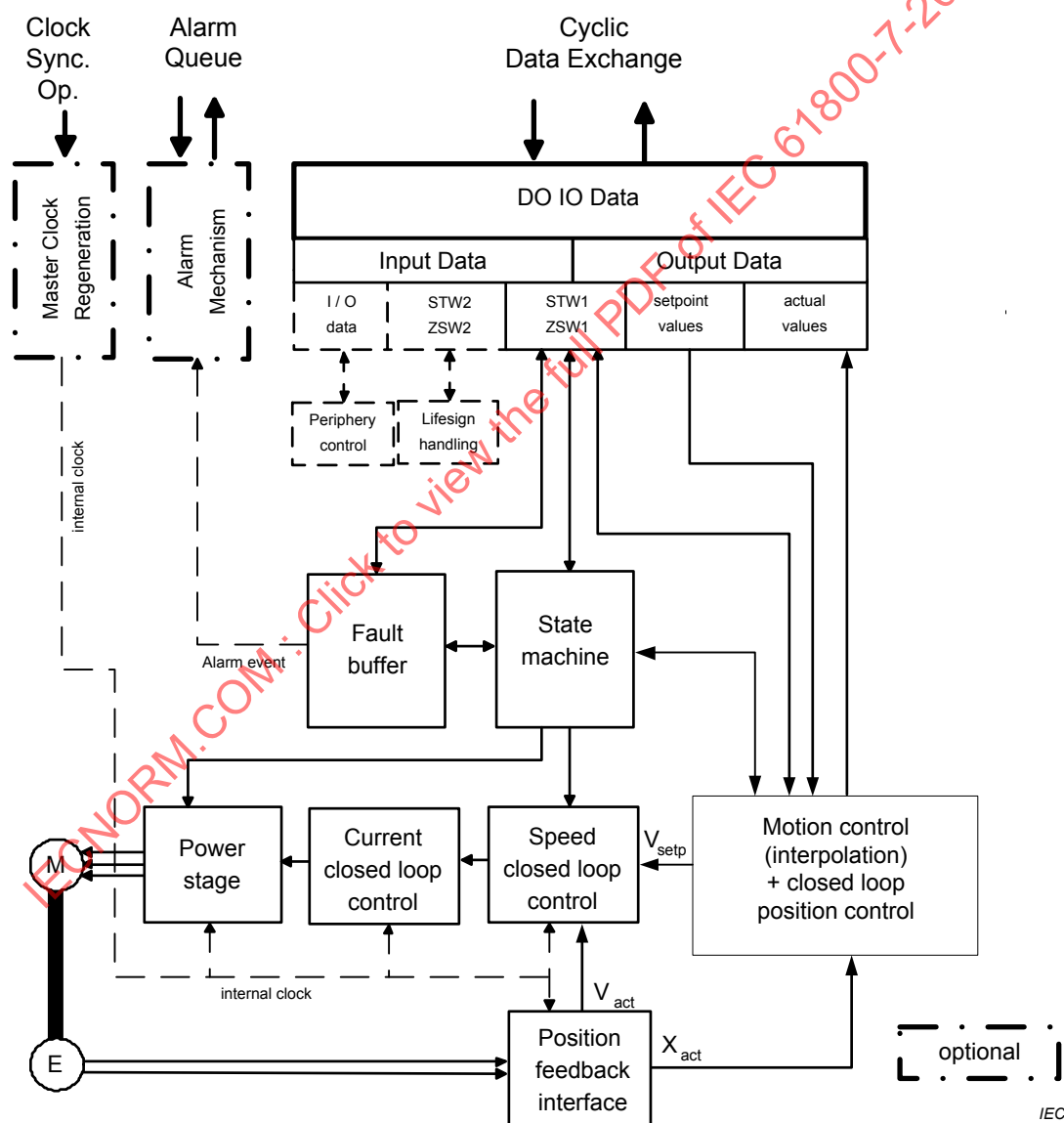


**Figure 32 – General functionality of a PROFIdrive Axis DO with Application Class 3 functionality**

Generally, the Positioning mode comprises the two submodes “Program” and “Manual Data Input” (MDI). A drive who supports the Positioning mode shall support the Program submode and may support the MDI submode.

#### 6.3.3.4.2 Positioning mode with Program submodule

The motion controller for Program submodule consists of the position closed loop control, the path interpolation, the program interpreter and the program storage (see Figure 33). The path interpolation cyclically generates position setpoints for the position closed loop control of the axis. The input to the path interpolation is a motion command which consists of the new target position (TARPOS), and the velocity, acceleration and deceleration for the calculation of the path from the actual axis position to the new target position. With the Program submodule, the motion command is provided by the program interpreter from a motion program. One or several motion programs are stored by motion records in a device specific manner in the program storage. Controlling of the program interpreter is done by the dedicated bits of STW1 (see Table 73) and the signal SATZANW out of the DO IO Data.

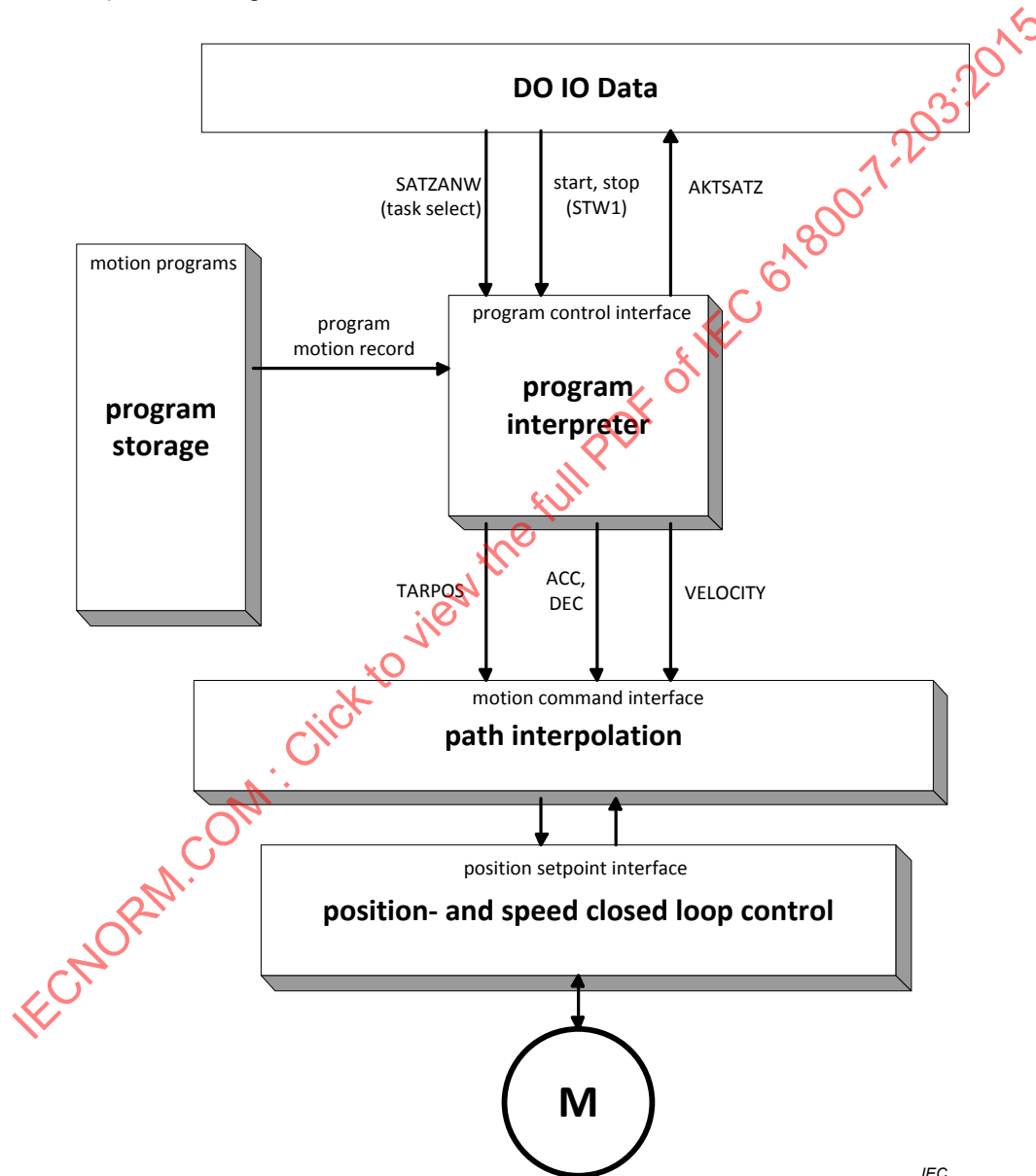


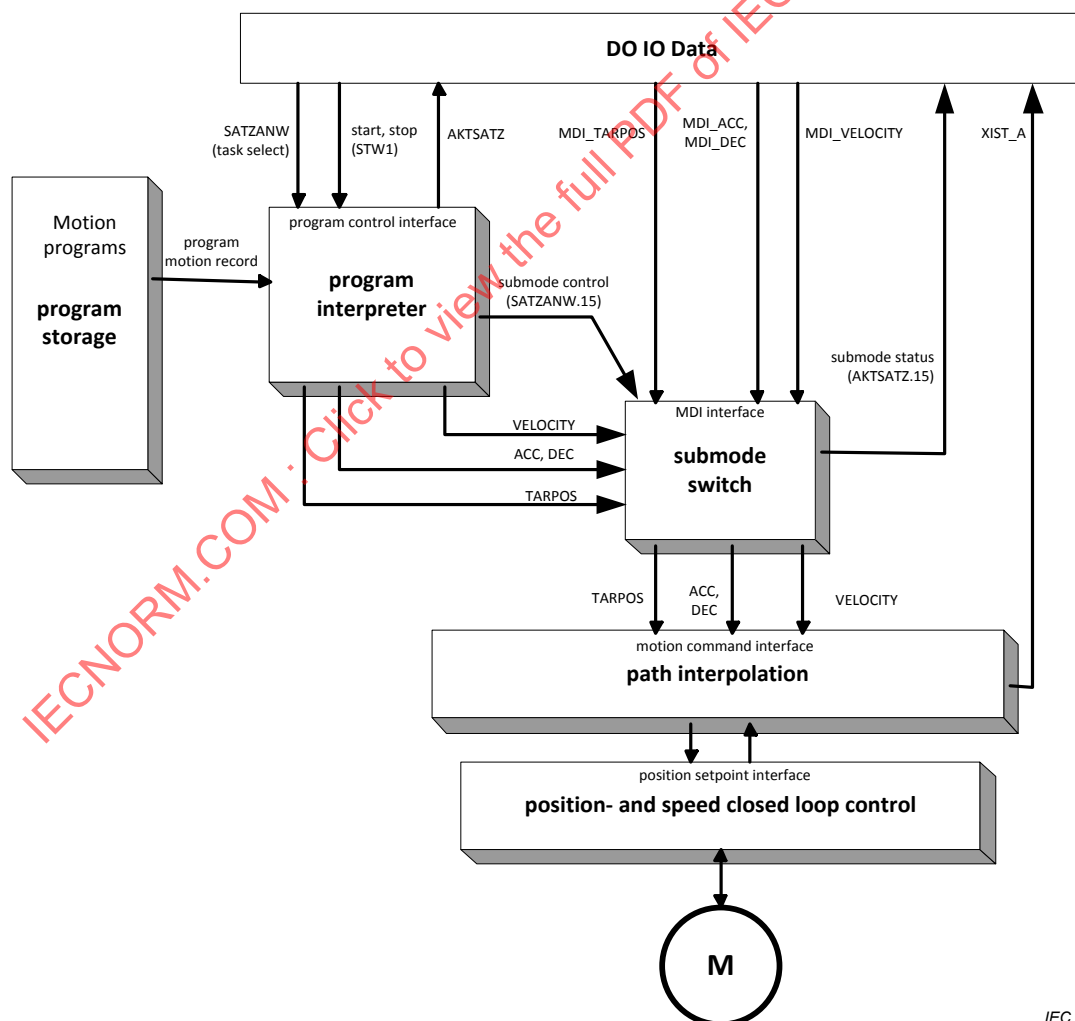
**Figure 33 – Functionality of the Motion Controller in the Program submodule**

The start of a motion program or the change to a new program while a program is still running, is done by selecting the first motion record of the new program via SATZANW (while SATZANW Bit15 = 0) and a positive edge of STW1 Bit6 according to 6.3.3.4.6. The motion program is then executed by the program interpreter motion record for motion record as long as there is no stop or terminate condition in a motion record and the program is not

terminated by STW1 Bit4 = 0 (reject Traversing Task). The motion of the axis may also be stopped intermediately by STW1 Bit5=0 (intermediate stop). See also Figure 35.

#### 6.3.3.4.3 Positioning mode with MDI submode

The motion controller for Manual Data Input (MDI) submode also comprises, in addition to the Program submode components, a submode switch which enables the direct access to the motion command interface from the DO IO Data without using the program interpreter. This gives the advantage of immediate control of the motion command interface by the controller via DO IO DATA. Changeover from the program execution to the MDI interface and vice versa is controlled by Bit15 of SATZANW (see Table 83). If MDI submode is active, the input for the motion command interface of the path interpolator will be taken from the signals MDI\_TARPOS, MDI\_ACC, MDI\_DEC and MDI\_VELOCITY (see Figure 34). These values get valid as the input for the calculation of a new path from the actual axis position to the new target position with the rising edge of STW1 Bit6 (see Figure 38). Controlling of the motion process is done by the dedicated bits of STW1 (see Table 73) from the DO IO Data. See also Figure 35. The signal MDI\_ACC defines the acceleration of the motion at the beginning of the path, while the signal MDI\_DEC defines the deceleration at the end of the path (independent of the absolute motion direction). The signal MDI\_MOD defines additional attributes for the motion command and the changeover from the predecessor motion command to the new motion command (see Table 85).



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Figure 34 – Functionality of the Motion Controller in the MDI submode

**Table 83 – Definition of signal SATZANW**

| Bits     | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 9   | Number of the motion record in the program storage intended to start (value range: 0 to 1 023)<br>Bits 0 to 9 are only relevant in Program submode.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 10 to 14 | Reserved for future use by PROFIdrive profile.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 15       | Control of submode switch for the selection of submodes (toggle of submode switch with change of motion command source only in S41):<br><br>= 1 Activation of the MDI submode. If there is a program still running (extended state machine not in the state Basic State), the positioning interface will change to MDI Submode only after the program ends or is terminated (STW1 bit4).<br><br>= 0 Deactivation of the MDI submode. If a MDI motion command is still being executed, the path interpolation shall stop and the MDI motion command shall be rejected. |

**Table 84 – Definition of signal AKTSATZ**

| Bits     | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 9   | Number of the motion record currently active (executed by the path interpolation).<br>Bits 0 to 9 are only relevant in Program submode (in MDI-submode and while no program is being executed the number should be 0).                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 10 to 14 | Reserved for future use by PROFIdrive profile.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 15       | Status of submode switch and currently active submode (source of currently active Traversing Task):<br><br>= 1 MDI submode active. The input values for the motion command will be taken from the signals TARPOS, VELOCITY_A, MDI_ACC and MDI_DEC. If a motion command is still executed in the path interpolation (S45, S43), the source of the motion command was MDI.<br><br>= 0 Program submode active. The initial motion record for the start of a new motion program will be taken from bits 0 to 9 of SATZANW. If a motion command is still executed (S45, S43), the motion command is part of a motion program and the current motion record is posted in AKTSATZ bit 0 to 9. |

**Table 85 – Definition of signal MDI\_MOD**

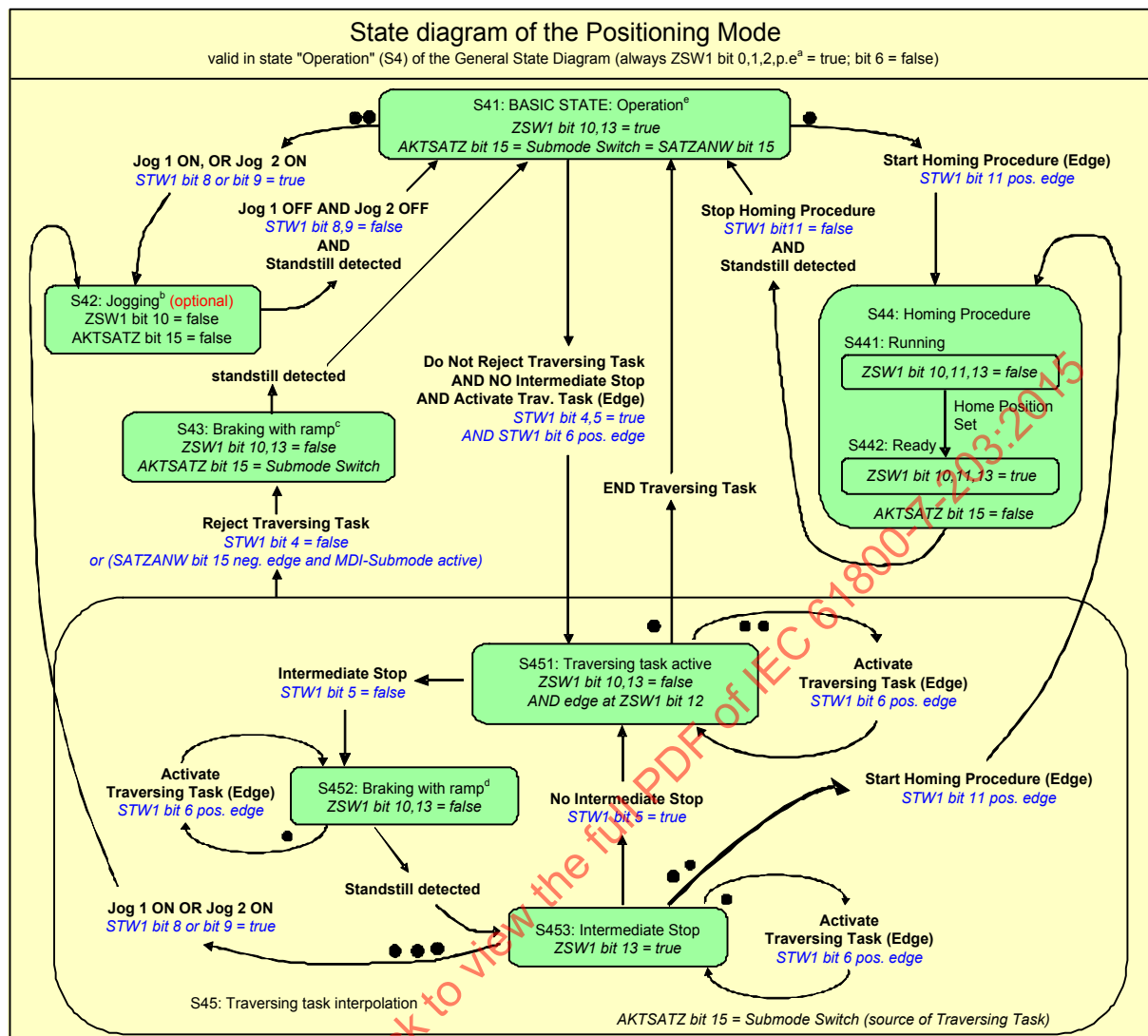
| Bits    | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0       | <p>Absolute/Relative positioning mode</p> <p>= 1 Absolute positioning. The target position in the signal TARPOS defines the absolute target position for the motion.</p> <p>= 0 Relative positioning. The target position in the signal TARPOS defines the relative target position for the motion related to the actual axis position.</p>                                                                                                                                                                                                                       |
| 1       | <p>Positive Modulo positioning direction (implementation optional).<br/>This command is only functional if the axis type is a rotating modulo axis and the absolute position mode is activated (MDI_MOD bit 0 = 1).</p> <p>= 1 For a modulo Axis, the absolute position shall be reached by a motion in the positive direction. If bit 1 and bit 2 are both 1, the target position of a modulo axis shall be reached by the shortest path.</p> <p>= 0 If bits 1 and 2 are both 0, the target position of a modulo axis shall be reached by the shortest path.</p> |
| 2       | <p>Negative Modulo positioning direction (implementation optional).<br/>This command is only functional if the axis type is a rotating modulo axis and the absolute position mode is activated (MDI_MOD bit 0 = 1).</p> <p>= 1 For a modulo Axis, the absolute position shall be reached by a motion in the negative direction. If bit 1 and bit 2 are both 1, the target position of a modulo axis shall be reached by the shortest path.</p> <p>= 0 If bits 1 and 2 are both 0, the target position of a modulo axis shall be reached by the shortest path.</p> |
| 3 to 15 | Reserved for future use by PROFIdrive profile.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

#### 6.3.3.4.4 Positioning mode extended state diagram

The extended state diagram for the positioning mode in Program submode and MDI submode is shown in Figure 35. The program submode and the MDI submode only differ in the source for the motion commands. The source for motion commands is controlled by the submode switch. The submode switch is controlled by bit 15 in the signal SATZANW. The currently active positioning submode (active source of motion commands) is shown in the signal AKTSATZ Bit15 (see also Table 84).

The meaning of “Activate Traversing Task” according to the positioning submodes is as follows:

- Program submode: Activation of the motion program beginning at the motion record number in SATZANW Bits 0 to 9.
- MDI-Submode: Activation of a new motion command. The setpoints for the motion command are taken out of the signals TARPOS, VELOCITY\_A, MDI\_ACC and MDI\_DEC.



IEC

<sup>a</sup> p.e. = status bit for Pulses Enabled/Disabled.

<sup>b</sup> Effect of the Jog bits STW1 bit8, bit9 on the speed setpoint (Y) according to the definition in Figure 29.

<sup>c</sup> Braking with ramp is with maximum deceleration value.

<sup>d</sup> Deceleration value for braking with ramp is taken from the currently active Traversing Task.

<sup>e</sup> Toggling of submode switch (change of motion command source) only in state S41.

NOTE 1 STW1 bit x,y = These control word bits are set by the control.

NOTE 2 ZSW1 bit x,y = These status word bits indicate the current state.

NOTE 3 **Standstill detected** is an internal result of a stop operation.

**Figure 35 – State diagram of the positioning mode**

#### 6.3.3.4.5 Homing procedure

The drive executes the homing procedure autonomously. The strategy of the homing procedure is defined manufacturer-specific by the parameterisation of the drive.

The procedure for the activation and cancelling of the homing procedure is shown in detail in Figure 36 and Figure 37.

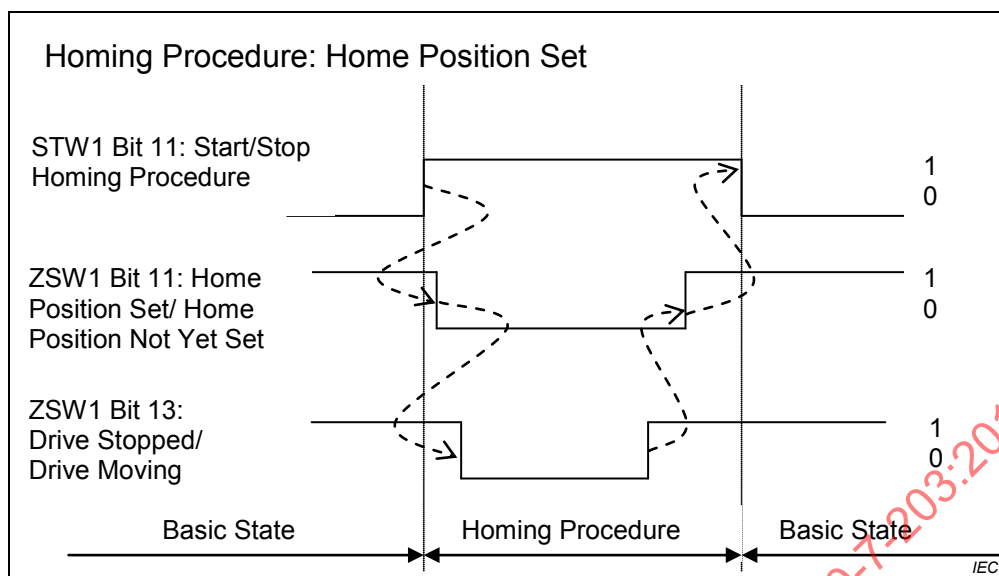


Figure 36 – Homing Procedure: Home Position Set

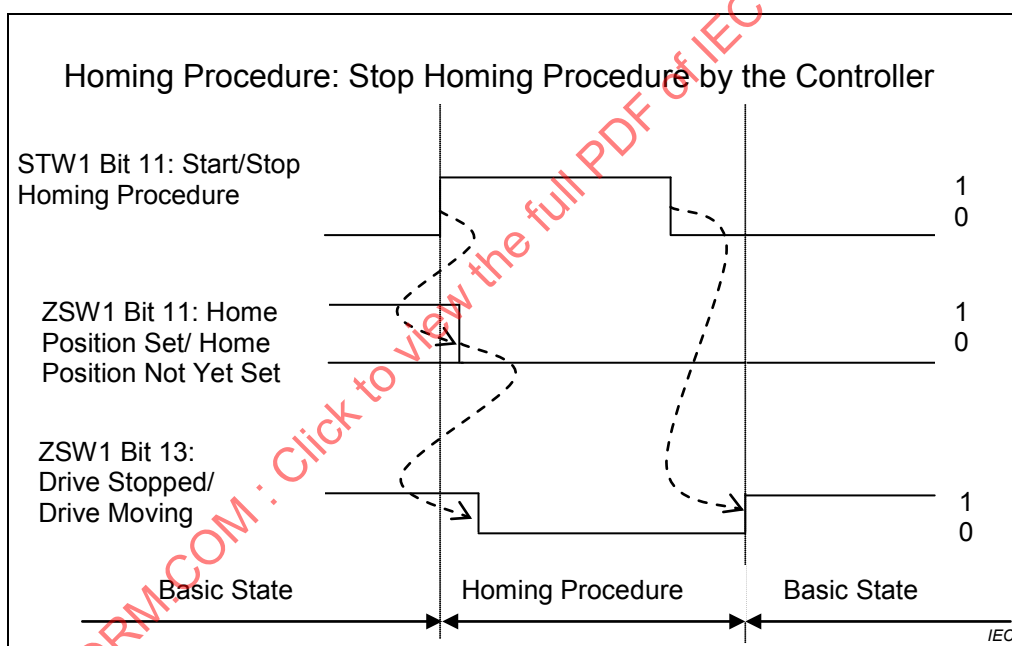


Figure 37 – Homing Procedure: Abortion by the controller

#### 6.3.3.4.6 Traversing Task control

The procedure for the activation of a Traversing Task (motion program or motion command) is shown in detail in Figure 38 and Figure 39.

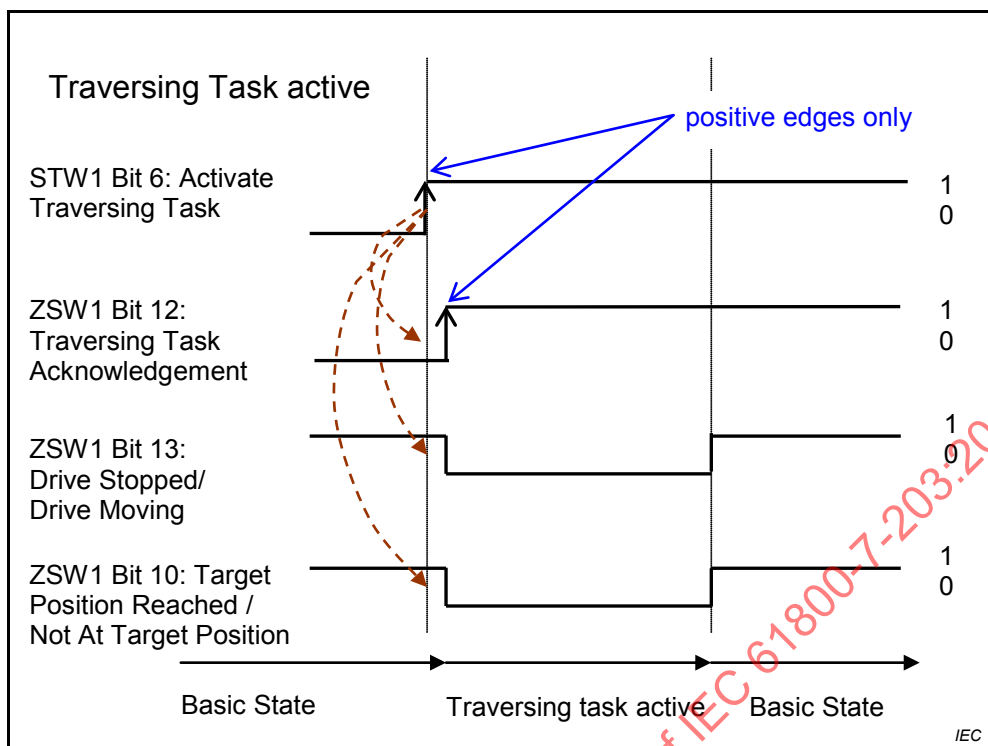


**Figure 38 – Traversing Task active**

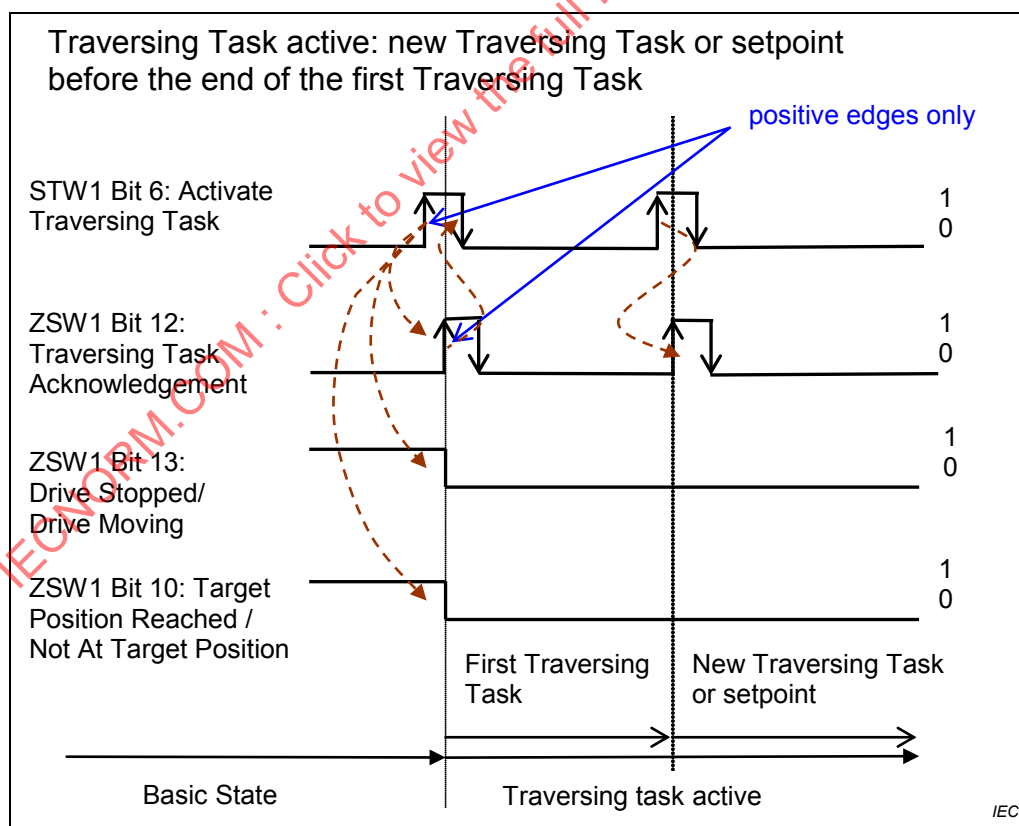


**Figure 39 – Change of the Traversing Tasks immediately**

The procedure for activation of a Traversing Task according to the definition in Figure 38 and Figure 39 is valid in S4 state of the general state machine. If the general state machine is not



in state S4, all Traversing Tasks are aborted and ZSW1 bit 12 is set to zero independent from STW1 bit 6.

### **6.3.4 DO IO Data**

#### **6.3.4.1 General**

The setpoints to the Axis and also the actual values from the Axis are transferred as DO IO Data. The DO IO Data is transferred using the Cyclic Data Exchange service. The representation of data shall be in big-endian format.

The individual setpoints/actual values may be configured as Signals to be included in the DO IO Data of the Axis. Furthermore, the controller may read-out the normalisation for the individual DO IO Data from the DO/Axis. There are four DO IO Data descriptive elements in the profile-specific parameter section for this DO IO Data configuration.

A detailed description is provided in 6.3.4.4 and 6.3.4.5.

The following advantages are obtained due to the telegram configuring and normalisation.

- Interoperability and interchangeability of PROFIdrive Controllers and Drive Objects.
- Standard components may be simply commissioned.
- Automation mechanisms in the controller application. By reading-out parameters, the controller may adapt its cyclic interface to the Axis. This read-out procedure shall be taken into account when running-up.

#### **6.3.4.2 Signals**

A series of signals with appropriate signal numbers is defined to configure the DO IO Data (setpoints, actual values).

The following values are permissible for the signal numbers:

- 0 -> not assigned.
- 1 to 99 -> standard signal numbers (profile-specific).
- 100 to 61 999 -> signal numbers (device-specific).
- 62 000 to 65 535 -> standard signal numbers (profile-specific).

All of the defined signal numbers are listed Table 86.

**Table 86 – Signal list – assignment**

| Signal No. | Significance                     | Abbreviation | Length<br>16-/32 bit | Sign | Description                        |
|------------|----------------------------------|--------------|----------------------|------|------------------------------------|
| 1          | Control word 1                   | STW1         | 16                   |      | Refer to 6.3.2.2                   |
| 2          | Status word 1                    | ZSW1         | 16                   |      | Refer to 6.3.2.5                   |
| 3          | Control word 2                   | STW2         | 16                   |      | Refer to 6.3.2.3                   |
| 4          | Status word 2                    | ZSW2         | 16                   |      | Refer to 6.3.2.6                   |
| 5          | Speed setpoint A                 | NSOLL_A      | 16                   | with | N2 normalised<br>Refer to 6.3.4.5  |
| 6          | Speed actual value A             | NIST_A       | 16                   | with | N2 normalised<br>Refer to 6.3.4.5  |
| 7          | Speed setpoint B                 | NSOLL_B      | 32                   | with | N4 normalised<br>Refer to 6.3.4.5  |
| 8          | Speed actual value B             | NIST_B       | 32                   | with | N4 normalised<br>Refer to 6.3.4.5  |
| 9          | Sensor 1 control word            | G1_STW       | 16                   |      | Refer to 6.3.6                     |
| 10         | Sensor 1 status word             | G1_ZSW       | 16                   |      | Refer to 6.3.6                     |
| 11         | Sensor 1 position actual value 1 | G1_XIST1     | 32                   |      | Refer to 6.3.6                     |
| 12         | Sensor 1 position actual value 2 | G1_XIST2     | 32                   |      | Refer to 6.3.6                     |
| 13         | Sensor 2 control word            | G2_STW       | 16                   |      | Refer to 6.3.6                     |
| 14         | Sensor 2 status word             | G2_ZSW       | 16                   |      | Refer to 6.3.6                     |
| 15         | Sensor 2 position actual value 1 | G2_XIST1     | 32                   |      | Refer to 6.3.6                     |
| 16         | Sensor 2 position actual value 2 | G2_XIST2     | 32                   |      | Refer to 6.3.6                     |
| 17         | Sensor 3 control word            | G3_STW       | 16                   |      | Refer to 6.3.6                     |
| 18         | Sensor 3 status word             | G3_ZSW       | 16                   |      | Refer to 6.3.6                     |
| 19         | Sensor 3 position actual value 1 | G3_XIST1     | 32                   |      | Refer to 6.3.6                     |
| 20         | Sensor 3 position actual value 2 | G3_XIST2     | 32                   |      | Refer to 6.3.6                     |
| 21         | Input (digital)                  | E_DIGITAL    | 16                   |      | Refer to 6.3.7                     |
| 22         | Output (digital)                 | A_DIGITAL    | 16                   |      | Refer to 6.3.7                     |
| 23         | Input (analog)                   | E_ANALOG     | 16                   |      | Refer to 6.3.7                     |
| 24         | Output (analog)                  | A_ANALOG     | 16                   |      | Refer to 6.3.7                     |
| 25         | System deviation                 | XERR         | 32                   | with | Refer to 6.3.5                     |
| 26         | Position controller, gain factor | KPC          | 32                   | with | Refer to 6.3.5                     |
| 27         | Position setpoint value A        | XSOLL_A      | 32                   | with |                                    |
| 28         | Position actual value A          | XIST_A       | 32                   | with |                                    |
| 29         | Position actual value B          | XIST_B       | 32                   | with |                                    |
| 30         | Position actual value C          | XIST_C       | 32                   | with |                                    |
| 31         | Position actual value D          | XIST_D       | 32                   | with |                                    |
| 32         | Traversing block selection       | SATZANW      | 16                   |      | Refer to 6.3.3.4.2                 |
| 33         | Actual traversing block          | AKTSATZ      | 16                   |      | Refer to 6.3.3.4.2                 |
| 34         | MDI target position              | MDI_TARPOS   | 32                   | with | Refer to 6.3.3.4.3                 |
| 35         | MDI velocity                     | MDI_VELOCITY | 32                   |      | Refer to 6.3.3.4.3                 |
| 36         | MDI acceleration                 | MDI_ACC      | 16                   |      | Refer to 6.3.3.4.3                 |
| 37         | MDI deceleration                 | MDI_DEC      | 16                   |      | Refer to 6.3.3.4.3                 |
| 38         | MDI mode                         | MDI_MOD      | 16                   |      | Refer to 6.3.3.4.3 and<br>Table 85 |
| 39         | Sensor 1 position actual value 3 | G1_XIST3     | 64                   |      | Refer to 6.3.6                     |

| Signal No.          | Significance                                     | Abbreviation | Length<br>16-/32 bit | Sign | Description                                                |
|---------------------|--------------------------------------------------|--------------|----------------------|------|------------------------------------------------------------|
| 40 – 50             | Profile-specific                                 |              |                      |      | Reserved                                                   |
| 51                  | Output current smoothed                          | IAIST_GLATT  | 16                   |      | Refer to 6.5                                               |
| 52                  | Active current<br>(torque proportional)          | ITIST_GLATT  | 16                   | with | Refer to 6.5                                               |
| 53                  | Torque actual value smoothed                     | MIST_GLATT   | 16                   | with | Refer to 6.5                                               |
| 54                  | Active power smoothed                            | PIST_GLATT   | 16                   |      | Refer to 6.5                                               |
| 55                  | Frequency setpoint                               | FSOLL        | 16                   |      | Refer to 6.5                                               |
| 56                  | Frequency actual value smoothed                  | FIST_GLATT   | 16                   |      | Refer to 6.5                                               |
| 57                  | Speed actual value A                             | NIST_A_GLATT | 16                   | with | Refer to 6.5                                               |
| 58                  | Drive status/fault word                          | MELD_NAMUR   | 16                   |      | Refer to 6.5                                               |
| 59                  | Output current                                   | IAIST        | 16                   |      | Refer to 6.5                                               |
| 60                  | Torque actual value                              | MIST         | 16                   | with | Refer to 6.5                                               |
| 61                  | Active current smoothed<br>(torque proportional) | ITIST        | 16                   | with | Refer to 6.5                                               |
| 62                  | Active power                                     | PIST         | 16                   |      | Refer to 6.5                                               |
| 63                  | Frequency actual value                           | FIST         | 16                   |      | Refer to 6.5                                               |
| 64 to 79            | Profile-specific                                 |              |                      |      | Reserved                                                   |
| 80                  | Control word 2 for Encoder                       | STW2_ENC     | 16                   |      | Refer to 6.3.2.3                                           |
| 81                  | Status word 2 for Encoder                        | ZSW2_ENC     | 16                   |      | Refer to 6.3.2.6                                           |
| 82 to 89            | Encoder signals (Encoder Profile)                |              |                      |      | Reserved                                                   |
| 90 to 99            | Profile-specific (Safety)                        |              |                      |      | Reserved                                                   |
| 100 to<br>59 999    | Device-specific (PROFIdrive)                     |              |                      |      | Recommended for<br>vendor specific drive<br>signals        |
| 60 000 to<br>60 999 | Device-specific (Encoder)                        |              |                      |      | Recommended for<br>vendor specific<br>encoder signals      |
| 61 000 to<br>61 999 | Device-specific (Safety)                         |              |                      |      | Recommended for<br>vendor specific drive<br>safety signals |
| 62 000 to<br>65 535 | Profile-specific                                 |              |                      |      | reserved                                                   |

### 6.3.4.3 Standard telegrams

#### 6.3.4.3.1 General

Standard telegrams 1 to 4 are defined for speed setpoint interface operations (AC1 and AC4). The standard telegrams are selected when configuring the DO IO Data (refer to 6.3.4.4).

The standard telegrams have a structure according to Table 87 to Table 95 and Table 147.

#### 6.3.4.3.2 Standard telegram 1

Content: n-setpoint interface, 16 bit

**Table 87 – Definition of standard telegram 1**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | NSOLL_A  | NIST_A       |

#### 6.3.4.3.3 Standard telegram 2

Content: n-setpoint interface, 32 bit, without sensor

**Table 88 – Definition of standard telegram 2**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | NSOLL_B  | NIST_B       |
| 3              |          |              |
| 4              | STW2     | ZSW2         |

#### 6.3.4.3.4 Standard telegram 3

Content: n-setpoint interface, 32 bit, with one sensor

**Table 89 – Definition of standard telegram 3**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | NSOLL_B  | NIST_B       |
| 3              |          |              |
| 4              | STW2     | ZSW2         |
| 5              | G1_STW   | G1_ZSW       |
| 6              |          | G1_XIST1     |
| 7              |          |              |
| 8              |          | G1_XIST2     |
| 9              |          |              |

#### 6.3.4.3.5 Standard telegram 4

Content: n-setpoint interface, 32 bit, with two sensors

**Table 90 – Definition of standard telegram 4**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | NSOLL_B  | NIST_B       |
| 3              |          |              |
| 4              | STW2     | ZSW2         |
| 5              | G1_STW   | G1_ZSW       |
| 6              | G2_STW   | G1_XIST1     |
| 7              |          |              |
| 8              |          | G1_XIST2     |
| 9              |          |              |
| 10             |          | G2_ZSW       |
| 11             |          | G2_XIST1     |
| 12             |          |              |
| 13             |          | G2_XIST2     |
| 14             |          |              |

**6.3.4.3.6 Standard telegram 5**

The standard telegrams 5 and 6 are derived from standard telegrams 3 and 4 for additional use of the Dynamic Servo Control (DSC/refer to 6.3.5).

Content: n-setpoint interface, 32 bit, with one sensor; additionally position difference and position controller gain in the setpoint direction for DSC

**Table 91 – Definition of standard telegram 5**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | NSOLL_B  | NIST_B       |
| 3              |          |              |
| 4              | STW2     | ZSW2         |
| 5              | G1_STW   | G1_ZSW       |
| 6              | XERR     | G1_XIST1     |
| 7              |          |              |
| 8              | KPC      | G1_XIST2     |
| 9              |          |              |

**6.3.4.3.7 Standard telegram 6**

Content: n-setpoint interface, 32 bit, with two sensors; additionally position difference and position controller gain in the setpoint direction for DSC

**Table 92 – Definition of standard telegram 6**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | NSOLL_B  | NIST_B       |
| 3              |          |              |
| 4              | STW2     | ZSW2         |
| 5              | G1_STW   | G1_ZSW       |
| 6              | G2_STW   | G1_XIST1     |
| 7              | XERR     |              |
| 8              |          | G1_XIST2     |
| 9              | KPC      |              |
| 10             |          | G2_ZSW       |
| 11             |          | G2_XIST1     |
| 12             |          |              |
| 13             |          | G2_XIST2     |
| 14             |          |              |

#### 6.3.4.3.8 Standard telegram 7

The standard telegram 7 is defined for positioning mode (AC 3).

Content: Positioning interface (Program submode)

**Table 93 – Definition of standard telegram 7**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | SATZANW  | AKTSATZ      |

#### 6.3.4.3.9 Standard telegram 9

The standard telegram 9 is also defined for positioning mode (AC 3).

Content: Positioning interface (Program submode plus MDI submode)

**Table 94 – Definition of standard telegram 9**

| IO Data number | Setpoint     | Actual value |
|----------------|--------------|--------------|
| 1              | STW1         | ZSW1         |
| 2              | SATZANW      | AKTSATZ      |
| 3              | STW2         | ZSW2         |
| 4              | MDI_TARPOS   | XIST_A       |
| 5              |              |              |
| 6              | MDI_VELOCITY |              |
| 7              |              |              |
| 8              | MDI_ACC      |              |
| 9              | MDI_DEC      |              |
| 10             | MDI_MOD      |              |

**6.3.4.3.10 Standard telegram 8**

The standard telegram 8 is defined for the position setpoint interface (AC 5).

Content: x-setpoint interface, 32 bit (position setpoint interface)

**Table 95 – Definition of standard telegram 8**

| IO Data number | Setpoint | Actual value |
|----------------|----------|--------------|
| 1              | STW1     | ZSW1         |
| 2              | XSOLL_A  | XIST_A       |
| 3              |          |              |
| 4              | STW2     | ZSW2         |
| 5              | NSOLL_A  | NIST_A       |

**6.3.4.3.11 Standard telegram 20**

The standard telegram 20 is exclusively defined for the use of the speed setpoint interface according to the VIK-NAMUR recommendations for process technology (AC 1).

Content: n-setpoint interface for the process technology, 16 bit  
(Definition: refer to 6.5).

**6.3.4.4 Configuring the DO IO Data**

IO Data in the data telegram may be assigned the individual setpoints/actual values using the DO IO Data configuring (telegram configuration). The standard signals from 6.3.4.2 as well as manufacturer-specific signals may be configured as setpoints/actual values.

There are four parameter numbers (PNU) in the profile-specific parameter section to configure this DO IO Data (see Table 96).

**Table 96 – Parameters for configuring a telegram**

| PNU    | Significance                                                            | Access authorisation | Data type          |
|--------|-------------------------------------------------------------------------|----------------------|--------------------|
| 915[x] | DO IO Data configuring (setpoint telegram)                              | read/write           | Array[x]Unsigned16 |
| 916[x] | DO IO Data configuring (actual value telegram)                          | read/write           | Array[x]Unsigned16 |
| 922    | Telegram selection                                                      | read/write           | Unsigned16         |
| 923[y] | List of all of the parameters for signals (profile and device-specific) | read only            | Array[y]Unsigned16 |

**P922: Telegram selection**

P922 shall be readable in every Application Class.

If the telegram selection is set with the Communication System configuration or in a manufacturer-specific way, the actual configuration shall be readable in parameter P922.

The permissible values are given in Table 97.

**Table 97 – Coding of P922**

| Value            | Meaning                                                                                                                                                                                          |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Telegram may be freely configured (P915[x], P916[x])                                                                                                                                             |
| 1                | Standard telegram 1: n-set interface, 16 bit (PROFIdrive profile, version 2)                                                                                                                     |
| 2                | Standard telegram 2: n-set interface, 32 bit, without sensor                                                                                                                                     |
| 3                | Standard telegram 3: n-set interface, 32 bit, with one sensor                                                                                                                                    |
| 4                | Standard telegram 4: n-set interface, 32 bit, with two sensors                                                                                                                                   |
| 5                | Standard telegram 5: n-set interface, 32 bit, with one sensor; additionally the position difference and the position controller gain are transferred in the setpoint direction to implement DSC  |
| 6                | Standard telegram 6: n-set interface, 32 bit, with two sensors; additionally the position difference and the position controller gain are transferred in the setpoint direction to implement DSC |
| 7                | Standard telegram 7: positioning interface (program submode)                                                                                                                                     |
| 8                | Standard telegram 8: x-setpoint interface, 32 bit (position setpoint interface)                                                                                                                  |
| 9                | Standard telegram 9: positioning interface (program plus MDI submode)                                                                                                                            |
| 10 to 19         | Standard telegrams 10 to 19 (reserved for PROFIdrive profile)                                                                                                                                    |
| 20               | Standard telegram 20: n-set interface for the process technology, 16 bit, see 6.5                                                                                                                |
| 21 to 29         | Standard telegrams 21 to 29 (reserved for PROFIdrive profile)                                                                                                                                    |
| 30 to 39         | Standard Safety telegrams 30 to 39 (reserved for PROFIdrive profile Safety Amendment)                                                                                                            |
| 40 to 80         | Standard telegrams 40 to 80 (reserved for PROFIdrive profile)                                                                                                                                    |
| 81 to 98         | Standard Encoder telegrams 81 to 98 (reserved for Encoder Profile)                                                                                                                               |
| 99               | Standard telegram 99 (reserved for PROFIdrive profile)                                                                                                                                           |
| 100 to 60 000    | Device-specific telegram                                                                                                                                                                         |
| 60 001 to 65 535 | Standard telegrams 60 001 to 65 535 (reserved for PROFIdrive profile)                                                                                                                            |

The following definitions are valid if selecting a telegram with P922.



- The standard pre-assignment of P922 should be a value of 1 to 99 for a standard telegram 1 to 99.
- If P922 is changed to 0, the previous setting of P915[x], P916[x] is kept.
- If P922 is changed to 1 to 65 535, then P915[x], P916[x] are also changed – if they have been implemented.
- To change P915 and P916, P922 shall be set to 0.

#### **P915[x], P916[x]: Configuring DO IO DATA in the telegram (x = DO IO DATA number – 1)**

Instead of selecting a telegram with parameter P922, a telegram may also be configured by using P915[x] and P916[x].

The following definitions are valid when configuring the telegrams.

- All of the signals which may be configured as DO IO Data are represented by a manufacturer-specific defined parameter number.
- The actual telegram is configured by entering the manufacturer-specific parameter number into parameter P915[x] (setpoint telegram) and P916[x] (actual value telegram). The DO IO Data number (1 to n) is selected via the array index x (0 to (n-1)).
- It is permitted to fix the content of P 915 and P 916.
- A telegram configured with P915[x], P916[x] should fit to the actual telegram configuration (i.e. the length), otherwise a device-specific alarm- or error response will be issued.
- The array size depends on the way that the telegram was configured.
- For DO IO DATA 1, only control word or status word 1 are permissible.
- DO IO Data which is not used is marked with zero (P915[x] = 0 or P916[x] = 0).

#### **P923[y]: List of all the parameters for signals (y = signal number)**

Using parameter P923[y], an assignment is made between the signal numbers and the associated manufacturer-specific parameter numbers. The array index y is the number of the signal. Array indices 1 to 99 consist of the standard signals defined in the profile (refer to 6.3.4.2), array indices 100 to 65 535 contain the device-specific signals if they are defined.

The following is valid for parameter P923[y].

- There is an entry for all standard signals which the device supports and for the device-specific signals.
- Standard signals which are not supported are identified with the entry 0.
- Gaps between device-specific signal numbers are filled with zeros.

#### **Example for configuring a telegram**

The following example (see Figure 40) specifies a standard telegram configuration (refer to P922) for the setpoint with signal numbers 1 (STW1) and 5 (NSOLL\_A), which are represented by the manufacturer-specific parameters P833 and P711 (refer to P915[x], P923[y]).

The controller may determine the following assignments by reading-out parameters P915[x], P923[y].

- P915[x] -> assignment: Parameter number/DO IO Data number.
- P923[y] -> assignment: Parameter number/ signal number.

The description elements of P711 contain information for the DO IO Data normalisation (refer to 6.3.4.5).

- Refer to the manufacturer-specific normalisation parameter P1401 (DO IO Data reference parameter).
- Bit position for the normalisation (DO IO Data normalisation).

**P922** = 1 (Standard telegram 1) -> IO Data 1 = STW1 / IO Data 2 = NSOLL\_A

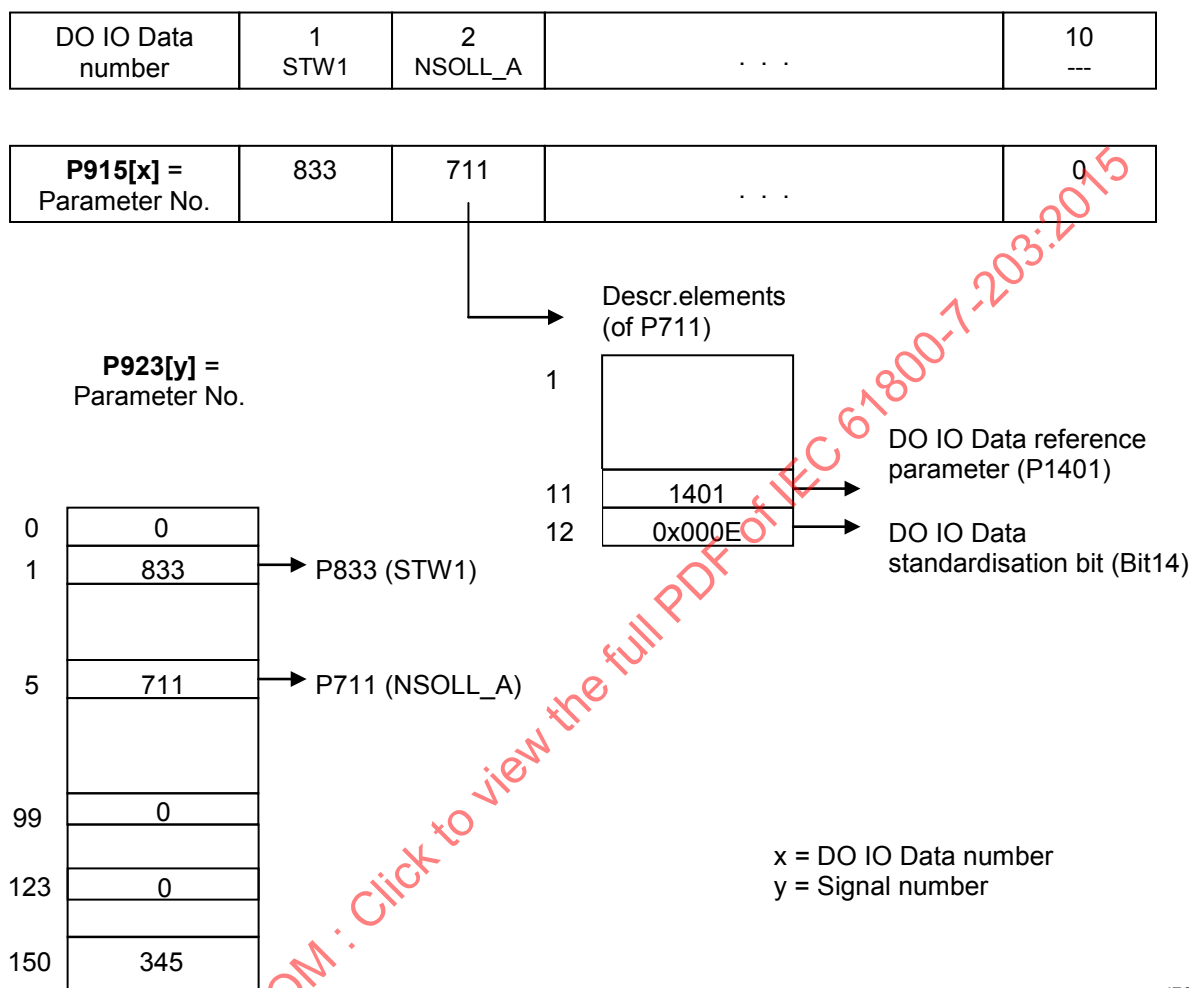


**Figure 40 – Example for configuring a telegram**

#### 6.3.4.5 DO IO Data normalisation

DO IO Data of the following data type is normalised:

- always: N2, N4, X2, X4;
- optional: Integer16, Integer32, Floating Point.

If there is no P923 available or the drive does not support a parameter description, the default normalisation shall be N2 or N4. PROFIdrive standard signals always have a fixed defined normalisation.

#### Non-normalised DO IO Data (e.g. data type Unsigned16)

The physical values may be calculated from the transferred value of a DO IO Data for non-normalised variables (e.g. data type Unsigned16) using the parameter description elements standardisation factor (subindex 3, refer to 6.2.1.3) as well as variable attribute (subindex 4, refer to 6.2.1.3).

### Normalised DO IO Data (data types N2, N4, X2, X4 or optional Integer16, Integer32, Floating Point)

To calculate the physical value from the transferred value of a DO IO Data for normalised variables (data types N2, N4 or X2, X4 or optional Integer16, Integer32, Floating Point), additional description elements are required.

Setpoints and actual values (e.g. NSOLL\_A, NIST\_A, NSOLL\_B, NIST\_B) shall be transferred as normalised DO IO Data, which often refer to various motor characteristic variables such as the maximum speed or the maximum current. Often, these motor characteristic variables are saved in a manufacturer-specific parameter (e.g. transferring the speed NSOLL\_A = 0x4000 corresponds to 100 % of P2000 = 3 000 r/min).

Whilst enabling the controller to deliver setpoints to drives from various manufacturers, the normalisation is fix for standard telegrams. In addition and also for vendor specific telegrams and signals, this normalisation information shall be able to be read out. To realise this, the already existing parameter description elements are supplemented by the “DO IO Data reference parameter” (subindex 11, refer to 6.2.1.3) and “DO IO Data normalisation” (subindex 12, refer to 6.2.1.3) components.

The “DO IO Data reference parameter” component contains the parameter number of the reference value and the “DO IO Data normalisation” component (the bit number of the bit) which refers to the reference value.

### Examples for normalising DO IO Data

A controller will read out the normalisation of a speed setpoint signal from the DO in order to enter a speed setpoint of 1 500 r/min:

- Example A: data type = N2 100 % = 0x4000 (NSOLL\_A is always N2)
- Example B: data type = X2 100 % = 0x1000 (for X = bit 12)
- Example C (see Table 100 and Table 101): data type = Float 100 % = 1,0 E+0

Example A and B (see Table 98 and Table 99) apply to data type Integer16 as well.

To realise this, the following steps are required.

- The controller shall first determine the manufacturer-specific parameter for the speed setpoint signal with the signal number (in example A: 5, in examples B: 100 and in example C: 101) out of P923[x] (in examples A: P923[5] = 711, in examples B: P923[100] = 712 and C: P923[101] = 713).
- The DO IO Data reference parameter (in the example: P2000) and the DO IO Data normalisation bit (in the example A: bit 14 corresponding to 0x4000; in example B: bit 12 corresponding to 0x1000) may be determined from the description element of this parameter.
- The controller may calculate the setpoint to be entered by reading out the contents of P2000 (in the example: 3 000,0) and the variable attribute of P2000 (in the example: r/min). (in the example A: 0x2000 corresponds to 1 500 r/min; in the example B: 0x0800 corresponds to 1 500 r/min).

**Table 98 – Example A/B for normalising DO IO Data, parameter values**

| Meaning | Example A<br>content of P711 | Example B<br>content of P712 | Content<br>of P2000 |
|---------|------------------------------|------------------------------|---------------------|
| Value   | for example 0x2000           | for example 0x0800           | 3 000,0             |

**Table 99 – Example A/B for normalising DO IO Data, parameter description elements**

| Meaning                                                          | Example A<br>content of P711            | Example B<br>content of P712            | Content<br>of P2000 |
|------------------------------------------------------------------|-----------------------------------------|-----------------------------------------|---------------------|
| Identifier:<br>Bit 0-7 = data type                               | 113 (N2)<br>or 3 (Integer16)            | 123 (X2)<br>or 3 (Integer16)            | 8 (float)           |
| No. of elements                                                  | 1                                       | 1                                       | 1                   |
| Standardisation factor                                           | 0,006 1 ( $100/2^{14}$ )                | 0,024 4 ( $100/2^{14}$ )                | 1,0                 |
| Variable attribute:<br>Variable index /<br>conversion index      | 24/0 ( %)                               | 24/0 ( %)                               | 11/67 (r/min)       |
| Name                                                             | ,nset'                                  | ,nset'                                  | ,nnorm'             |
| Lower limit value                                                | 0x8000 (-200 %)                         | 0x8000 (-800 %)                         | 1 000,0             |
| Upper limit value                                                | 0x7FFF<br>[(200 %-2 <sup>-14</sup> ) %] | 0x7FFF<br>[(800 %-2 <sup>-14</sup> ) %] | 10 000,0            |
| DO IO Data reference<br>parameter                                | 2000                                    | 2000                                    | 0                   |
| DO IO Data normalisation:<br>Bit 0-5 = Normalisation bit<br>0-31 | 14 (bit 14 -> 0x4000)                   | 12 (bit 12 -> 0x1000)                   | 0                   |
| Bit 15 = Normalisation<br>valid                                  | 1 (yes)                                 | 1 (yes)                                 | 0 (no)              |

Example C (Floating Point):

**Table 100 – Example C for normalising DO IO Data, parameter values**

| Meaning                             | Example C<br>content of P713 | Content<br>of P2000 |
|-------------------------------------|------------------------------|---------------------|
| Value                               | for example 0,5              | 3 000,0             |
| NOTE 0,5 corresponds to 1 500 r/min |                              |                     |

**Table 101 – Example C for normalising DO IO Data, parameter description elements**

| Meaning                                                                                       | Example C<br>content of P713     | Content<br>of P2000 |
|-----------------------------------------------------------------------------------------------|----------------------------------|---------------------|
| Identifier:<br>Bit 0-7 = data type                                                            | 8 (float)                        | 8 (float)           |
| No. of elements                                                                               | 1                                | 1                   |
| Standardisation factor                                                                        | 100,0 (100/1,0)                  | 1,0                 |
| Variable attribute:<br>Variable index / conversion index                                      | 24/0 ( %)                        | 11/67 (r/min)       |
| Name                                                                                          | ,nset'                           | ,nnorm'             |
| Lower limit value                                                                             | -4,0 (-400 %)                    | 1 000,0             |
| Upper limit value                                                                             | 4,0 (400 %)                      | 10 000,0            |
| DO IO Data reference parameter                                                                | 2000                             | 0                   |
| DO IO Data normalisation:<br>Bit 0-5 = Normalisation bit 0-31<br>Bit 15 = Normalisation valid | 0 (always with float)<br>1 (yes) | 0<br>0 (no)         |

### 6.3.5 Dynamic Servo Control (DSC)

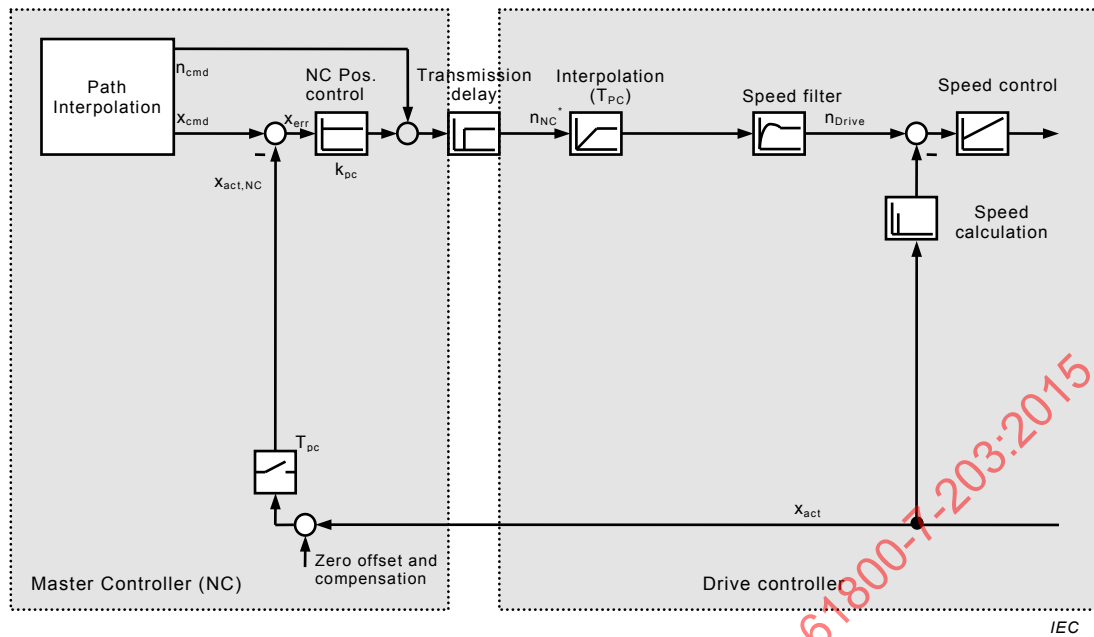
#### 6.3.5.1 Features

This function improves the dynamic performance of the position control loop by minimising the delays which normally occur with a velocity setpoint interface. In this case, only a relatively simple expansion of the transferred setpoints and an additional feedback network are required in the drive.

This function is upwards-compatible to the velocity setpoint interface. If required, it may be switched over during operation to the velocity setpoint interface.

#### 6.3.5.2 Structure

The control loop based on the velocity setpoint interface generally has the structure given in Figure 41.



Key:

$n_{cmd}$  speed command

$x_{cmd}$  position command

$x_{err}$  position error command

$x_{act}$  actual position

$T_{pc}$  position controller sampling time ( $= T_{CAC}$ )

$k_{pc}$  position controller gain

**Figure 41 – Structure of the position control circuit based on the velocity setpoint interface without DSC**

The actual position calculated in the drive is also directly fed back with DSC (see Figure 42).



The controller may select a different format for the position actual values and position setpoint value than the drive (for example, in order to display a wider traversing range than the drive) without loading the computational performance of the drive or having to increase telegram formats or to modify the dynamic performance of the control loop. It is also possible to compute feedback branch 1 referring to the load side and feedback branches 2 and 3 referring to the motor side, without changing the system behaviour.

It is permissible that the position actual value as supplied from the drive cyclically overflows, as long as the controller is sampled often enough so that overflows such as these are recognised. The feedback network (branches 2 and 3) shall not respond to such overflows with transient reactions.

The cyclic overflow of the position actual values in the drive shall not be synchronised with a mechanical overflow at the machine, but may be, for example, selected using the numerical format.

### 6.3.5.5 Using multiple sensors

Feedback branch 4 for the velocity actual value always uses the motor sensor.

There are three operating situations for the feedback branches 1, 2 and 3 in Figure 42:

- feedback branches 1, 2 and 3 use the motor-side sensor;
- feedback branches 2 and 3 use the motor sensor, feedback branch 1 uses the load-side sensor;
- feedback branches 1, 2 and 3 use the load-side sensor.

If there is no load-side sensor, case 1 always applies. In this case, feedback branch 1, 2 and 3 use the actual value from the motor sensor, whereby a different representation is possible in branch 1 (numerical format, load reference). This case applies to, for example, linear or rotary direct drives.

The feedback branches 2 and 3 may compute the motor-side actual value in a format which is favourable for the drive; the physical weighting of a motor-side sensor increment on the load side shall not be known.

If there is a load-side sensor which should be used for the position control loop, the two other operating cases are practical.

In case 2, branch 1 is not completely compensated by branch 2, as the actual values of the two sensors normally do not cover one another. However, the feedback network is still stable with respect to conventional control loops as not only the load-side actual value, but also the two actual values are fed back. The main advantage of this version is the fact that the load-side actual value shall not be supplied from the drive, but may also come from a sensor directly connected to the bus or to the controller.

Case 2 is handled in the drive as if there was no load-side sensor, i.e. the same as case 1 (not taking into account the fact, circumstances permitted, that an actual value of this sensor is made available to the controller).

In case 3, feedback branches 2 and 3 may compute the load-side actual value in a format which is favourable for the drive. The physical weighting of a load-side sensor increment shall not be known. The controller shall also ensure that in this case the normalisation of  $x_{err}$  and  $x_{act}$  are the same at the interface so that a simple computation is possible in the drive. The transition from the load to the motor side is made using the position controller gain factor  $k_{pc}$ .



### 6.3.5.6 Interface

Two additional signals are transferred in the setpoint direction:

- system deviation  $x_{err}$ .
- position controller gain factor  $k_{pc}$ .

These two signals have their own assigned index in signal list P923. They may be located at any position of the telegram using parameter P915. In order to simplify the implementation in the controller and drive, it is favourable if they are located at the end of the setpoint telegram.

The standard telegrams 5 and 6, defined for the Dynamic Servo Control (DSC) function, are described in more detail in 6.3.4.3.

If the two signals  $x_{err}$  and  $k_{pc}$  have been configured, the feedback network in the drive is activated. If only one of the two signals is configured, it is assumed that this is used for other purposes and the feedback network remains inactive.

The normalisation of XERR is identical to the normalisation of G1\_XIST1. Exception: If the load-side actual value is transferred in G1\_XIST1, and operating case 2 is present, then the normalisation of XERR corresponds to the motor-side actual value.

KPC has the unit  $(1/1\ 000)\ s^{-1}$ .

### 6.3.5.7 Operating states

From the drive perspective, there are two operating states, which differ as a result of  $k_{pc} = 0$  or  $k_{pc} \neq 0$ .

- $k_{pc} = 0$ : The feedback network is ineffective. The position control loop in the drive is opened. Generally, the controller uses this to completely open the position control loop, for example, for spindle operation or when errors occur. The controller may also select a conventional closed-loop position control without the need of re-configuration of the drive.  $x_{err}$  is invalid. It is recommended to send  $x_{err} = 0$ . The velocity setpoint is supplied via  $n_{cmd}$ .
- $k_{pc} \neq 0$ : The feedback network is effective. The position control loop in the drive is closed. A velocity pre-control value is entered via  $n_{cmd}$ , which may also be zero.

The controller may change over between these two states at any time. Furthermore, the controller may change the value of  $k_{pc}$  at any time (for example to adapt the dynamic performance when the gearbox ratio is changed or to compensate for non-linear gearboxes).

### 6.3.5.8 Implementation information

If the DSC functionality is used, the controller shall work with the optimised  $T_{DP}$  cycle ( $T_M > T_{DX}$ ) which is realised in the enhanced synchronised Isochronous Mode (refer to IEC 61800-7-303:2015, 4.9.2).

The feedback branch 2 shall precisely emulate the effect of feedback branch 1 between points A and B. Both branches shall:

- operate with an actual value which comes from the same time instant and which is sampled with the same frequency,
- have the same delay,
- contain the same fine interpolation.

This is specified in the structure diagram (block diagram) using the dotted arrows.

The feedback network may also be re-configured by interchanging elements, as long as the conditions are maintained, that branch 2 compensates branch 1 and branch 3 closes the control loop. Such versions, which are structured differently, under certain circumstances, are better emulated on existing hardware.

It is possible, for example, to compute branch 2 and process  $x_{err}$  up to point B on a communication CPU which is located in an intermediate position. However, this is assuming that computational performance is still available and that only branch 3 and processing from point B are calculated on the drive processor. Instead of a communication CPU, a slower time level may be used on the drive processor.

However, when re-configuring the network, it should still be observed that actual values which cyclically overflow cannot initiate transient reactions of the position control loop.

It is recommended that the feedback network also be continuously calculated during  $k_{pc} = 0$ . The memory, which is contained by the network, is always tracked in this way and the transition to  $k_{pc} \neq 0$ , which may occur at any time, is easier to implement.

For a transition to  $k_{pc} \neq 0$ , the interpolation filters in the  $x_{err}$  branch and in the  $n_{cmd}$  branch shall be bypassed for one clock cycle ( $T_{PC}$ ).

For a transition to  $k_{pc} = 0$ , the drive-internal controller output goes to zero as a jump function. The controller also simultaneously increases  $n_{cmd}$  by the same absolute value as a step function so that the velocity sum at the speed controller input always runs continuously. In order for this to also work during motion, the interpolation filter shall be bypassed in the  $n_{cmd}$  branch for one clock cycle ( $T_{PC}$ ).

The velocity setpoint filter ("speed filter") specified in the block diagram is optional and has nothing to do with the DSC function. It has only been drawn-in to make a clear differentiation to conventional closed-loop position control structures.

### 6.3.6 Position feedback interface

#### 6.3.6.1 Overview

The position feedback interface defined in this profile is an interface between the Axis and a higher level control. The interface gives the possibility for the control to get position feedback information over the PROFIdrive Interface taken from the sensors connected to the Drive (see Figure 43). The functionality described in the position feedback interface is implemented in the drive, not in the sensor itself.

A position feedback interface consists of the following objects that may be used for telegram configuring (refer to 6.3.4.4) through assignment (DO IO Data number/parameter number):

- Gx\_STW Control Word Control of the sensor functionality
- Gx\_ZSW Status Word Sensor states, sensor acknowledgements, sensor error messages, etc.
- Gx\_XIST1 Actual Position-1 Actual position value
- Gx\_XIST2 Actual Position-2 Additional actual position value

These objects Gx\_\* are available for a max. of 3 sensors (Gx = Sensor 1 to 3), and may also be used individually (for example, only G1\_STW).

The sensors are parameterised via device-specific parameters.

The position feedback interface is defined for the application with a cyclic speed setpoint interface.

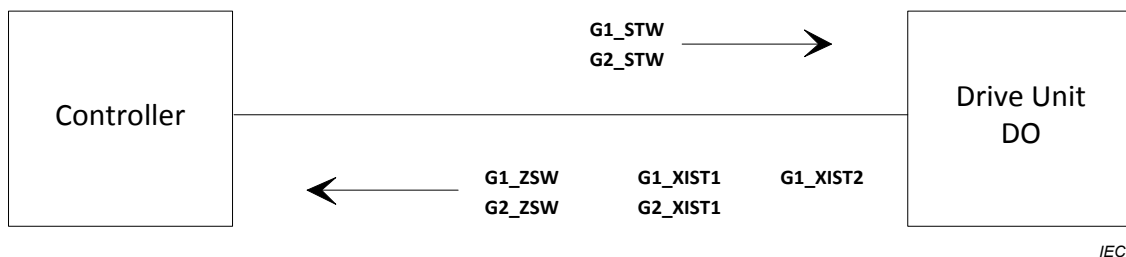


**Figure 43 – Example of the sensor interface  
(Sensor-1: two actual values/Sensor-2: one actual value)**

### 6.3.6.2 Actual positions

#### 6.3.6.2.1 General

Because of possible user data failure, actual positions ( $Gx\_XISTx$ ) cannot be transmitted as partial actual values. For that reason, cyclically absolute actual position values are always transmitted (i.e. after a certain number of revolutions there is an actual position overflow).

In Data\_Exchange, the drive always – independently of the controller's operating modes Clear and Operate – sends the actual positions ( $Gx\_XISTx$ ).

The following applies to the evaluation of the actual positions ( $Gx\_XISTx$ ).

- The receiver may evaluate an actual position incrementally, whereby the zero point is set by approaching a home position and by setting it, or by the controller reading an absolute value (refer to explanation below). This may be applied to all sensor types.
- An actual position value may also be viewed as an absolute value (which may, if necessary, be charged up only against a zero shift in the controller), if limited to absolute sensors on axes with a finite traversing range (which is less than the display range of the sensor).
- In the case of continuously rotating axes, incremental evaluation is preferable (no modulo handling in the drive).
- It should be possible for the controller to select the modulo range and the modulo strategy (there should be none in the drive). If the drive permits modulo processing, this should be able to be disabled via a parameter.

Explanation:

The actual position value transmitted in  $Gx\_XISTx$  is an absolute actual value which the drive may simply set to 0 when it is started and after the parking sensor has been disabled. For that reason, a higher level control should only use the position differences between two position controller cycles to calculate its internal actual position value.

- A sensor shall deliver  $Gx\_XIST1$ . If a sensor only uses a serial protocol and therefore only has an absolute value, then this value will be delivered in  $Gx\_XIST2$  and also in  $Gx\_XIST1$ .
- An increase in the Shift factor automatically results in an increase in resolution. This should go for  $Gx\_XIST1$  and the absolute value in  $Gx\_XIST2$  as far as technically possible.  
(That means there will not only be padding with zeros inserted if the values are shifted further to the left.)
- The absolute value in  $Gx\_XIST2$  shall be valid at the same time as that from  $Gx\_XIST1$ . Only then shall the absolute value be usable to make corrections to the incremental value.  
This means that the drive shall also make corrections to the absolute value via the incremental value: several sampling periods may pass until the absolute value is available

from the sensor. This “old” absolute value shall be compensated with the incoming incremental position to create the same valid instant in time for both values.

- Assigning different functions to the Gx\_XIST2 (as well as the normalisation of Gx\_XIST2 at the different functions) is governed by a prioritisation of the functions (refer to Table 106).

The profile parameter P979 “sensor format” contains the important properties of the sensors. Properties are for example the normalisation of Gx\_XIST1 and Gx\_XIST2.

#### 6.3.6.2.2 Structure of parameter 979 “sensor format”

The structure of parameter 979 is given in Table 102 to Table 105.

**Table 102 – Structure of parameter 979 (sensor format)**

| Subindex | Meaning                                       | Comments                           |
|----------|-----------------------------------------------|------------------------------------|
| 0        | Header                                        | information for the indices 1 to n |
| 1        | Sensor type                                   | 1. sensor (G1)                     |
| 2        | Sensor resolution                             | 1. sensor (G1)                     |
| 3        | “shift factor” for G1_XIST1                   | 1. sensor (G1)                     |
| 4        | “shift factor” for absolute value in G1_XIST2 | 1. sensor (G1)                     |
| 5        | Determinable revolutions                      | 1. sensor (G1)                     |
| 6 to 10  | Reserved for future use                       | 1. sensor (G1)                     |
| 11 to 20 | Equal to Subindex 1 to 10                     | 2. sensor (G2)                     |
| 21 to 30 | Equal to Subindex 1 to 10                     | 3. sensor (G3)                     |
| 31 to n  | Reserved for the profile                      |                                    |

#### Subindex 0: Header

**Table 103 – Subindex 0 (header) of parameter 979**

| Bits     | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 3   | Version of the parameter structure, least significant number (value range: 0 to 15)<br>This version field is incremented when additional data description information is added or when assigning previously unassigned bits (compatible extension).<br>0: reserved<br>1: Identifier for the predecessor structure related to profile version 4.1<br>2: Identifier for the presented structure (support of bits 29 and 30 in 979[1])<br>>8: manufacturer-specific (the manufacturer has included additional indices, whereas those defined in the profile remain unaltered.) |
| 4 to 7   | Version of the parameter structure, most significant number (value range: 0 to 15)<br>This version field is incremented when previously defined data description information is modified (incompatible modification).<br>0: reserved<br>1: Identifier for the present structure<br>>8: manufacturer-specific                                                                                                                                                                                                                                                                |
| 8 to 11  | Number of described sensors (Gx) in the parameter. (value range: 0 to 15)<br>It is recommended to limit the number of described sensors to the number of active sensor interfaces to reduce communication overhead between controller and DO.                                                                                                                                                                                                                                                                                                                               |
| 12 to 15 | Number of the assigned indices describing a sensor (sensor substructure) (value range: 5 to 10).                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 16 to 31 | Reserved for future use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Subindex 1: Sensor type****Table 104 – Subindex 1 (sensor type) of parameter 979**

| Bits    | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0       | = 0 Rotary sensor<br>= 1 Linear sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 1       | = 0 A fine resolution in Gx_XIST1 displays a relative position (no reference to the signal period). This means the position of the sensor signal within a sinus signal is not displayed in the switch-on instant.<br>= 1 A fine resolution in Gx_XIST1 displays the absolute position within a signal period. The transferred value may be interpreted as an absolute value, because the fine resolutions are synchronous in every switch-on instant.                                                                                                                                                                                               |
| 2       | = 0 No 64 Bit absolute information available.<br>= 1 Reserved for future extensions: 64 Bit absolute information available.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3 to 28 | Reserved for future use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 29      | = 0 Data in parameter 979 substructure Gx is static and will not change after state transition from state parking to state normal operation.<br>= 1 Data in parameter 979 substructure Gx may change after state transition from state parking to state normal operation. This means the controller has to read the content of this substructure with every state change from "parking" or "parking & error" to "normal operation". This functionality is to manage drives which are able to handle different measurement systems at one interface. This functionality is only available with version of the 979 parameter structure 1.2 or higher. |
| 30      | = 0 If currently Data in parameter 979 substructure Gx is invalid (parameter 979[1] bit 31 = 0), this may change to valid (parameter 979[1] bit 31 = 1) at a future time. Change of validity from invalid to valid shall only be possible while the measurement system is in state "parking". This functionality is only available with version of the 979 parameter structure 1.2 or higher.<br>= 1 Validity of Data in parameter 979 substructure Gx which is currently signalled in parameter 979[1] bit 31 is static and will not change.                                                                                                       |
| 31      | = 0 Data in parameter 979 substructure Gx is invalid<br>= 1 Data in parameter 979 substructure Gx is valid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Subindex 2: Sensor resolution****Table 105 – Subindex 2 (sensor resolution) of parameter 979**

| Sensor type <sup>a</sup>                                                                                                                                                                                                                                                                                                                                              | Meaning                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Rotary sensor                                                                                                                                                                                                                                                                                                                                                         | Number of pulses (=signal period) per revolution <sup>b</sup> |
| Linear sensor                                                                                                                                                                                                                                                                                                                                                         | Length of a signal period in Nanometers <sup>b</sup>          |
| <sup>a</sup> The sensor type results from Subindex 1 Bit 0.<br><sup>b</sup> If the sensor delivers no signal period (=A and B-tracks) but rather a serial protocol, then the following is valid: for a rotary sensor, the parameter contains the number of increments per revolution. For a linear sensor, the parameter contains the increment length in Nanometers. |                                                               |

The sensor resolution given in subindex 2 of parameter 979 is equally valid for Gx\_XIST1 and the absolute value in Gx\_XIST2. This implies that Gx\_XIST1 and the absolute value in Gx\_XIST2 shall be able to be broken down to the same elementary unit when different physical resolutions are present in the incremental and absolute sensor part of the encoder.

**Subindex 3: "Shift factor" for Gx\_XIST1**

Specifies how many bits defining the sum of quadrant information and fine resolution are displayed in Gx\_XIST1 (value range: 0 to 32).

The fine resolution results from the signal period interpolation. An “Impulse quadruplication” or “arctangent interpolation evaluation” is to be calculated to the fine resolution. Only values of  $2^n$  are possible for the Shift factor because the fine resolution should be interpretable within a signal period (see Subindex 1 Bit 1). Therefore, overflows in the fine resolution always fall on a bit-boundary.

Sensors whose resolutions are less than 32 bits, may set their sensor information to left justified, so that the bit at which the modulo overflow takes place is known.

#### **Subindex 4: “Shift factor” for absolute value in Gx\_XIST2**

Specifies how many bits defining the sum of quadrant information and fine resolution of the transmitted absolute value in Gx\_XIST2 are to be displayed. (value range: 0 to 32) (see also Subindex 3).

#### **Subindex 5: Determinable revolutions**

Specifies which absolute position information may be delivered by the sensor. This is relevant for rotary and also linear sensors.

- Rotary sensors
  - A value of 0 indicates that the sensor has no absolute information or may only display values less than one absolute revolution. (For example, a multipole resolver). Notice, that with value = 0, the sensor interface will not support the absolute value reading function via Gx\_XIST2.
  - A value of 1 indicates that the sensor may display exactly one absolute revolution (For example a resolver with 1 pole pair). Notice, that with values of 1 or greater, the encoder interface shall support the absolute value reading functionality via Gx\_XIST2.
  - Values greater than 1 indicate a multi-turn sensor (For example, 4 096 is a commonly used value).
- Linear sensors
  - A value of 0 indicates that the sensor has no absolute information (for example standard incremental linear scale).
  - A value of 1 or greater indicates that the sensor delivers absolute position information.

#### **6.3.6.2.3 Examples of the actual value format**

Meaning of the abbreviations:

- F – fine resolution
- P – pulses
- Q – quadrant information (quadrants which are calculated of the signs of sinus and cosine)
- R – revolutions

In these examples, all Gx\_XIST1 are specified with shift factor 11 ( $P_{979.3}=11$ ), except in example 8. All Gx\_XIST2 are specified with shift factor 9 ( $P_{979.4}=9$ ), except in Examples 3, 5, 7 and 8.

The fine resolution information is optional and defined device-specific according to the quality of the position feedback interface. The shift factor for Gx\_XIST1 may be freely defined by the application and may not match the internal resolution of the fine interpolation of the drive. Unused bits of fine resolution in the actual value format shall be filled with zero bit value by the drive. The maximum fine resolution that the drive is capable of delivering need not be evaluated from P979.

EXAMPLE 1 Multi-turn absolute value encoder with additional incremental tracks.

12 Bit revolutions (multi-turn), 11 Bit increments (2 048 pulses per revolution) (see Figure 44)

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | Q  | Q | F | F | F | F | F | F | F | F | F |

Gx\_XIST1: integrated; initial value arbitrary

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P | Q | Q | F | F | F | F | F | F | F |

absolute value in Gx\_XIST2

IEC

**Figure 44 – Actual value format, Example 1**

EXAMPLE 2 Multi-turn absolute value encoder with additional incremental tracks.

12 Bit revolutions (multi-turn), 9 Bit increments (512 pulses per revolution) (see Figure 45)

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | Q  | Q | F | F | F | F | F | F | F | F | F |

Gx\_XIST1: integrated; initial value arbitrary

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0  | 0  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P | Q | Q | F | F | F | F | F | F | F |

absolute value in Gx\_XIST2

IEC

**Figure 45 – Actual value format, Example 2**

EXAMPLE 3 Incremental encoder (with additional C/D tracks for commutation information).

11 Bit increments (2 048 pulses per revolution), C/D tracks are with no effect on the actual value format (see Figure 46)

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | Q  | Q | F | F | F | F | F | F | F | F | F |

Gx\_XIST1: integrated; initial value arbitrary

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |

absolute value in Gx\_XIST2

IEC

**Figure 46 – Actual value format, Example 3**

EXAMPLE 4 Linear absolute value encoder with additional incremental tracks.

25 Bit, one period of the incremental track is divided in 160 values of the protocol, 250 000 pulses in 4 Metres = 17,9 Bit (see Figure 47)

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P | Q | Q | F | F | F | F | F | F | F |

Gx\_XIST1: integrated; initial value arbitrary

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0  | 0  | 0  | 0  | 0  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P | P | Q | Q | F | F | F | F | F | F |

absolute value in Gx\_XIST2

IEC

Figure 47 – Actual value format, Example 4

EXAMPLE 5 "Only" incremental encoder.

5 000 pulses = 12,28 Bits (decimal pulses) (see Figure 48)

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P  | P | Q | Q | F | F | F | F | F | F | F |

Gx\_XIST1: integrated; initial value arbitrary

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |

absolute value in Gx\_XIST2

IEC

Figure 48 – Actual value format, Example 5

EXAMPLE 6 2-pole resolver (see Figure 49).

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R | Q | Q | F | F | F | F | F | F | F |

Gx\_XIST1: integrated; initial value arbitrary

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0 | Q | Q | F | F | F | F | F | F | F |

absolute value in Gx\_XIST2

IEC

Figure 49 – Actual value format, Example 6

EXAMPLE 7 8-pole resolver (see Figure 50).

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | P  | P  | Q  | Q | F | F | F | F | F | F | F | F | F |

Gx\_XIST1: integrated; initial value arbitrary

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |

absolute value in Gx\_XIST2

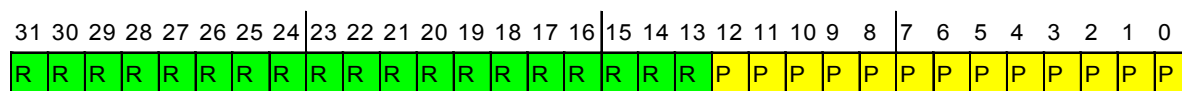
IEC

Figure 50 – Actual value format, Example 7

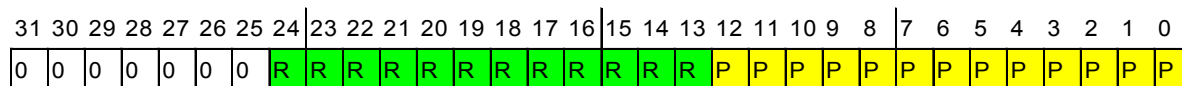


EXAMPLE 8 "Only" absolute value encoder (no additional incremental tracks).

25 Bit, consisting of 8 192 (13 bits) steps per revolution and 4 096 (12 bits) distinguishable revolutions (see Figure 51)



Gx\_XIST1: integrated; initial value arbitrary



absolute value in Gx\_XIST2

IEC

**Figure 51 – Actual value format, Example 8**

### 6.3.6.3 Assigning the actual values in the telegram

Object Gx\_XIST1 is used exclusively to transfer the cyclic position actual value.

The assignment of Gx\_XIST2 with different functions (and the normalisation of Gx\_XIST2 for the various functions) is controlled according to the priority assignment of the various functions and states defined in Table 106.

**Table 106 – Assigning Gx\_XIST2 (sensor-x position actual value-2)**

| Priority | Function                                              | Info from Gx_ZSW | Related State   | Gx_XIST2 assignment                                                                                         | Gx_XIST2 normalisation |
|----------|-------------------------------------------------------|------------------|-----------------|-------------------------------------------------------------------------------------------------------------|------------------------|
| --       | Communication in "Preparation"                        | x                | --              | Position actual value (cyclic)                                                                              | as in P979             |
| 1        | Parking sensor                                        | x                | SD12            | Not valid                                                                                                   | --                     |
| 2        | Sensor error                                          | x                | BD2             | Error code                                                                                                  | --                     |
| 3        | Reference mark search<br>or<br>measurement on the fly | x                | SD4<br>SD11     | Position actual value<br>(reference mark or measured<br>value)                                              | as Gx_XIST1 in<br>P979 |
| 4        | Absolute value cyclically                             | x                | SD1 and<br>SD10 | Position actual value (cyclic).<br>Only possible if an absolute<br>value measurement system is<br>available | as in P979             |

If the communication system is in the "Clear" state, it is recommended to transmit the absolute position actual value in Gx\_XIST2 automatically if already present in the drive. A valid absolute position actual value in Gx\_XIST2 is indicated by Gx\_ZSW, bit 13. This helps the controller to synchronise faster to the drive and therefore shortens the overall system startup time.

### 6.3.6.4 Error codes in Gx\_XIST2

If the position feedback interface is in state "Sensor error", an error code according to the definition in Table 107 is transmitted in signal Gx\_XIST2.

**Table 107 – Error codes in Gx\_XIST2**

| <b>Gx_XIST2</b> | <b>Meaning</b>                    | <b>Explanation</b>                                                                                                                                                                                                                                                         |
|-----------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x0001          | Sensor group error                | Error in the processing of the sensor signal which causes an invalid Gx_XIST (e.g. electronic malfunction, invalid sensor signal input, etc.).                                                                                                                             |
| 0x0002          | Zero mark monitoring              | Warning about inconsistency between correctly processed Gx_XIST and sensor reference signal (e.g. lost pulses, etc.).                                                                                                                                                      |
| 0x0003          | Failure parking sensor            | Error because of not possible transition to SD12 (parking). This may be for example because the drive is currently running (state S4) and the motor measurement system is forced to parking.                                                                               |
| 0x0004          | Abort reference value search      | Error occurred during the initialisation or during the search for reference mark.<br>There was an internal error or GxSTW, Bit7 changed to 1 while the position feedback interface was in state SD5.                                                                       |
| 0x0005          | Abort reference value retrieval   | Error occurred during reading of the reference value. There is no valid reference value or the command is not allowed or GxSTW, Bit7 changed to 1 while the position feedback interface was in state SD4.                                                                  |
| 0x0006          | Abort measurement on the fly      | Error occurred during the initialisation or during the action of the function “measurement on the fly”.<br>There was an internal error or GxSTW, Bit7 changed to 0 while the position feedback interface was in state SD10.                                                |
| 0x0007          | Abort measured value retrieval    | Error occurred during reading the result of the function “measurement on the fly”. There is no valid value or the command is not allowed or GxSTW, Bit7 changed to 0 while the position feedback interface was in state SD11.                                              |
| 0x0008          | Abort absolute value transmission | Error because of not possible absolute value transmission from encoder to the feedback interface. This may be for example because of an absolute value encoder (with serial interface) not present or not working.                                                         |
| 0x0009          | Abort absolute value transmission | Reserved                                                                                                                                                                                                                                                                   |
| 0x000A          | Abort absolute value transmission | Absolute value track of encoder not readable.                                                                                                                                                                                                                              |
| 0x000B          | Abort absolute value transmission | Reserved                                                                                                                                                                                                                                                                   |
| 0x000C – 0x0F00 | reserved for profile              |                                                                                                                                                                                                                                                                            |
| 0x0F01          | Command not supported             | Error because of not supported optional function (e.g. shift/preset home position).                                                                                                                                                                                        |
| 0x0F02          | C-LS fault                        | Error in the monitoring of the controller sign-of-life (this fault code is used in the encoder profile for encoder devices which do not support the PROFIdrive fault buffer. This fault code shall not be used by drives which support the PROFIdrive fault buffer).       |
| 0x0F03          | reserved for profile              |                                                                                                                                                                                                                                                                            |
| 0x0F04          | Synchronisation fault             | Synchronisation to the clock master was lost (this fault code is used in the encoder profile for encoder devices which do not support the PROFIdrive fault buffer. This fault code shall not be used by drives which support the PROFIdrive fault buffer).                 |
| 0x0F05          | Overtemperature fault             | The maximum operating temperature of the sensor was exceeded (this fault code is used in the encoder profile for encoder devices which do not support the PROFIdrive fault buffer. This fault code shall not be used by drives which support the PROFIdrive fault buffer). |
| 0x0F06 – 0x1000 | reserved for profile              |                                                                                                                                                                                                                                                                            |
| from 0x1001     | manufacturer-specific             |                                                                                                                                                                                                                                                                            |

If there is more than one error codes present at the same time, the error code with the highest severity is reported in Gx\_XIST2. This is to show to the controller the most relevant error code for the validity of Gx\_XIST1. For example if first an over temperature error occurs and as a result the sensor signal gets invalid, Gx\_XIST2 first shows error code 0x0F05 and afterwards 0x0001.

### 6.3.6.5 Position feedback control word

The sensor control word is specified in Table 108.

**Table 108 – Sensor control word**

| Bit    | Value  | Meaning                                                                                      | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------|--------|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0      | 1      | Function requests <sup>a</sup> :<br><br>Reference mark search,<br><br>measurement on the fly | Function 1-4:<br><br>Request reference mark search (Bit 7 = 0)<br><br>Bit 0: Function 1 (Reference Mark 1)<br>Bit 1: Function 2 (Reference Mark 2)<br>Bit 2: Function 3 (Reference Mark 3)<br>Bit 3: Function 4 (Reference Mark 4)<br><br>Request measurement on the fly (Bit 7 = 1)<br><br>Bit 0: Function 1 (Probe 1 pos. edge)<br>Bit 1: Function 2 (Probe 1 neg. edge)<br>Bit 2: Function 3 (Probe 2 pos. edge)<br>Bit 3: Function 4 (Probe 2 neg. edge)                                                                                                                                                |
| 1      | 1      |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2      | 1      |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3      | 1      |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4 to 6 | 1 to 3 |                                                                                              | Command: 0: ---<br>1: activate Functions <sup>b</sup> x (specified by bits 0-3, 7)<br>2: read Value <sup>c</sup> x (specified by bits 0-3, 7)<br>3: cancel Functions <sup>d</sup> x<br>4-7: reserved (activation causes an error)                                                                                                                                                                                                                                                                                                                                                                           |
| 7      | 0/1    |                                                                                              | Mode <sup>g</sup> :<br><br>Bit 7 = 0: Reference mark search (zero mark or BERO)<br>Bit 7 = 1: Measurement on the fly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 8      |        |                                                                                              | Reserved (without effect)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 9      |        |                                                                                              | Reserved (without effect)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 10     |        |                                                                                              | Reserved (without effect)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 11     | 0/1    | Home position mode                                                                           | Modifier for home position mode:<br><br>Bit 11 = 0: set home position (absolute)<br>Bit 11 = 1: shift home position (relative)                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 12     | 1      | Request set/shift of home position <sup>e</sup>                                              | Request for set/shift of home position.<br>Edge-triggered. Handshake with Gx_ZSW, bit 12.<br>Definition of preset/shift value is device-specific.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 13     | 1      | Request absolute value cyclically <sup>f</sup>                                               | Request of additional cyclic transmission of the absolute actual position in Gx_XIST2. Transmission of XIST2 in Gx_XIST2 (if function supported by the measurement system) is possible in SD1 and SD10 (see also Table 106).<br><br>Used for, for example: – additional measuring system monitoring<br>– synchronisation at running-up                                                                                                                                                                                                                                                                      |
| 14     | 1      | Activate parking sensor                                                                      | Request to switch off monitoring of the measuring system and the actual value measurements in the drive. This makes it possible to remove a sensor (or a motor with a sensor) on the machine without having to change the drive configuration, or without causing a fault. In addition, when parking of the sensor interface is instructed by this Gx_STW1, bit14, all actual errors of the sensor interface are cleared. Typically, the parking of the motor measurement system while the drive is running (S4) is not allowed and will result in a sensor interface error (Error code 0x0003 in GxXIST2). |
| 15     | 1      | Acknowledging a sensor error                                                                 | Request to reset a sensor error (Gx_ZSW, bit15).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

- a Selection of Function (bit 0 to 3) and Command (bit 4 to 7) shall be set simultaneously. If a Command is requested without having selected a valid Function (bit 0 to 3 are all zero), the function request will cause an error (error code 0x0004 – 0x0007) and the position feedback interface changes to the SD3 state.
- b Activation of multiple functions with one command is possible (e.g. sensor control word = 0x0013). If only one of these multiple function request causes an error, none of the functions of this function request are performed and the position feedback interface changes to the SD3 state. With activation of the measurement process, an already existing measured value is generally discarded. The activation of a measurement process is only possible with the activate command and the related function bit set true. Deactivation of an active measurement process is only possible with the cancel command (cancels all measurement processes at once) or with parking of the sensor interface (also when the measured value is found).
- c Only one function shall be selected. If more than one function is requested, the position feedback interface changes to the SD3 with error code 0x0005 or 0x0007 in Gx\_XIST2.
- d The cancel function command will cancel all functions (sensor control word bits 0 to 3 are with no effect) and force the position feedback interface to change to the SD1 state (until it is not already parked or in the error state). After the cancel of the measurement processes, all measured values or reference values are still present and may be read out by the “read Value” command.
- e Set-/Shift home position functionality is an optional functionality. If not implemented, requesting this function will cause an error with error code 0x0F01 in Gx\_XIST2.
- f If the PROFIBUS is in the “Clear” state, it is recommended to transmit the absolute position actual value in Gx\_XIST2 automatically if already present in the drive. A valid absolute position actual value in Gx\_XIST2 is indicated by Gx\_ZSW, bit 13 (refer to 6.3.6.3).
- g If one of the modes “reference mark search” or “measurement on the fly” is still active (SD4, SD5, SD10, SD11), during the mode bit GxSTW, Bit7 changes to another mode, not equal to the actual active state, the position feedback interface shall abort the actual mode/state and switch to the error state SD3/SD13.

### 6.3.6.6 Position feedback status word

The sensor status word is specified in Table 109.

**Table 109 – Sensor status word**

| Bit | Value | Meaning                                                                                | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----|-------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | 1     | Function status:<br><br>Reference mark search,<br><br>or<br><br>measurement on the fly | Status <sup>a</sup> : Function 1-4 active (reference mark search/measurement on the fly)                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 1   | 1     |                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2   | 1     |                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 3   | 1     |                                                                                        | Bit 0: Function 1 (Reference Mark 1/Probe 1 pos. edge)<br>Bit 1: Function 2 (Reference Mark 2/Probe 1 neg. edge)<br>Bit 2: Function 3 (Reference Mark 3/Probe 2 pos. edge)<br>Bit 3: Function 4 (Reference Mark 4/Probe 2 neg. edge)                                                                                                                                                                                                                                                                           |
| 4   | 1     |                                                                                        | Status: Value 1 to 4 available (reference mark/probe )                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 5   | 1     |                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 6   | 1     |                                                                                        | Bit 4: Value 1 (Reference Mark 1/Probe 1 pos. edge)<br>Bit 5: Value 2 (Reference Mark 2/Probe 1 neg. edge)<br>Bit 6: Value 3 (Reference Mark 3/Probe 2 pos. edge)<br>Bit 7: Value 4 (Reference Mark 4/Probe 2 neg. edge)                                                                                                                                                                                                                                                                                       |
| 7   | 1     |                                                                                        | Simultaneously to bit 0 to 3 (value available only if related function is available).                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 8   | 1     | Probe 1 deflected                                                                      | Static mode Probe 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 9   | 1     | Probe 2 deflected                                                                      | Static mode Probe 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 10  |       |                                                                                        | Reserved, set to zero                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 11  |       |                                                                                        | Error acknowledgement in process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 12  | 1     | Set/shift of home position executed <sup>b</sup>                                       | Acknowledgement for "Request for set/shift of home position".<br>Edge triggered. Signals the setting/shifting of Gx_XIST1 and Gx_XIST2 value. Handshake with Gx_STW, bit 12.                                                                                                                                                                                                                                                                                                                                   |
| 13  | 1     | Transmit absolute value cyclically <sup>c</sup>                                        | Indication of cyclic transmission of the absolute actual position in Gx_XIST2. Possible only if sensor delivers an absolute value Information (displayed in P979.5).<br>Reaction on Gx_STW, bit 13 ("request absolute value cyclically") according to Table 106 or Communication System in state "Clear".                                                                                                                                                                                                      |
| 14  | 1     | Parking sensor active <sup>d</sup>                                                     | Acknowledgement for "activate parking sensor" (Gx_STW, bit 14) or indication of invalid Gx_XIST1.                                                                                                                                                                                                                                                                                                                                                                                                              |
| 15  | 1     | Sensor error                                                                           | Signals a sensor device error or an error in the actual value measurement. The related error code is provided in Gx_XIST2 (see Table 107). If there is more than one error codes, the error code with highest severity is reported in Gx_XIST2 (this is to show the controller the most relevant error code for the validity of Gx_XIST1. For example if first an over temperature error occurs and as a result the sensor signal gets invalid, Gx_XIST2 first shows error code 0x0F05 and afterwards 0x0001). |

<sup>a</sup> If a function request causes an error, all functions are cancelled and the position feedback interface changes to the SD3 state, which means that the sensor status bits 0 to 7 are set to zero and the sensor error bit 15 is set (the corresponding error code is provided in Gx\_XIST2). Example: The function reference mark search for reference mark 1 to 4 is activated (sensor control word = 0x001F) while the drive only supports two reference marks. This will cause the sensor status word = 0x8000 and the 0x0004 error code in Gx\_XIST2.

<sup>b</sup> Set/Shift home position functionality is an optional functionality. If not implemented, bit 12 will be 0.

<sup>c</sup> If the communication system (PROFIBUS, PROFINET) is in the "Clear" state, it is recommended to transmit the absolute position actual value in Gx\_XIST2 automatically if already present in the drive. A valid absolute position actual value in Gx\_XIST2 is indicated by Gx\_ZSW, bit 13 (refer to 6.3.6.3).

<sup>d</sup> If the position feedback interface is in the state "parking" (SD12), bit 14 is set and only bits 8, 9, 14 of the sensor status word are serviced, all other bits shall be set to zero.

### 6.3.6.7 State diagram of the position feedback interface

#### 6.3.6.7.1 State diagram

Figure 52 shows the state diagram of the position feedback interface.

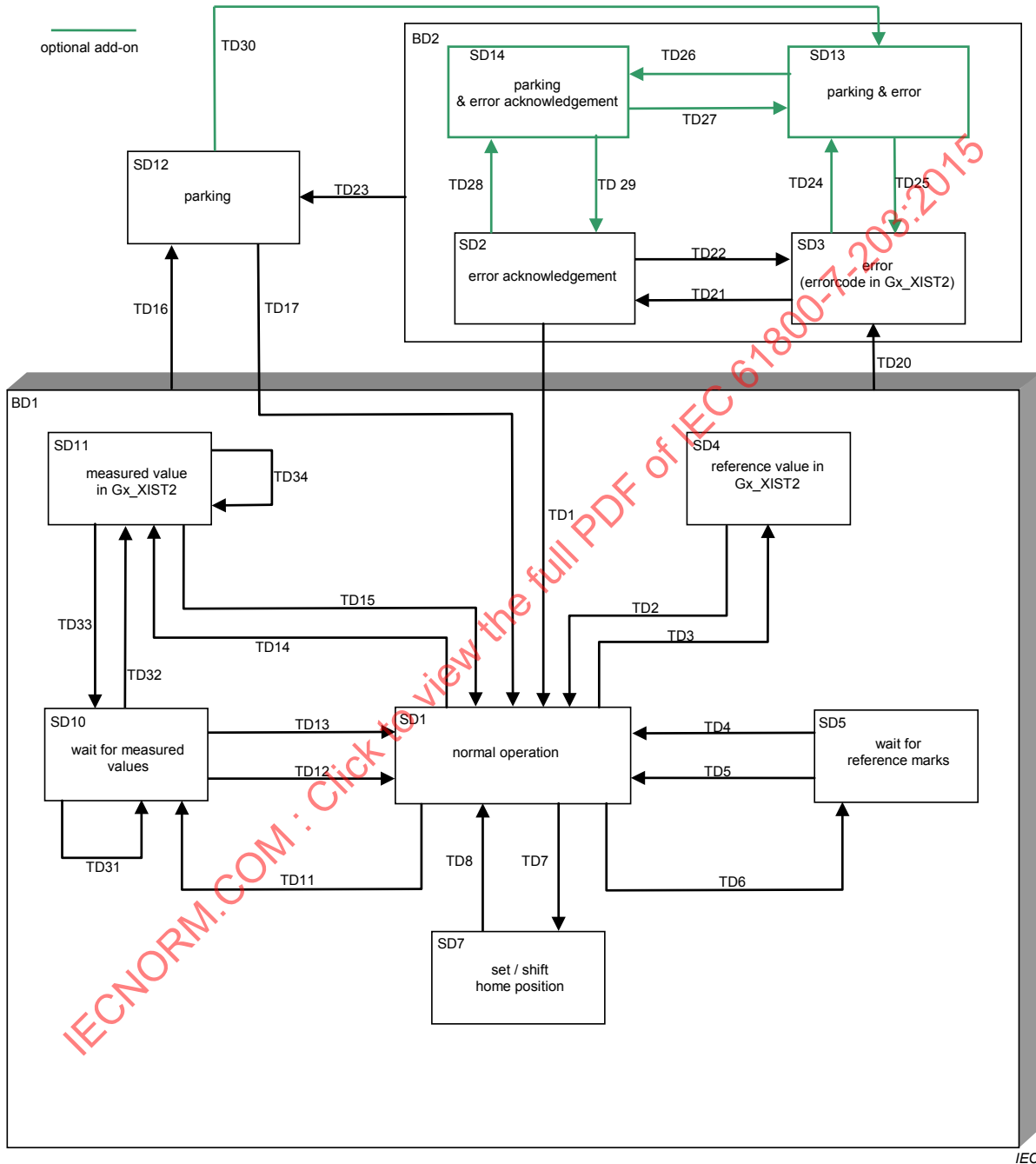


Figure 52 – State diagram of the position feedback interface with designations of the states and transitions

### 6.3.6.7.2 States

The states are specified in Table 110.

**Table 110 – States**

| State | Name                        | Action                                      | Explanation                                                                                                                                                                                                                              | Identification/Status information                                                                                                         |
|-------|-----------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| SD1   | normal operation            | None                                        | The position feedback interface operates normally. Transmission of XIST2 in Gx_XIST2 is possible if requested by GxSTW bit 13=1.                                                                                                         | Gx_ZSW bit 0-7 = 0000 0000b, Gx_ZSW bit 10-15 = 00x000b                                                                                   |
| SD2   | error acknowledgement       | Error is acknowledged                       | Error acknowledgment is being processed.                                                                                                                                                                                                 | Gx_ZSW bit 11 = 1, bit 0-7 = 0000 0000b, Gx_ZSW bit 15 = 1 as long as valid Errorcode is posted in Gx_XIST2 (as long as error is present) |
| SD3   | error                       | Errorcode is posted in Gx_XIST2             | There is an error present.                                                                                                                                                                                                               | Gx_ZSW bit 15 = 1, Gx_ZSW bit 11 = 0, bit 0-7 = 0000 0000b                                                                                |
| SD4   | reference value in Gx_XIST2 | Load reference value in Gx_XIST2            | The reference value is loaded in Gx_XIST2.                                                                                                                                                                                               | Gx_ZSW bit 4-7 <> 0000b, bit 0-3 = 0000b                                                                                                  |
| SD5   | wait for reference marks    | Wait for reference marks                    | The reference mark is expected.                                                                                                                                                                                                          | Gx_ZSW bit 0-3 <> 0000b, bit 4-7 = 0000b                                                                                                  |
|       |                             |                                             | SD6 is not used any more.                                                                                                                                                                                                                |                                                                                                                                           |
| SD7   | set/shift home position     | Set or shift value in Gx_XIST1 and Gx_XIST2 | Gx_XIST1 and Gx_XIST2 are set or shifted by a predefined preset value. Set or shift is controlled by the mode bit Gx_STW, bit 11. See also Note 1.                                                                                       | Gx_ZSW bit 12 = 1 (edge triggered), bit 0-7 = 0000 0000b                                                                                  |
|       |                             |                                             | SD8 is not used any more. Transmission of XIST2 in Gx_XIST2 is controlled according to Table 106.                                                                                                                                        |                                                                                                                                           |
|       |                             |                                             | SD9 is not used any more.                                                                                                                                                                                                                |                                                                                                                                           |
| SD10  | wait for measured value     | Waiting for measured values                 | Measurement Task active, waiting for measured values. At least one of the four measurement latch processes is active and waiting for measured values. Transmission of XIST2 in Gx_XIST2 shall take place if requested by GxSTW bit 13=1. | Gx_ZSW bit 0-3 <> 0000b, bit 4-7 = 0000b                                                                                                  |
| SD11  | measured value in XIST2     | Load measured value in Gx_XIST2             | The requested measured value is loaded into Gx_XIST2.                                                                                                                                                                                    | Gx_ZSW bit 4-7 <> 0000b, for bits 0-3: bit related to the requested measured value = 0                                                    |
| SD12  | parking                     | All errors are cleared if Gx_STW bit 14 = 1 | The position feedback interface is in a state where it is inactive and does not deliver a valid Gx_XIST1 value. This is also the position feedback interface initial state. See Note 2.                                                  | Gx_ZSW bit 14 = 1                                                                                                                         |

| State                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Name                                    | Action                          | Explanation                                                                   | Identification/Status information                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| SD13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | parking & error (optional)              | Errorcode is posted in Gx_XIST2 | There is an error present and Gx_XIST1 is signalled invalid.                  | Gx_ZSW bit 15 = 1, Gx_ZSW bit 14 = 1, Gx_ZSW bit 11 = 0, bit 0-7 = 0000 0000b                                                                |
| SD14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | parking & error acknowledged (optional) | Error is acknowledged           | Error acknowledgement is being processed while Gx_XIST1 is signalled invalid. | Gx_ZSW bit 14 = 1, Gx_ZSW bit 11 = 1, bit 0-7 = 0000 0000b, Gx_ZSW bit 15 = 1. Errorcode is posted in Gx_XIST2 (as long as error is present) |
| <p>NOTE 1 Concerning set/shift home position:</p> <p>The preset function supports the adaptation of the encoder zero point to the mechanical zero point of the system. The set/shift home position function has an absolute and a relative operation mode selectable by bit 11 in the Gx_STW1. The value to be taken for the set/shift function cannot be set dynamically by the DO IO Data. It is 0 by default and may be set on a device-specific basis. The set/shift value is given in scaled measuring units. When set/shift of home position is requested, the position feedback interface reads the current position value and calculates an internal offset value from the preset value and the read position value. The position feedback interface acknowledges the preset by setting bit 12 in the sensor status word. Bit 12 in the sensor control word can now be set to zero by the controller. The position feedback interface will end the preset cycle by clearing bit 12 in the sensor status word. The preset/shift home position functionality is optional.</p> <p>NOTE 2 Concerning parking a sensor:</p> <p>A parked sensor delivers no valid Gx_XIST1 values. The position feedback interface may be in the parked state because of "instructed parking" which is initiated by Gx_STW bit 14 = 1 or because of "autonomous parking" which is initiated internally by an invalid Gx_XIST1. If the position feedback interface is in "instructed parking", the interface is completely deactivated and therefore will not generate any error messages. All actual errors are also cleared, if allowed by the hardware, an instructed parked sensor can be separated from the drive. Data validity in P979 for the respective sensor will be indicated by Bit 31 in Subindex 1 (see 6.3.6.2.2).</p> <p>Reactivating the sensor: When a sensor becomes reactivated, a new initialisation of the sensor is carried out.</p> |                                         |                                 |                                                                               |                                                                                                                                              |

### 6.3.6.7.3 Transitions

The transitions are specified in Table 111.



Table 111 – Transitions

| Transition Number | Source State                                   | Destination State                              | Condition                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------|------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TD1               | SD2 (error acknowledgment)                     | SD1 (normal operation)                         | Gx_STW bit 15 = 0 and error removed                                                                                                                                                                                                                                                                                                                                                                                                                 |
| TD2               | SD4 (reference value in Gx_XIST2)              | SD1 (normal operation)                         | Gx_STW bit 4-6 = 000b                                                                                                                                                                                                                                                                                                                                                                                                                               |
| TD3               | SD1 (normal operation)                         | SD4 (reference value in Gx_XIST2)              | Gx_STW bit 7 = 0 and Gx_STW bit 4-6 = 010b and Gx_STW bit 0-3 <> 0000b and Reference value is found                                                                                                                                                                                                                                                                                                                                                 |
| TD4               | SD5 (wait for reference marks)                 | SD1 (normal operation)                         | Gx_STW bit 4-6 = 000b and reference mark found                                                                                                                                                                                                                                                                                                                                                                                                      |
| TD5               | SD5 (wait for reference marks)                 | SD1 (normal operation)                         | Gx_STW bit 4-6 = 011b                                                                                                                                                                                                                                                                                                                                                                                                                               |
| TD6               | SD1 (normal operation)                         | SD5 (check reference task)                     | Gx_STW bit 7 = 0 and Gx_STW bit 4-6 = 001b and Gx_STW bit 0-3 <> 0000b                                                                                                                                                                                                                                                                                                                                                                              |
| TD7               | SD1 (normal operation)                         | SD7 (set/shift value in Gx_XIST1 and Gx_XIST2) | Gx_STW bit 12 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| TD8               | SD7 (set/shift value in Gx_XIST1 and Gx_XIST2) | SD1 (normal operation)                         | Gx_STW bit 12 = 0                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                   |                                                |                                                | TD9 is not used any more                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                   |                                                |                                                | TD10 is not used any more                                                                                                                                                                                                                                                                                                                                                                                                                           |
| TD11              | SD1 (normal operation)                         | SD10 (wait for measured values)                | Gx_STW bit 7 = 1 and Gx_STW bit 4-6 = 001b and Gx_STW bit 0-3 <> 0000b                                                                                                                                                                                                                                                                                                                                                                              |
| TD12              | SD10 (wait for measuring values)               | SD1 (normal operation)                         | Gx_STW bit 4-6 = 011b                                                                                                                                                                                                                                                                                                                                                                                                                               |
| TD13              | SD10 (wait for measuring values)               | SD1 (normal operation)                         | Gx_STW bit 4-6 = 000b and measured values found                                                                                                                                                                                                                                                                                                                                                                                                     |
| TD14              | SD1 (normal operation)                         | SD11 (measured value in Gx_XIST2)              | Gx_STW bit 7 = 1 and Gx_STW bit 4-6 = 010b and Gx_STW bit 0-3 <> 0000b and related measured value found                                                                                                                                                                                                                                                                                                                                             |
| TD15              | SD11 (measured value in Gx_XIST2)              | SD1 (normal operation)                         | (Gx_STW bit 4-6 = 000b while no measurement process is active (all measured values found)) or (Gx_STW bit 7 = 1 and Gx_STW bit 4-6 = 011b)                                                                                                                                                                                                                                                                                                          |
| TD16              | Every state in BD1                             | SD12 (parking)                                 | Gx_STW bit 14 = 1<br>additional condition, when SD13, SD14 are implemented:<br>or when (Gx_XIST1 is invalid and no error is occurred or present).<br>NOTE If the sensor related to this position feedback interface is the motor measurement system, the condition Gx_STW bit 14 = 1 can alternatively result in a sensor interface error (Error code 0x0003, see Table 107) when the drive is running and no transition to SD12 will be performed. |
| TD17              | SD12 (parking)                                 | SD1 (normal operation)                         | Gx_STW bit 14 = 0 and Gx_ZSW bit 14 was set for at least 100 ms<br>additional condition, when SD13, SD14 are implemented:<br>and Gx_XIST1 is valid.                                                                                                                                                                                                                                                                                                 |
|                   |                                                |                                                | TD18 is not used any more                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                   |                                                |                                                | TD19 is not used any more                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Transition Number                                                                                                                                                                                                                    | Source State                          | Destination State                     | Condition                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TD20                                                                                                                                                                                                                                 | from every state in BD1               | SD3 (error)                           | Error occurred or a command is illegal                                                                                                                                        |
| TD21                                                                                                                                                                                                                                 | SD3 (error)                           | SD2 (error acknowledgment)            | Gx_STW bit 15 = 1 and Gx_XIST1 valid                                                                                                                                          |
| TD22                                                                                                                                                                                                                                 | SD2 (error acknowledgment)            | SD3 (error)                           | Gx_STW bit 15 = 0 and an error still exists while Gx_XIST1 is valid                                                                                                           |
| TD23                                                                                                                                                                                                                                 | Every state in BD2                    | SD12 (parking)                        | Gx_STW bit 14 = 1 or<br>(Gx_STW bit 15 = 0 and error removed, while Gx_XIST1 is invalid)                                                                                      |
| TD24                                                                                                                                                                                                                                 | SD3 (error)                           | SD13 (parking & error)                | Gx_XIST1 invalid                                                                                                                                                              |
| TD25                                                                                                                                                                                                                                 | SD13 (parking & error)                | SD3 (error)                           | Gx_XIST1 valid and Gx_ZSW bit 14 = 1 for at least 100 ms                                                                                                                      |
| TD26                                                                                                                                                                                                                                 | SD13 (parking & error)                | SD14 (parking & error acknowledgment) | Gx_STW bit 15 = 1 while Gx_XIST1 invalid                                                                                                                                      |
| TD27                                                                                                                                                                                                                                 | SD14 (parking & error acknowledgment) | SD13 (parking & error)                | Gx_STW bit 15 = 0 and error still exists                                                                                                                                      |
| TD28                                                                                                                                                                                                                                 | SD2 (error acknowledgment)            | SD14 (parking & error acknowledgment) | Gx_XIST1 invalid while Gx_STW bit 15 = 1                                                                                                                                      |
| TD29                                                                                                                                                                                                                                 | SD14 (parking & error acknowledgment) | SD2 (error acknowledgment)            | Gx_XIST1 valid and Gx_ZSW bit 14 was set for at least 100 ms while Gx_STW bit 15 = 1                                                                                          |
| TD30                                                                                                                                                                                                                                 | SD12 (parking)                        | SD13 (parking & error)                | Gx_STW bit 14 = 0 and (Gx_XIST1 invalid and an error or an illegal command has occurred)                                                                                      |
| TD31                                                                                                                                                                                                                                 | SD10 (wait for measuring values)      | SD10 (wait for measuring values)      | New command <sup>a</sup> in Gx_STW bit 0-6 and<br>Gx_STW bit 7 = 1 and Gx_STW bit 4-6 = 001b and Gx_STW bit 0-3 <> 0000b                                                      |
| TD32                                                                                                                                                                                                                                 | SD10 (wait for measuring values)      | SD11 (measured value in Gx_XIST2)     | Gx_STW bit 7 = 1 and Gx_STW bit 4-6 = 010b and Gx_STW bit 0-3 <> 0000b and related measured value found                                                                       |
| TD33                                                                                                                                                                                                                                 | SD11 (measured value in Gx_XIST2)     | SD10 (wait for measuring values)      | (Gx_STW bit 7 = 1 and Gx_STW bit 4-6 = 001b and Gx_STW bit 0-3 <> 0000b) or<br>(Gx_STW bit 4-6 = 000b while measurement process still active (not all measured values found)) |
| TD34                                                                                                                                                                                                                                 | SD11 (measured value in Gx_XIST2)     | SD11 (measured value in Gx_XIST2)     | New command <sup>a</sup> in Gx_STW bit 0-6 and<br>Gx_STW bit 7 = 1 and Gx_STW bit 4-6 = 010b and Gx_STW bit 0-3 <> 0000b and related measured value found                     |
| <sup>a</sup> New command means that in Gx_STW bit 4-6 is a valid command (activate, read, cancel), while before Gx_STW bit 4-6 was = 0 (no command). For further details, see also Figure 55 and the related description in 6.3.6.9. |                                       |                                       |                                                                                                                                                                               |

The functions which may be executed are prioritized as indicated in Table 112.

**Table 112 – Prioritisation of Sensor Control Word**

| Priority                               | Bit                                                                                |
|----------------------------------------|------------------------------------------------------------------------------------|
| 1                                      | Gx_STW bit 14                                                                      |
| 2                                      | Gx_STW bit 15 (priority only if position feedback interface is in error state SD3) |
| 3                                      | Gx_STW bit 4-6                                                                     |
| 4                                      | Gx_STW bit 12                                                                      |
| 5                                      | Gx_STW bit 13                                                                      |
| Priority 1 means the highest priority. |                                                                                    |

### 6.3.6.8 Procedure for Error Acknowledgement

The procedure of request and response in Gx\_STW and Gx\_ZSW for the error acknowledgement process is shown in Figure 53 for an acknowledgeable error and in Figure 54 for an unacknowledgeable error (fault cause still present).

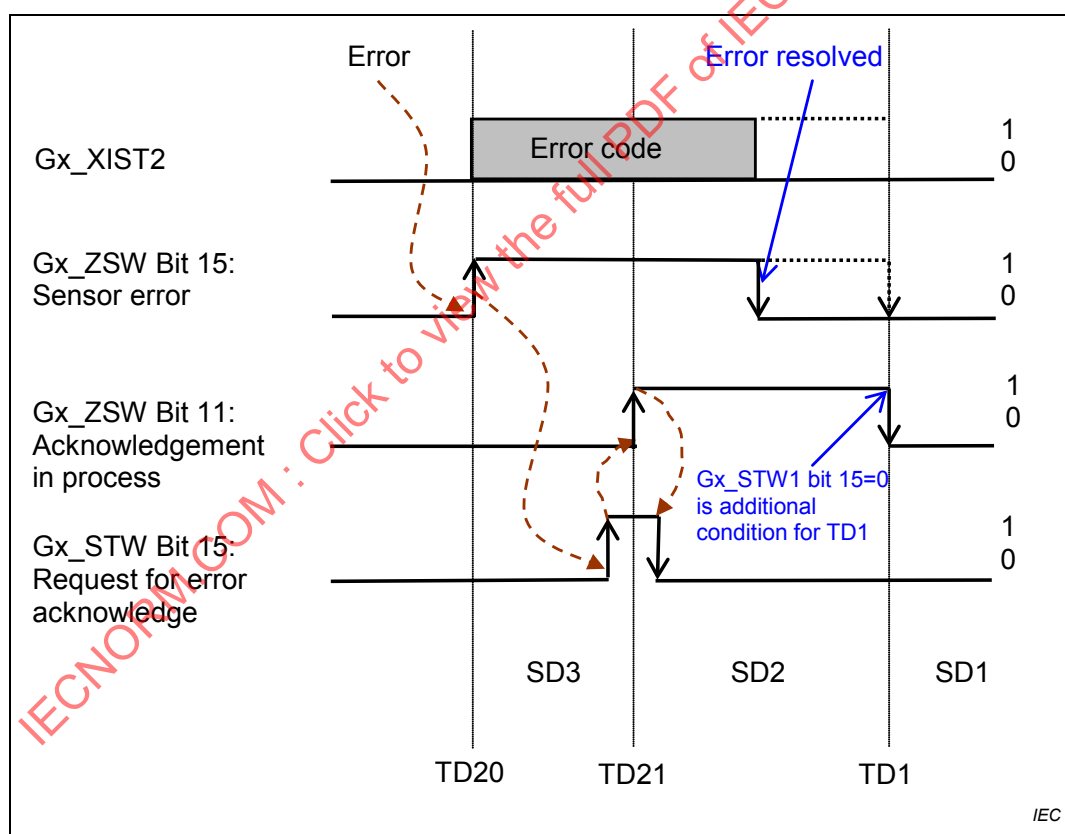


**Figure 53 – Acknowledgement of acknowledgeable sensor error**

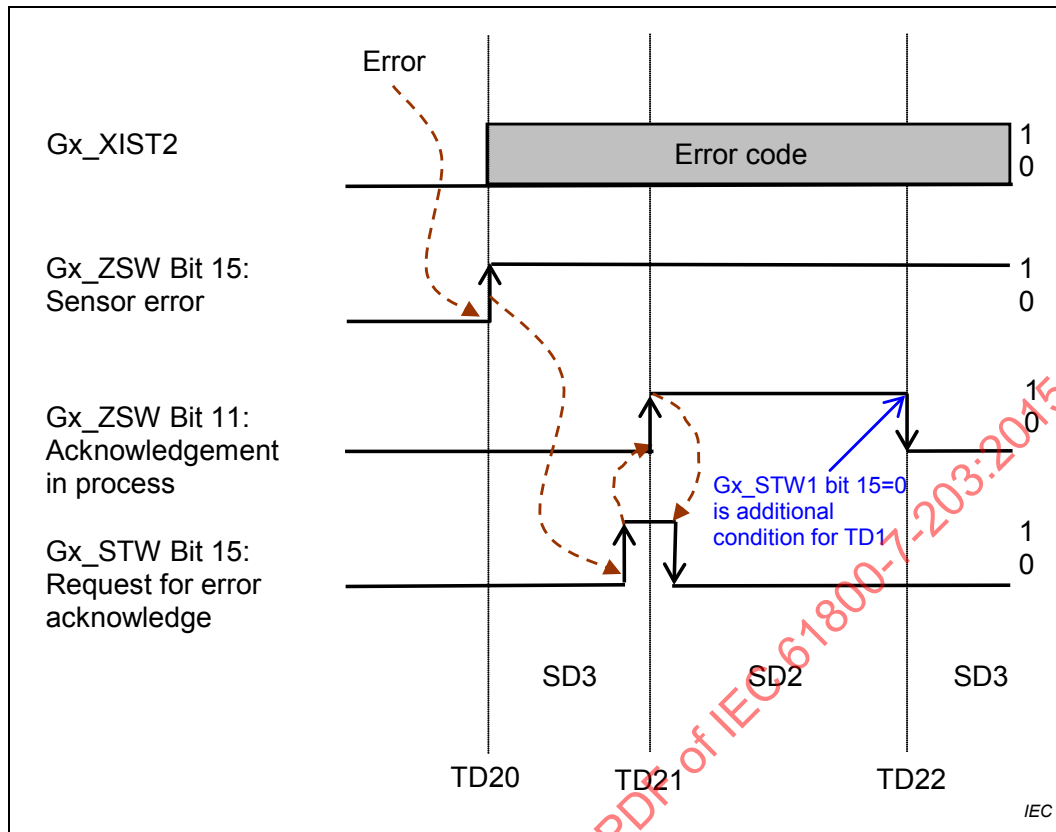


**Figure 54 – Acknowledgement of unacknowledgeable sensor error**

### 6.3.6.9 Procedure for measurement on the fly

The procedure of request and response in Gx\_STW and Gx\_ZSW for the measurement on the fly process is shown in Figure 55 and Figure 56.

The evaluation of the command and related function bits in Gx\_STW is done according to Figure 55 with the change from no command (Gx\_STW bits 4-6 = 0) to a valid command (Gx\_STW bits 4-6  $\neq$  0). An active measurement process (waiting for measured value) is indicated by the related “Function x active” bit in Gx\_ZSW bit 0-3. The falling edge of the related “Function x active” bit in Gx\_ZSW indicates that the measurement value is sampled and ready to be read out by the controller (if the measurement function is not cancelled by the controller). The “Function x active” bit in Gx\_ZSW is also used for proper handshake of the “Function x activate” command in Gx\_STW. Therefore, the indication of the presence of the measured value may be delayed if the handshake is not yet finished (see first activate command example in Figure 56).

Figure 56 shows an example of immediate reactivation of the measurement process without read out of the measured value by the controller. When activating the measurement process, an already existing measured value is generally discarded.

EXAMPLE Measurement on the fly

Example for:

Probe 2 positive edge (function 3)

Position control with sensor 1

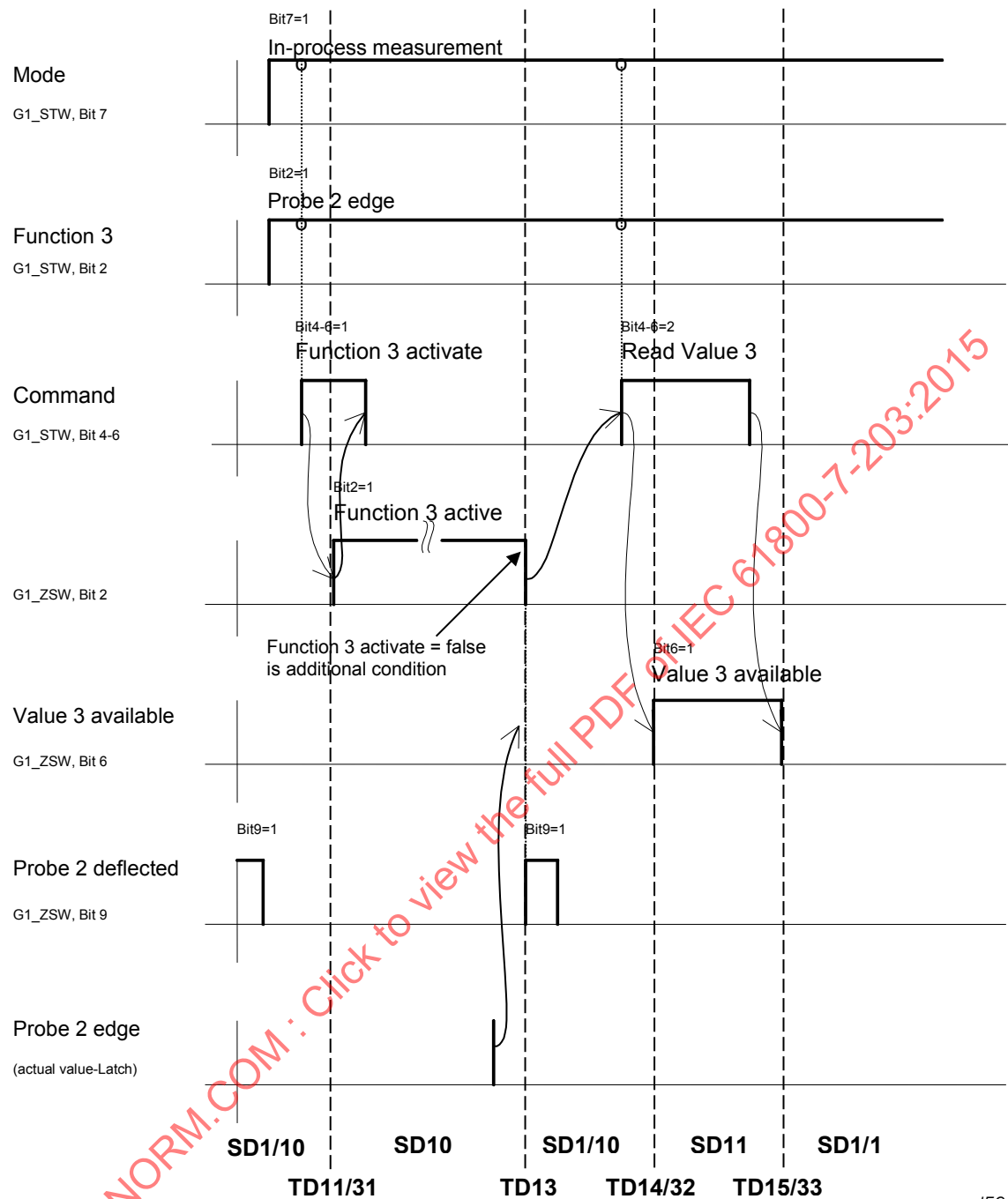
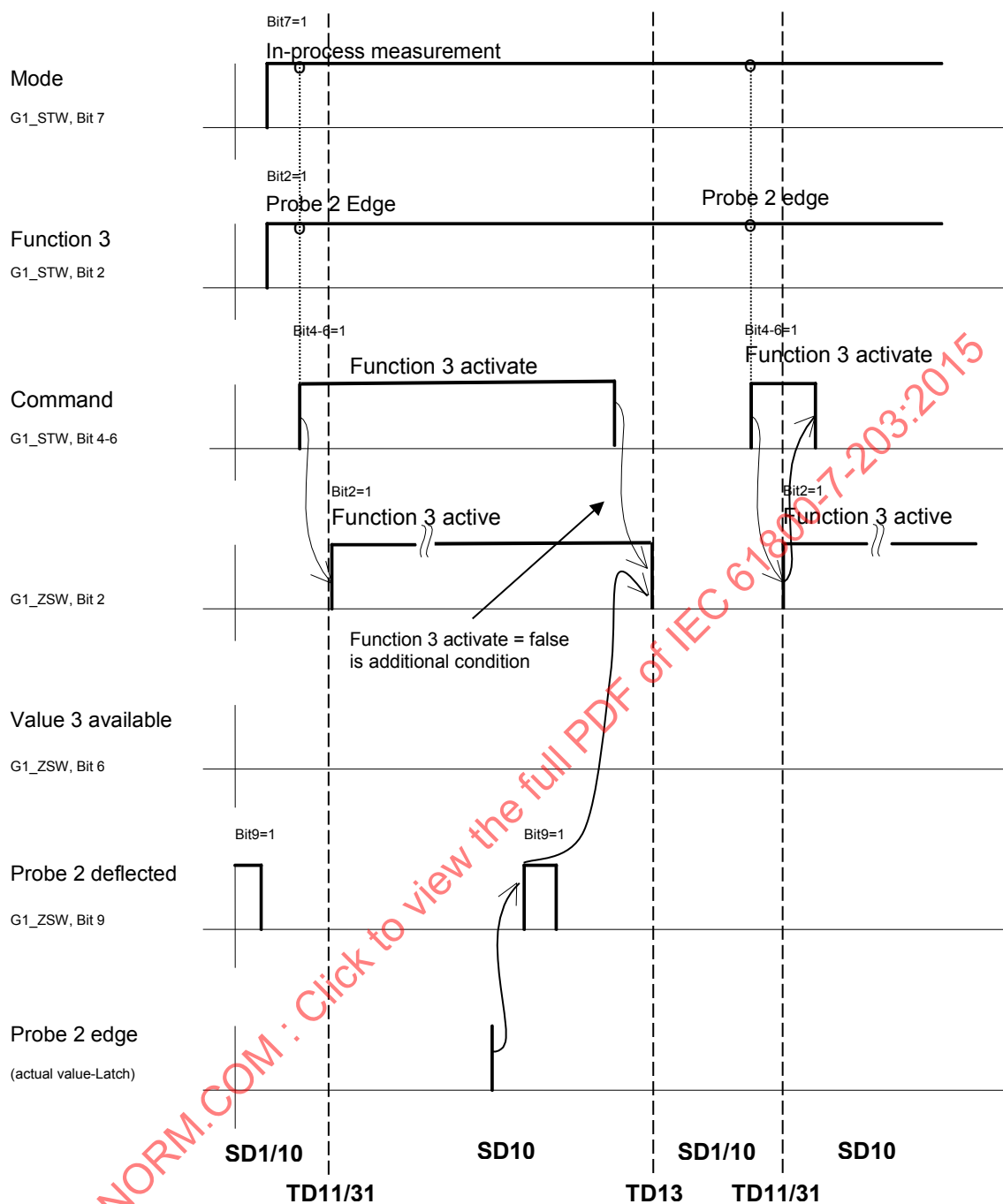


Figure 55 – Timing diagram: Measurement on the fly – sequence 1



IEC

**Figure 56 – Timing diagram: Measurement on the fly – sequence 2**

#### 6.3.6.10 Procedure for Reference mark search

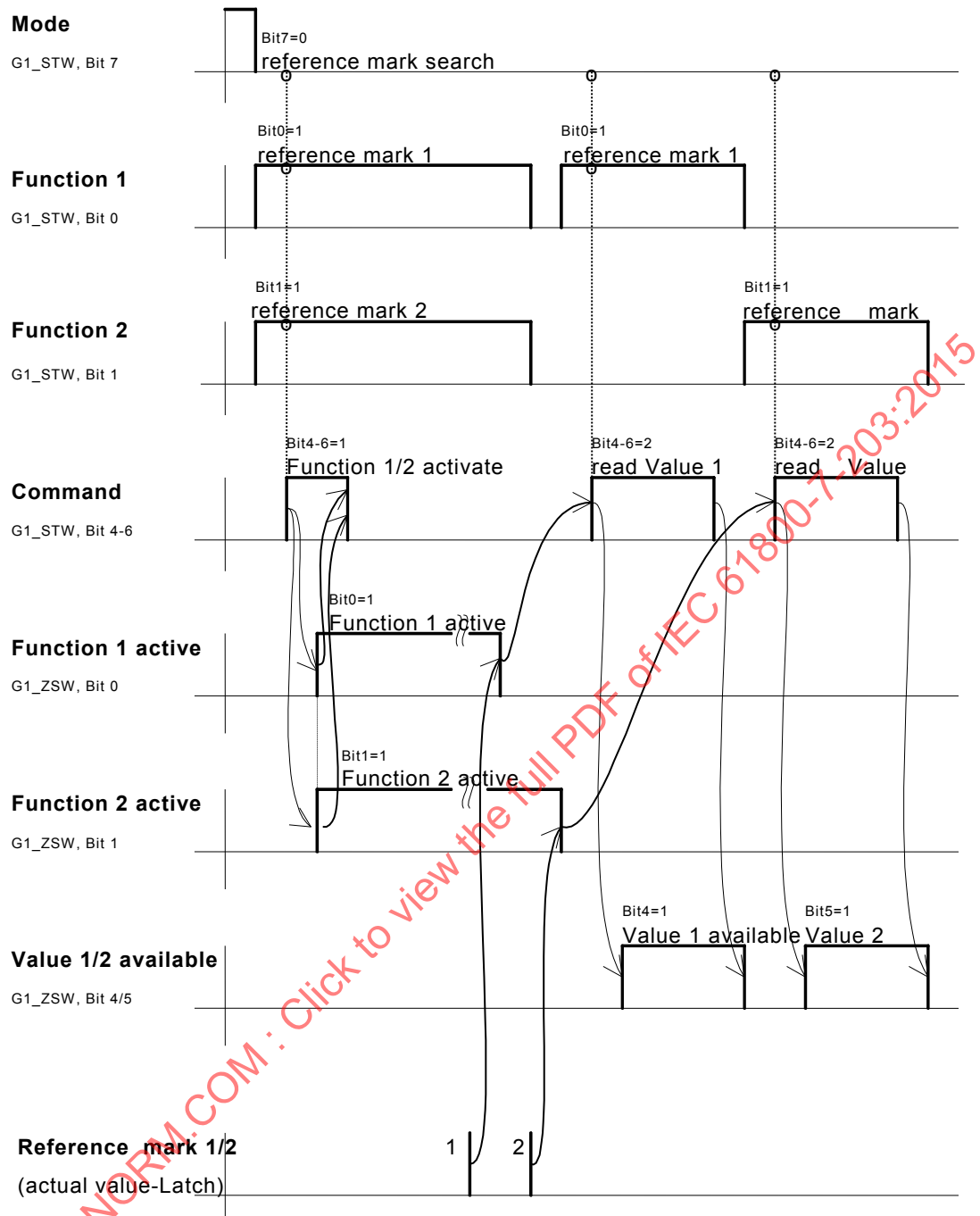
The procedure of request and response in Gx\_STW and Gx\_ZSW for the reference mark search process is shown in the example given in Figure 57.

EXAMPLE Reference mark search

Example for:

Distance-coded referencing, two reference marks (Function1/Function 2)

Position control with Sensor 1



IEC

Figure 57 – Timing diagram: Reference mark search

### 6.3.6.11 Device-specific expansions

A measurement on the fly/reference mark search may be optimised through the following device-specific steps.

- Using the additional actual positions XISTA,-B,-C,-D (the actual values requested by the controller are then not multiplexed in Gx\_XIST2, but are made available in XISTA,-B,-C,-D).
- Edge change (0 -> 1) of the status signal "Value 1 – 4 available" already with edge change (1 -> 0) of the status signal "Function 1 – 4 active" (the controller may access the values immediately).  
Edge change (1 -> 0) of the status signal "Value 1 – 4 available" with recognition of the next command for this function 1 – 4.

- XISTA                      Actual Position A              Additional actual position value
- XISTB                      Actual Position B              Additional actual position value
- XISTC                      Actual Position C              Additional actual position value
- XISTD                      Actual Position D              Additional actual position value

The objects XISTA,-B,-C,-D are independent of the sensor.

The following rules apply to the assignment of functions 1 – 4 to the additional actual values:

- Function 1              ->      XISTA
- Function 2              ->      XISTB
- Function 3              ->      XISTC
- Function 4              ->      XISTD
- XISTA,-B,-C,-D not in the telegram              -> Function 1 – 4 in Gx\_XIST2 multiplexed

### 6.3.7 Periphery

A drive hardware may also include I/O peripherals (onboard periphery) which are related to a DO. These I/O peripherals may also be made accessible via PROFIdrive.

A signal number is assigned to each I/O type (refer to 6.3.4.2):

- 21 E\_DIGITAL      input (digital)              16 bits
- 22 A\_DIGITAL      output (digital)              16 bits
- 23 E\_ANALOG      input (analog)              16 bits
- 24 A\_ANALOG      output (analog)              16 bits

When configuring DO IO Data (refer to 6.3.4.4), an I/O signal number may be assigned to a DO IO Data. An example is given in Table 113.

**Table 113 – Example for standard telegram with additional peripheral control**

| DO IO DATA number | Setpoint  | Actual value |
|-------------------|-----------|--------------|
| 1                 | STW1      | ZSW1         |
| 2                 | NSOLL_B   | NIST_B       |
| 3                 |           |              |
| 4                 | A_DIGITAL | E_DIGITAL    |
| 5                 | A_DIGITAL | E_DIGITAL    |
| 6                 |           | E_ANALOG     |
| 7                 |           | E_ANALOG     |

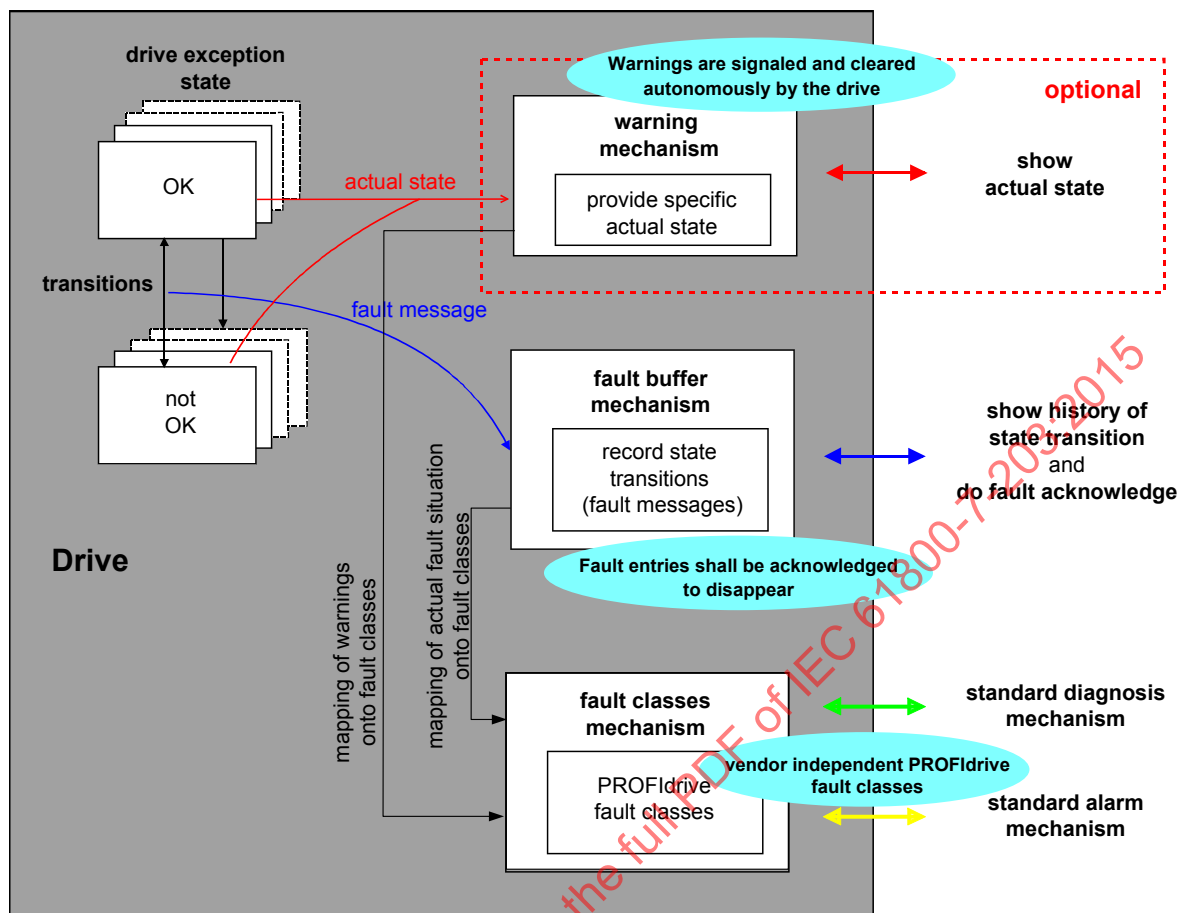
Mapping the I/O area within the drive and parameter assignment of the I/O is defined to be device-specific.

### 6.3.8 Diagnosis

#### 6.3.8.1 Overview

A brief overview about the principle methods PROFIdrive provides for diagnostic functionality is shown in Figure 58. Notice that the fault buffer mechanism is the only mandatory diagnostic functionality, and only the mechanism is specified.





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Figure 58 – Overview about the diagnostic mechanisms of PROFIdrive

### 6.3.8.2 Warning mechanism

Parameters 953 to 960 (warning words) of data type V2 are reserved for the warning mechanism. Other parameters may be used for this purpose in a manufacturer-specific way. Every bit of a warning word is assigned a Drive Axis exception state. Bit value "0" signifies "warning not present" (OK); bit value "1" signifies "warning present". The warning words are only changed locally from the drive.

If at least one warning bit is set, then the warning bit ZSW1, bit7 is additionally set (see Figure 59).

A warning word is assigned 32 warning texts (data type V2 with additional text array), which include the contents of the warning or drive exception for visualisation purposes.

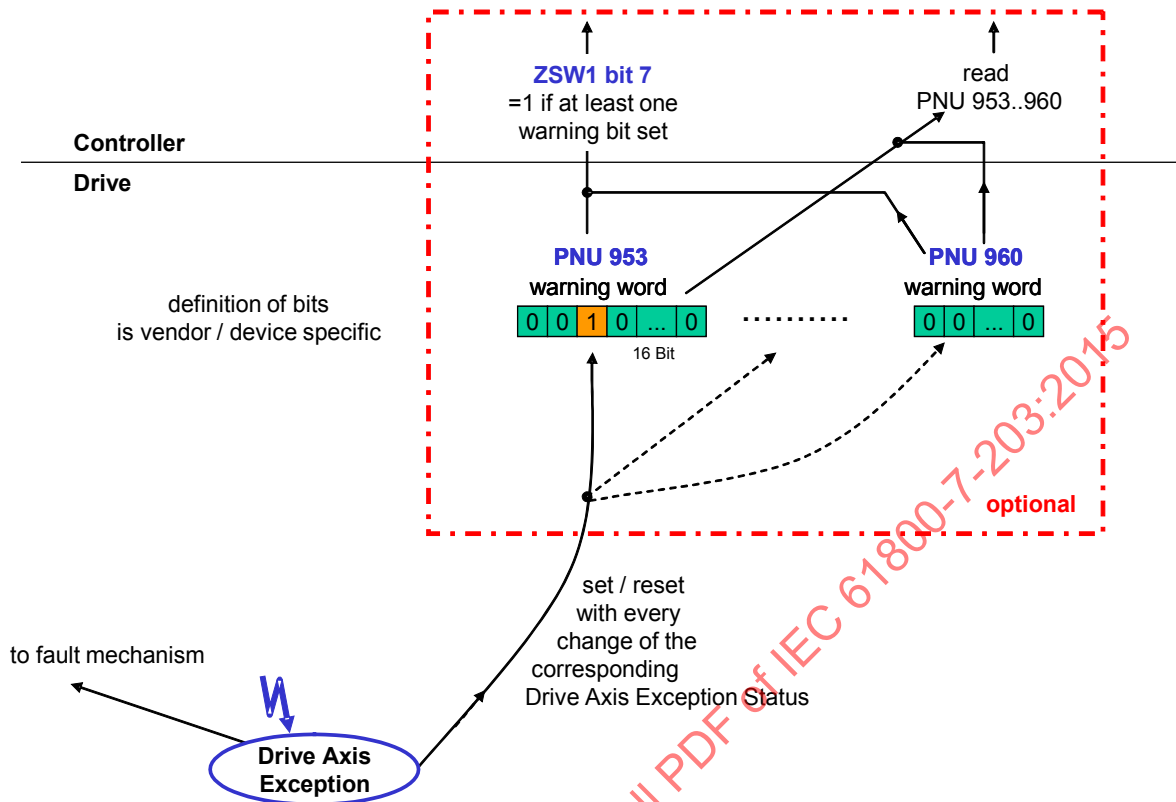


Figure 59 – Working of the warning mechanism

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### 6.3.8.3 Fault buffer mechanism

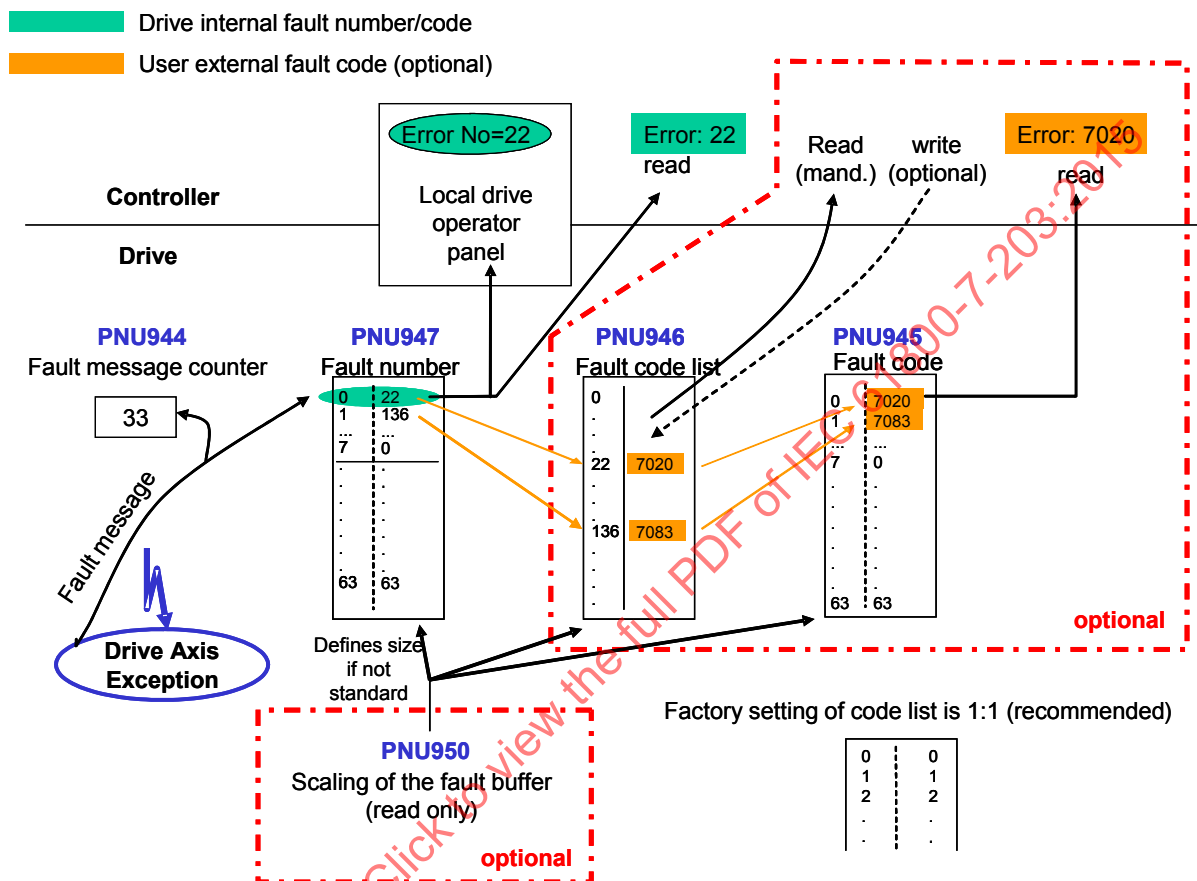
A fault situation, which may be associated with one or several fault messages (drive exceptions state changes), generates a device-specific fault reaction. For example it may cause the power converter to be powered-down. An unacknowledged fault situation is also indicated by ZSW1, bit3 (fault present). The fault buffer mechanism defines a fault tracking system in order to save the fault messages. This fault tracking system consists of the fault buffer (which consists at least out of the fault number list and the fault message counter, see also Figure 60). The fault buffer contains the fault messages which have been generated during the fault situation; the fault number list contains explanations and assignments to the various fault messages defined in the device. The mechanism, as to how the fault tracking system may be operated, is described in the following paragraphs.

#### Fault buffer

Figure 63 illustrates the structure of a fault buffer. The fault buffer comprises rows and columns. In the most detailed situation, the fault buffer has four columns which are represented by the fault number (PNU 947), fault code (PNU 945), fault time (PNU 948) and fault value (PNU 949) parameters. The parameters consist each of an array. The fault buffer rows are represented by the parameter sub-indices which form the actual fault buffer.

The fault messages are entered into the fault buffer in the sequence in which they are detected. This means that each line in the fault buffer represents a fault message; the fault number, fault code, fault value and fault time of a fault message may be addressed in the particular parameter using the same subindex.

The fault buffer is subdivided into fault situations which are in turn further subdivided into fault messages. The scaling of the fault buffer – how many fault situations and how many fault messages per fault situation are contained in a fault buffer – may be set by parameter P950 "Scaling of the fault buffer" (refer also to 6.4). The implementation of the parameter is optional. If a Drive Unit has not implemented parameter P950, the default configuration of eight fault situations with eight fault messages per fault situation is assumed.



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Figure 60 – Overview about the fault buffer mechanism

For example, the mechanism of the entering and saving of fault situations and fault messages in the fault buffer is explained with the default configuration. If other quantities of the fault situation and the fault message are chosen by parameter P950, the example shall be adapted. The last fault situation, which has still not been acknowledged, starts with subindex 0, the last acknowledged fault situation with subindex 8. The maximum permissible subindex is 63 (see Figure 63). This means that the oldest fault situation which is saved starts with subindex 56. In a fault situation, a maximum of eight fault messages may be saved. If more than eight fault messages occur during a fault situation, the eighth message is overwritten by the most recent fault message (see Figure 62). If a fault situation comprises less than eight fault messages, the fault number and the fault code zero are displayed in the subindex which is not assigned a fault message. Conversely, if for a subindex, the fault number and the fault code are displayed as zero, the fault message with the next to last subindex was the last fault message of the fault situation. If a previously unacknowledged fault situation is acknowledged, this fault situation is shifted to the position of the first acknowledged fault situation. The contents of the first acknowledged fault situation has been previously shifted to the position of the second acknowledged fault situation. The second acknowledged fault situation is shifted to the position of the third acknowledged fault situation and so on (see Figure 61). This implies, as a result, that the seventh acknowledged fault situation is also overwritten. The fault messages (fault causes) which are still present after the acknowledgement form a new fault situation (fault causes which are still present after

The diagram illustrates the functional architecture of a fault management system, showing the interaction between a **Controller** and a **Drive**.

**Controller Side:**

- ZSW1 bit 3 Fault Present:** A signal that triggers the fault management process.
- STW1 bit 7:** Fault Acknowledge = 1 (positive edge) for at least 20 ms, indicating the controller's acknowledgment of the fault.
- PNU 952 Fault situation counter:** A counter that increments (+1) when a fault is detected. It is optional and can be reset.
- PNU 944 Fault message counter:** A counter that increments (+1) when a fault message is sent. It is reset when the fault buffer is complete (all zero).
- PNU 947 Fault number:** A stack of fault numbers, indexed from 0 (oldest entry) to 7 (most recent entry). It is divided into two sections: **unacknowledged faults** (indices 0-7) and **acknowledged faults** (indices 8 and above). The **Actual fault situation** is indicated by the unacknowledged faults section. The **Last recently acknowledged fault situation** is indicated by the acknowledged faults section.

**Drive Side:**

- read / write:** Signals for data transfer between the Controller and the Drive.
- write = 0:** A signal indicating that the drive is not writing to the fault buffer.
- reset bit 3:** A signal that resets the fault buffer.
- complete fault buffer (all zero):** A signal indicating that the fault buffer is empty.
- fault reaction (device/fault specific):** A signal that triggers a specific fault reaction.
- fault acknowledgement completed or fault buffer reset:** A signal indicating that the fault has been acknowledged or the fault buffer has been reset.

**Flow of Information:**

- The **Controller** sends a **read** signal to the **Drive** to retrieve fault information.
- The **Drive** sends a **write** signal to the **Controller** to store fault information.
- The **Controller** sends a **reset** signal to the **Drive** to reset the fault buffer.
- The **Drive** sends a **fault reaction** signal to the **Controller** when a fault occurs.
- The **Drive** sends a **fault acknowledgement completed or fault buffer reset** signal to the **Controller** when the fault has been acknowledged or the fault buffer has been reset.

**Figure 61 – Fault acknowledgement for the fault buffer mechanism**

If the same fault situation as the last acknowledged fault situation occurs, it is permitted to not shift this fault situation in order to keep the fault history.

Note that the fault present bit (ZSW1, bit3) is set if there is at least one unacknowledged fault message entry in the fault buffer, independent of the related fault reaction (see also Figure 61).

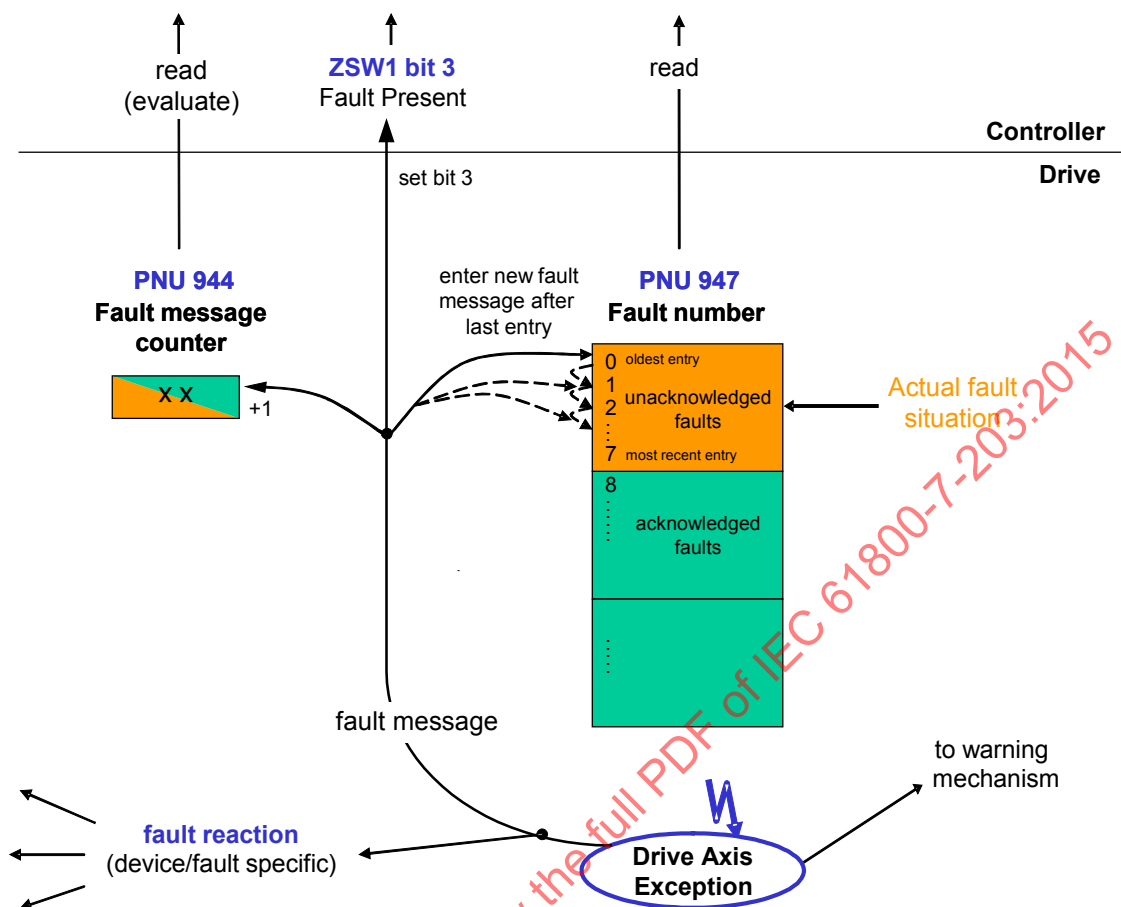


**Figure 62 – Processing of the fault messages in the fault buffer mechanism**

## Automatic fault buffer evaluation

The fault message counter (parameter 944) is incremented each time the fault buffer changes. To evaluate the fault buffer automatically by a program, the program should read out the fault message counter before and after evaluating the fault buffer. By checking that the contents of the fault message counter are the same before and after evaluating the fault buffer, it is guaranteed that the fault buffer was consistently evaluated, and had not changed during the evaluation.

## Time characteristics when acknowledging a fault

A fault is acknowledged by the controller with a positive edge at bit 7 of control word 1. The fault acknowledgment bit shall be available for at least 20 ms so that it is guaranteed that a DO recognises the positive edge. DOs shall have successfully completed fault processing within a maximum of 3 s.

### Erasing the fault buffer

The whole fault buffer (actual fault situation and all other fault situations) and the fault message counter (parameter 944) is erased when the fault situation counter (parameter 952) is reset to 0 (see Figure 61).

### Mapping the internal fault number to the user's perspective (fault code)

The fault number (parameter 947) contains the internal fault number. The fault code is used to systematically number fault messages from the user's perspective (see Figure 60). The control or HMI system shall emulate the internal fault number to the fault code for the user. This emulation may be optionally specified by the drive with the fault code list (parameter 946) which contains the fault code for each fault number.

Optionally, the user may directly read the fault code for each fault message (parameter 945) from the drive (see Table 114).

**Table 114 – Fault buffer parameters**

| Parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Designation                 | Explanation                                                                                                      | Minimum | Complete |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------|---------|----------|
| 944                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault message counter       | Is incremented each time that the fault buffer changes                                                           | m       | m        |
| 945                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault code                  | Contains the fault code for each fault message for the user                                                      | o       | o        |
| 946                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault code list             | Assignment of the internal fault number to the fault code for the user                                           | o       | o        |
| 947                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault number                | Contains the internal fault number for each fault message                                                        | m       | m        |
| 948                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault time                  | Contains the fault instant for each fault message                                                                | o       | o        |
| 949                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault value                 | Contains the fault value for each fault message                                                                  | o       | o        |
| 950                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Scaling of the fault buffer | Contains the number of fault situations of the fault buffer and the number of fault messages per fault situation | o       | o        |
| 951                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault number list           | Contains the parameter of the fault value and the fault text for each internal fault number                      | --      | m        |
| 952                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fault situation counter     | Sum of all of the fault situations since the last reset                                                          | o       | m        |
| m mandatory in this fault buffer version<br>o optional in this fault buffer version<br>-- not realised in this fault buffer version<br><br>Minimum: Minimum fault buffer version, which shall only include the fault message counter and the internal fault number.<br><br>Complete: Full fault buffer version, which shall contain in addition to the fault number, the optional fault time and the fault value: a text and the fault value parameter for each internal fault number (fault number list) and the fault situation counter. The full version of the fault buffer is specified for evaluation at a numerical control.<br><br>All parameters in Table 114 shall be only readable with the exception of parameter 952, which shall also be writable (see also Figure 61) and parameter 946, which may also be writable. |                             |                                                                                                                  |         |          |

**Example with the default number of fault situations and fault message (8x8)**

|                                 | PNU947       | PNU945     | PNU948     | PNU949      |           |
|---------------------------------|--------------|------------|------------|-------------|-----------|
|                                 | Fault number | Fault code | Fault time | Fault value | Sub-index |
| <b>Actual fault situation n</b> | 5            | 72         | Time 2     | Value 2     | 0         |
|                                 | 11           | 50         | Time 3     | Value 3     | 1         |
|                                 | 0            | 0          | xxxx       | xxxx        | 2         |
|                                 |              |            |            |             | 3         |
|                                 |              |            |            |             | 4         |
|                                 |              |            |            |             | 5         |
|                                 |              |            |            |             | 6         |
|                                 |              |            |            |             | 7         |
| <b>Fault situation n - 1</b>    | 3            | 90         | Time 1     | xxx         | 8         |
|                                 | 0            | 0          | xxx        | xxx         | 9         |
|                                 | x            | x          | xxx        | xxx         | 10        |
|                                 |              |            |            |             | 11        |
|                                 |              |            |            |             | 12        |
|                                 |              |            |            |             | 13        |
|                                 |              |            |            |             | 14        |
|                                 |              |            |            |             | 15        |
| ⋮                               | ⋮            | ⋮          | ⋮          | ⋮           | ⋮         |
| <b>Fault situation n - 7</b>    |              |            |            |             | 56        |
|                                 |              |            |            |             | 57        |
|                                 |              |            |            |             | 58        |
|                                 |              |            |            |             | 59        |
|                                 |              |            |            |             | 60        |
|                                 |              |            |            |             | 61        |
|                                 |              |            |            |             | 62        |
|                                 |              |            |            |             | 63        |

max. 8 x 8 entries, last unacknowledged fault situation = n

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**Figure 63 – Fault buffer with fault sequence example**

Various fault messages are defined in a device. It includes, among others, for example the fault codes given in Table 115.

**Table 115 – Fault codes examples**

| Fault code | Example for meaning |
|------------|---------------------|
| 50         | Over-current        |
| 72         | Over-voltage        |
| 90         | Fuse failure        |

The current actual value is saved in parameter 15 and the voltage actual value in parameter 110. A fault number list is saved in the device as is shown in Figure 64.

Two fault situations have occurred. For the first fault situation, the "fuse failure" fault message has occurred, for the second, which has still not been acknowledged, first the fault message "overvoltage" and then "overcurrent" occurred. This fault sequence is entered as an example in Figure 63.

| 951                        |     |                | 946                        |          |
|----------------------------|-----|----------------|----------------------------|----------|
| Fault number list          |     |                | Fault code list            |          |
| Subindex =<br>Fault number | PNU | Text           | Subindex =<br>Fault number | Code No. |
| 0                          | 0   | No fault       | 0                          | 0        |
| 1                          | XXX | XXX            | 1                          | XXX      |
| 2                          | XXX | XXX            | 2                          | XXX      |
| 3                          | 0   | Fuse failure   | 3                          | 90       |
| 4                          | XXX | XXX            | 4                          | XXX      |
| 5                          | 110 | Over - voltage | 5                          | 72       |
| ...                        |     |                | ...                        |          |
| 11                         | 15  | Over - current | 11                         | 50       |
| ...                        |     |                | ...                        |          |

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**Figure 64 – Fault number list and fault code list with example**

#### 6.3.8.4 Fault classes mechanism

Within the fault class mechanism, the vendor independent PROFIdrive fault classes according to Table 117 are defined. Out of every fault class, a PROFIdrive diagnosis object shall emerge if the fault classes attribute WARNING\_PRESENT or FAULT\_PRESENT is valid (see Table 116). The diagnosis objects related to a fault class (maximum two per fault class) emerge or disappear according to the settings or changes in the actual fault situation of the fault buffer mechanism and the settings of warnings in the warning mechanism (see also Figure 58). Thus, the PROFIdrive diagnosis objects represent the actual fault and warning situation of the DO.

It is recommended to compose a unique fault text for every diagnosis object for the signalling to the user according to the following specification:

Signalling Text for Fault Class Attribute = WARNING\_PRESENT:

"PROFIdrive\_Warning\_"<Fault Code>":"<Fault Class Name>

Signalling Text for Fault Class Attribute = FAULT\_PRESENT:

"PROFIdrive\_Fault\_"<Fault Code>":"<Fault Class Name>

**Table 116 – Definition of the fault classes attribute**

| Fault class attribute | Meaning                                                                                                                                        |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| NO_FAULT              | There are no faults and no warnings present.                                                                                                   |
| WARNING_PRESENT       | There is at least one exception present, but the drive is still working and follows the setpoint.                                              |
| FAULT_PRESENT         | There is at least one exception present, and one of these exceptions caused a stop reaction (the drive does not follow the setpoint any more). |



**Table 117 – Definition of the PROFIdrive fault classes**

| <b>Fault Code</b> | <b>Fault Class Name</b>              | <b>Comments</b>                                                                                                                                                                                                                                                                                                                             |
|-------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01                | Microcontroller Hardware or Software | Comprises exceptions in the main CPU of the drive, memory/checksum errors, over-/underrun in control processes, controller self test failed, etc.                                                                                                                                                                                           |
| 02                | Mains Supply                         | Comprises exceptions out of the mains supply like phase error, mains over-/undervoltage, etc.                                                                                                                                                                                                                                               |
| 03                | Low Voltage Supply                   | Comprises exceptions out of the low voltage supply supplied to the drive system (e.g. external 24 V supply).                                                                                                                                                                                                                                |
| 04                | DC Link Overvoltage                  | Exception because of overvoltage of the DC link, which typically is a result of excessive energy feedback from the motor/process or a faulty dummy load.                                                                                                                                                                                    |
| 05                | Power Electronics                    | Comprises exceptions in the inverter stage of the drive: phase current measurement errors, overcurrent supervision error.                                                                                                                                                                                                                   |
| 06                | Overtemperature Electronic Device    | Overtemperature because of overload or faulty cooling system.                                                                                                                                                                                                                                                                               |
| 07                | Isolation Fault                      | Exception because of over-current resulting from shortage between phase and phase or phase and ground.                                                                                                                                                                                                                                      |
| 08                | Motor Overload                       | Exception because of over-temperature of the motor. This may be a result from motor overload or a faulty cooling system.                                                                                                                                                                                                                    |
| 09                | Fieldbus System                      | Exception from the Communication System between the drive (DU) and the controller. For example, this may be temporary communication frame errors or exceptions in the isochronous operation.                                                                                                                                                |
| 10                | Safety Channel                       | Exception because of a fault in the drive safety function (e.g. results from the redundant safety paths don't match).                                                                                                                                                                                                                       |
| 11                | Feedback                             | Exception because of an exception in the feedback interface or the feedback sensor (e.g. encoder, position or velocity measurement system).                                                                                                                                                                                                 |
| 12                | Internal Communication               | Exception from the drive internal Communication System if there is a separate physical entity related to the internal Communication System (e.g. communication backplane, bus cable, etc.).                                                                                                                                                 |
| 13                | Infeed                               | Comprises exceptions out of the infeed unit of the drive: for example missing DC link voltage, etc.                                                                                                                                                                                                                                         |
| 14                | Brake Resistor                       | Exception from the dummy load circuit of the drive: Over-temperature brake resistor, brake resistor no current, etc.                                                                                                                                                                                                                        |
| 15                | Line Filter                          | Exception from the main line filter in front of the infeed unit if the filter is a separate physical entity (e.g. over-temperature, etc.).                                                                                                                                                                                                  |
| 16                | External                             | Exception posted by additional input channels to the drive. For example, a separate custom specific temperature sensor connected to the drive system by an digital input.                                                                                                                                                                   |
| 17                | Technology                           | Exception from a drive internal process supervision task/system. For example, supervision of a torque limit.                                                                                                                                                                                                                                |
| 18                | Engineering                          | Exception from differences between real and expected configuration information.                                                                                                                                                                                                                                                             |
| 19                | Other                                | Necessary because every entry in the actual fault situation of the fault buffer and the warning mechanism shall result in an exception in one of the PROFIdrive fault classes because of consistency. Therefore, if a drive exception does not match with one of the defined fault classes it shall be mapped with the fault class (Other). |
| 20                | Auxiliary Device                     | Exception because of a fault in an auxiliary device of the drive which can not be mapped to another fault class (e.g. special cooling devices often used for large drives).                                                                                                                                                                 |

### 6.3.9 Identification

#### 6.3.9.1 Drive Unit identification

Within a complex Communication System, many different devices are often networked together. In some cases, these devices are from different manufacturers. The following elements for the Drive Unit identification are defined here in order to provide the plant manufacturer and plant operator support during and after commissioning. It provides an overview and diagnostics of the PROFIdrive Drive Units connected to the Communication System.

The device manufacturer provides information for the device identification. The manufacturer's data is permanently anchored in the device and may only be read and not changed.

Parameter 964 is the device identification parameter. The data type is "Array[n] of Unsigned16". The assignment of the first subindices is defined and shown in Table 118. Manufacturer-specific data may then follow. The minimum array length is 5 elements. See also 6.3.9.5 for the PROFIdrive profile independent device identification by the I&M functionality.

**Table 118 – Structure of parameter 964 (Drive Unit identification)**

| Subindex | Contents                                                                 | Comments                                                                                                                 |
|----------|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 0        | Manufacturer                                                             | Device manufacturers vendor code (see note)                                                                              |
| 1        | Drive Unit type                                                          | Manufacturer-specific                                                                                                    |
| 2        | Version (Software)                                                       | xyxy (decimal)<br>Example: Version 2.1 results in 0201 decimal                                                           |
| 3        | Firmware date (year)                                                     | yyyy (decimal)                                                                                                           |
| 4        | Firmware date (day/month)                                                | ddmm (decimal)                                                                                                           |
| 5        | PROFINET: Number of Drive Objects (DO)<br>PROFIBUS: Number of drive Axis | If: the number of DO/Axis = 1, then: optional;<br>If: the number of DO/Axis > 1 or subindex 6 available, then: mandatory |
| 6<br>... | Manufacturer-specific                                                    | Optional                                                                                                                 |

NOTE The code for manufacturer (subindex 0) will be defined by PROFIBUS & PROFINET International (see [www.profibus.com](http://www.profibus.com)).

#### 6.3.9.2 Profile identification

Parameter 965 is the Profile identification number which identifies the profile and the profile version. The PROFIdrive profile is assigned to the Profile Number 3 (decimal) and the actual Version Number of this profile is 42 (decimal). The definition of byte 1 (Profile Number) and byte 2 (Version Number) of PNU965 is shown in Table 119.

**Table 119 – Definition of the Profile identification number**

| Profile Number<br>(byte 1, decimal) | Version Number<br>(byte 2, decimal) | Profile Version                  |
|-------------------------------------|-------------------------------------|----------------------------------|
| 3                                   | 2                                   | PROFIdrive Profile Version 2     |
| 3                                   | 3                                   | PROFIdrive Profile Version 3.1.2 |
| 3                                   | 40                                  | PROFIdrive Profile Version 4.0   |
| 3                                   | 41                                  | PROFIdrive Profile Version 4.1   |
| 3                                   | 42                                  | PROFIdrive Profile Version 4.2   |
| 3                                   | ...                                 | ...                              |

### 6.3.9.3 Drive Object identification

Inside a Modular device, the DOs may be of different type and based on different software.

The module manufacturer provides information for the DO identification. The manufacturer's data is permanently anchored in the DO and may only be read and not changed.

Local parameter 975 is the DO identification parameter. The data type is "Array[n] of Unsigned16". The assignment of the first subindices is defined and shown in Table 120. Manufacturer-specific data may then follow. The minimum array length is 7 elements.

**Table 120 – Structure of parameter 975 (DO identification)**

| Subindex  | Contents                             | Comments                                                       |
|-----------|--------------------------------------|----------------------------------------------------------------|
| 0         | Manufacturer                         | Device manufacturers vendor code (see note)                    |
| 1         | DO type                              | Manufacturer-specific                                          |
| 2         | Version (Software)                   | xyyy (decimal)<br>Example: Version 2.1 results in 0201 decimal |
| 3         | Firmware date (year)                 | yyyy (decimal)                                                 |
| 4         | Firmware date (day/month)            | ddmm (decimal)                                                 |
| 5         | PROFIdrive DO type class (Structure) | See Table 121 and Table 122                                    |
| 6         | PROFIdrive DO sub class 1            | See Table 123                                                  |
| 7         | Drive Object ID (DO-ID)              | Optional for PROFIBUS Drive Units                              |
| 8 to 9    | Reserved                             |                                                                |
| 10<br>... | Manufacturer-specific                | Optional                                                       |

NOTE The code for manufacturer (subindex 0) will be defined by PROFIBUS & PROFINET International (see [www.profibus.com](http://www.profibus.com)).

**Table 121 – Structure of P975.5**

| Bit     | Value    | Meaning                  |
|---------|----------|--------------------------|
| 0 to 7  | 0 to 255 | PROFIdrive DO-Type class |
| 8 to 15 | --       | Reserved                 |

**Table 122 – DO type class definition in P975.5**

| Decimal value of 1st Byte of P975.5<br>(Bit 0 ... 7) | Type class                          |
|------------------------------------------------------|-------------------------------------|
| 0                                                    | No type class information available |
| 1                                                    | Axis                                |
| 2                                                    | Infeed                              |
| 3                                                    | General I/O                         |
| 4                                                    | Controller                          |
| 5                                                    | Encoder                             |
| 6<br>to<br>255                                       | Reserved                            |

P975.5 shall be set to 1 if the DO is an Axis type DO according to the definition in 6.3.1. If the functionality of the DO does not match the defined type classes in Table 121, P975.5 is set to 0. In any case, the vendor is free to enter his own DO type class according to his vendor specific type class definition in P975.1.

**Table 123 – Assignment of the bits of DO sub class 1 identification in P975.6**

| Bit | Significance (Bit = true)     | Significance (Bit = false)        |
|-----|-------------------------------|-----------------------------------|
| 0   | Application Class 1 supported | Application Class 1 not supported |
| 1   | Application Class 2 supported | Application Class 2 not supported |
| 2   | Application Class 3 supported | Application Class 3 not supported |
| 3   | Application Class 4 supported | Application Class 4 not supported |
| 4   | Application Class 5 supported | Application Class 5 not supported |
| 5   | Application Class 6 supported | Application Class 6 not supported |
| 6   | reserved                      | reserved                          |
| 7   | reserved                      | reserved                          |
| 8   | reserved                      | reserved                          |
| 9   | reserved                      | reserved                          |
| 10  | reserved                      | reserved                          |
| 11  | reserved                      | reserved                          |
| 12  | reserved                      | reserved                          |
| 13  | reserved                      | reserved                          |
| 14  | Encoder Class 3 supported     | Encoder Class 3 not supported     |
| 15  | Encoder Class 4 supported     | Encoder Class 4 not supported     |

Notice that P975 is recommended to implement new drive system developments for all DO and Drive Unit types. At least P975 is mandatory for all Drive Units who support P978 and for all PROFINET IO devices.

#### **6.3.9.4 Base Mode Parameter Access identification**

In DUs and DOs, depending on the device and the manufacturer, there may be a Base Mode Parameter Access parameter manager of a different kind which will lead to different properties of the Base Mode Parameter Access service.

The module manufacturer may provide optional information for the DO or DU Base Mode Parameter Access service identification via parameter PNU974. PNU974 is readable only and the information in P974 is related to all Base Mode Parameter Access points of the DO that the Module is related to. In case of a Homogeneous D-Device, P974 is a global parameter. The content of P974 shall be static while the drive system is running and shall not change during operation.

The data type is "Array[n] of Unsigned16". The assignment of the subindices is defined as shown in Table 124.

If P974 is not present, the parameter manager should support the default of 240 bytes of block length and multi-parameter requests with up to 39 parameters per multi-parameter request. Note that the block length shown in PNU974 may be reduced by additional limitations of the communication system.

**Table 124 – Structure of parameter 974 (Base Mode Parameter Access identification)**

| Subindex | Contents                                                     | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | Max block length                                             | Maximum block length in bytes, for the parameter request and response block, which is supported by the parameter manager (limitations due to the communication system should be included, but may not be included if the communication system is not in the scope of the DO parameter manager).                                                                                                                                                                                              |
| 1        | Max number of parameter requests per multi-parameter request | =0 reserved.<br>=1 the parameter manager does not support multi parameter access service.                                                                                                                                                                                                                                                                                                                                                                                                    |
| 2        | Max latency per request<br>(n × 10ms)                        | Maximum latency time for the processing of a parameter request (time between request and response without time consumed on the communication line for a worst case scenario).<br>The latency time is calculated by multiplication of the value in this subindex by 10 ms. A value =0 indicates that there is no specification available. Note that the maximum latency time per request also includes additional time consumed for a multi-parameter request (of max. number of parameters). |

#### 6.3.9.5 I&M Parameter definition

For the Identification and Maintenance functionality (I&M) (see PNO/3.502), I&M Records may be allocated to the PROFIdrive components DU, DO and Submodules. For all PROFIdrive components, the I&M parameters are defined according to Table 125.

**Table 125 – PROFIdrive I&M parameter definition**

| I&M Parameter         | Value for PROFIdrive component |
|-----------------------|--------------------------------|
| PROFILE_ID            | 0x3A00                         |
| PROFILE_SPECIFIC_TYPE | 0x0000                         |
| REVISION_COUNTER      | 0x0000                         |

#### 6.3.10 Drive reset (power-on reset)

##### Summary

Especially for distributed applications, it makes sense to initiate a DO-specific reset which is controlled by the controller application. This may either be initiated manually (by the user) or automatically (by the application process). Applications are, for example: reset for the first start-up or reset after an error has been removed.

### P972 “drive reset”

The reset is possible using the optional parameter P972 (see Table 126) in the following manner:

- Power-on reset (reset: closed-loop drive control + communication software);
- Communication-down reset (reset: closed-loop drive control + communication software).

The Power-on reset is initiated by write accessing P972 (value 1), or, if required (see below) firstly prepared (value 2) and then initiated.

The Communication-down reset is prepared by write accessing P972 (value 3) and then initiated when the communication relationship is cancelled.

**Table 126 – PROFIdrive parameter value definition**

| Parameter value P972 | Meaning                                  |
|----------------------|------------------------------------------|
| 0                    | Initial status (or status after a reset) |
| 1                    | Power-on reset (initiation)              |
| 2                    | Power-on reset (preparation)             |
| 3                    | Communication-down reset (preparation)   |
| 4 to 99              | Reserved for profile                     |
| 100 to 65 535        | Vendor specific                          |

The implementation of the parameter and the realisation of the various versions are optional. The interlocking and checks for the drive when initiating a reset are device-specific.

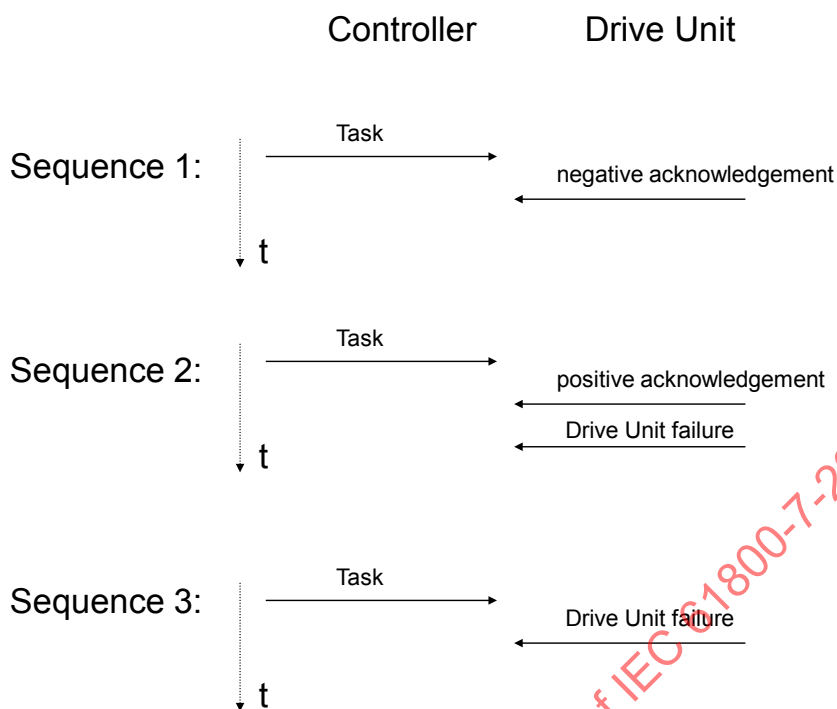
When write accessing P972, a negative acknowledgement is possible (see Table 127).

**Table 127 – PROFIdrive error code definition**

| Error Code | Value for PROFIdrive component                                                              |
|------------|---------------------------------------------------------------------------------------------|
| 0          | Illegal parameter number (P972 not implemented)                                             |
| 2          | Lower or upper value limit exceeded (e.g. value=3, but only values 1 and 2 are implemented) |
| 17         | Task cannot be executed due to operating status (e.g. the drive is moving)                  |
| 20         | Illegal value (e.g. value=2, but only value 1 implemented)                                  |

### Drive reset: Direct initiation (P972=1)

The write access to P972 (with value 1) results in a drive reset and therefore, from the perspective of the Controller in a Drive Unit failure (see Figure 65). It cannot be guaranteed that the positive acknowledgment is still sent in time from the Drive Unit or received from the Controller.



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**Figure 65 – Drive reset: Direct initiation (P972 = 1)**

#### **Drive reset: Preparation/initiation (e.g. P972 = 2/P972 = 1)**

For the sequence described above (direct initiation), after a DO fails and becomes operational again, the value of P972 = 0 cannot clearly indicate whether the reset was executed or not.

For security reasons, when the reset is automatically initiated (by the application process), it may be required to figure out if the reset was really processed successfully. This can be guaranteed if the reset is first prepared with write access (with value 2) and is then initiated by a write access (with the value 1). After this, by reading back the contents of P972, it may be clearly identified if the reset was executed (P972 = 0).

#### **EXAMPLE 1**

Step 1: Controller writes P972 = 2 and expects a positive acknowledgement to the write request.

Step 2: Controller writes P972 = 1, drive executes a power-on reset.

Step 3: After the connection has been re-established, the controller reads P972 from the drive.

If P972 = 0, the power-on reset was successfully executed; if P972 = 2, the write request P972 = 1 has been lost, and the controller shall repeat the action.

#### **Drive reset: Preparation/initiation by communication down (P972=3)**

If it is required to reset a large amount of Drive Units at the same time, the Communication-down reset sequence may be used. For this all Drive Units are first prepared with write access (with value 3). The reset is then initiated when the controller cancels the communication relationship to the Drive Unit. After this, by reading back the contents of P972, it may be clearly identified if the reset was executed (P972 = 0).

#### **EXAMPLE 2**

Step 1: Controller writes P972 = 3 and expects a positive acknowledgement to the write request.

Step 2: Controller cancels the communication relationship, drive executes a power-on reset.

Step 3: After the connection has been re-established, the controller reads P972 from the drive.

If P972 = 0, the power-on reset was successfully executed; if P972 = 3, the reset was not successfully executed.

### 6.3.11 Operation priority of parameters and control priority

#### P927: Operation priority of parameters

If there are several interfaces which may have the operation priority of parameters, parameter P927 specifies in a manufacturer-specific way which interface has the operation priority to set parameters.

If the controller attempts to write values without the rights to change parameters, an error message is issued.

#### P928: Control priority

Is to be set locally; specifies in a manufacturer-specific way which interface has the control priority to set DO IO Data. Value = 1 means PROFIdrive Interface 1 (main interface on PROFIBUS/PROFINET); other values are manufacturer-specific.

#### Change of the control priority between Supervisor and controller (in case of P928 = 1)

After drive reset, the Controller has the control priority as default.

It should be possible that a Supervisor may fetch the Control priority from the controller so that the Supervisor may issue setpoints for the drive.

The Control priority should be withdrawn from the operational controller and should also be able to be returned.

The changeover should be exclusively made by the Supervisor. The mechanism to change the control priority is manufacturer-specific. Parameter P928, for example, may be set to device-specific values in order to change the control priority.

The access to the DO IO Data of the Supervisor is also manufacturer-specific. The Supervisor may access the DO IO Data, for example, by the parameters P900 "Setpoint telegram" and P907 "Actual value telegram".

The requirements for changing the Control priority should be:

- Drive is not in the "ready" state
  - ZSW1, bit 1 = 0: "Not Ready To Switch On"
  - and ZSW1, bit 2 = 0: "Operation Disabled"
- Controller and Supervisors control an "OFF" command in the control word.
  - STW1, bit 0 = 0: "OFF (OFF1)"
  - or STW1, bit 1 = 0: "Coast Stop (OFF2)"
  - or STW1, bit 2 = 0: "Quick Stop (OFF3)"

If the control priority is changed to the Supervisor, the controller which had the control priority before loses the control priority. For this reason, the non-controlling controller receives a status word ZSW1 of the DO in which bit 9 is set to zero ("No Control Requested"). The controlling Supervisor receives acyclically a status word ZSW1 of the DO in which bit 9 is set to one ("Control Requested").



### Control requested by the DO/Control by PLC

DO IO Data validity and the readiness status of the DO application process is signalled by the following bits of the control and status words.

- Status word 1 bit 9: Control Requested

This bit is set by the DO, if it is prepared to be controlled by the controller and ready to accept the controller's control word and setpoints.

The DO shall not wait for STW1 Bit 10 of the controller to set the "Control Requested" bit.

Precondition:

The control priority shall be set to the PROFIdrive Interface 1 (main Interface).

- Control word 1 bit 10: Control By PLC

This bit is set by the controller, if it sends valid control words and setpoints.

- IO Data exception for Sign-Of-Life:

In the case of clock cycle synchronous application, the sign-of-lives which are part of the IO Data are evaluated by the DO independent of the setting of STW1 bit 10.

The DO always sends its status words and actual values, independent of ZSW1 bit 9 and STW1 bit 10.

The DO accepts the controller's control words and setpoints if STW1 bit 10 is set.

### 6.3.12 User data reliability

#### 6.3.12.1 General

For both transmission directions (Controller <-> DO), user data reliability is achieved using a Sign-Of-Life (4-bit counter).

The value range of the Sign-Of-Life is only 1 to 15 respectively (0 = invalid) since:

A DO that does not support the fail-safe mode receives a data telegram in the clear mode with the Output Data set to "0" (thus, failure of the Sign-Of-Life may be recognised only if LS = 0 is not permissible).

Through the DO's Sign-Of-Life, a maximum ratio of  $T_{CAC}/T_{DC}$  of 14/1 is possible. Regardless of the ratio  $T_{CAC}/T_{DC}$ , the counter is always incremented to the maximum value (15).

In Multi-Axis Drive Units, the reaction to Sign-Of-Life failures is DO specific (axis specific). Depending on the device, the reaction of one Drive Axis may affect also other DOs or Drive Axis in a vendor specific way.

#### 6.3.12.2 Controller's Sign-Of-Life (C-LS)

##### Transmission (C-LS)

A 4-bit counter is used in control word 2 (refer to 6.3.2.3) as the Sign-Of-Life for the controller. This counter is incremented by the controller in each controller application cycle, and thus also identifies the computation of new setpoint values by the controller (first DO IO Data cycle in the Controller Application Cycle). The DO receives the new Sign-Of-Life of the controller together with the new setpoint at the time  $T_{IO\_OUTPUT}$  in the following DO IO Data cycle.

## Synchronisation (C-LS)

The Controller application starts the Controller-LS with an arbitrary value between 1 and 15, at the earliest when changing from Preparation -> Synchronisation (refer to 6.1.2.7.6).

## Monitoring (C-LS)

If, in a Controller Application Cycle ( $T_{CAC}$ ), the DO application does not recognise a correct count (i.e. a positive or a negative deviation is recognised), it initially processes with the old DO IO Data values from the last valid controller frame. For setpoint generation, a device-specific failure strategy may be used.

If the DO application does not recognise the expected numerical value after a parameterised number of Controller Application Cycles ( $T_{CLS} = n \times T_{CAC}$ ;  $n$  may be selected via profile parameter 925; also refer to 6.3.12.4), the affected Drive Axis messages a fault. After fault acknowledgement, the DO application then attempts to automatically re-synchronise itself to the Sign-Of-Life of the controller application. Depending on the particular application, a new start may be required.

If the Controller Sign-Of-Life fails, it may be for the following reasons.

- Sign-Of-Life failure  
Failure of the controller application level (with DO IO Data transmission still operational)
- Isochroneous operation failure  
The DO IO Data from the Controller wasn't received correctly (corrupt frame) or was received too late (synchronisation lost)

EXAMPLE 1 Permanent LS failure (see Figure 66),  $T_{CLS} = 5 \times T_{CAC}$ : the strategy of the Sign-Of-Life failure counter is explained in 6.3.12.4:

|                            |            |   |    |    |    |    |               |    |    |    |
|----------------------------|------------|---|----|----|----|----|---------------|----|----|----|
| $T_{CAC}$ :                |            |   |    |    |    |    |               |    |    |    |
| Controller LS (reference): | 1          | 2 | 3  | 4  | 5  | 6  | 7             | 8  | 9  | 10 |
| Controller LS (actual):    | 1          | 2 | 2  | 2  | 2  | 2  | 2             | 2  | 2  | 2  |
| Failure counter:           | 0          | 0 | 10 | 20 | 30 | 40 | 50            | 50 | 50 | 50 |
| Response:                  | -> Failure |   |    |    |    |    | -> Switch-off |    |    |    |

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**Figure 66 – Example: Permanent failure of the controller LS**

EXAMPLE 2 Temporary LS failure (see Figure 67 and Figure 68),  $T_{CLS} = 5 \times T_{CAC}$ : The strategy of the Sign-Of-Life failure counter is explained in 6.3.12.4:

|                            |            |   |          |          |    |    |    |    |    |    |
|----------------------------|------------|---|----------|----------|----|----|----|----|----|----|
| <b>T<sub>CAC</sub> :</b>   |            |   |          |          |    |    |    |    |    |    |
| Controller LS (reference): | 1          | 2 | 3        | 4        | 5  | 6  | 7  | 8  | 9  | 10 |
| Controller LS (actual):    | 1          | 2 | <b>2</b> | <b>2</b> | 5  | 6  | 7  | 8  | 9  | 10 |
| Failure counter:           | 0          | 0 | 10       | 20       | 19 | 18 | 17 | 16 | 15 | 14 |
| Response:                  | -> Failure |   |          |          |    |    |    |    |    |    |

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**Figure 67 – Example: Temporary failure of the controller LS (negative deviation)**

|                            |            |   |          |          |    |    |    |    |    |    |
|----------------------------|------------|---|----------|----------|----|----|----|----|----|----|
| <b>T<sub>CAC</sub> :</b>   |            |   |          |          |    |    |    |    |    |    |
| Controller LS (reference): | 1          | 2 | 3        | 4        | 5  | 6  | 7  | 8  | 9  | 10 |
| Controller LS (actual):    | 1          | 2 | <b>4</b> | <b>5</b> | 5  | 6  | 7  | 8  | 9  | 10 |
| Failure counter:           | 0          | 0 | 10       | 20       | 19 | 18 | 17 | 16 | 15 | 14 |
| Response:                  | -> Failure |   |          |          |    |    |    |    |    |    |

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**Figure 68 – Example: Temporary failure of the controller LS (positive deviation; double step)**

NOTE 1 A permanent skew of the controller's Sign-Of-Life (failure of sampling time) causes an error (see above) unless the controller application can correct the Sign-Of-Life.

NOTE 2 If the cause of the Sign-Of-Life failure is a failure when processing the DO IO Data frame in the controller application, generating a diagnostics message by the DO application can be more suitable than transmitting a drive fault because the drive fault may no longer be processed.

NOTE 3 If the controller Sign-Of-Life fails within one cycle of the controller application for  $T_{CAC} \neq T_{DC}$ , this is only counted as one failure ( the Sign-Of-Life failure counter is only incremented once).

### 6.3.12.3 DO's Sign-Of-Life (DO-LS)

#### Transmission (DO-LS)

A 4-bit counter in status word 2 (refer to 6.3.2.6) is used as a Sign-Of-Life for the DO. The DO increments this counter with each DO IO Data cycle ( $T_{DC}$ ).

#### Synchronisation (DO-LS)

The DO application starts the DO's Sign-Of-Life with an arbitrary value between 1 and 15: after successful PLL synchronisation and at the change ( $n \rightarrow n + 1$ ) of the controller's Sign-Of-Life.

#### Monitoring (DO-LS)

If the controller application does not recognise a correct count in a controller application cycle (i.e. a positive or negative deviation has been recognised), it initially uses the old DO IO Data values from the last valid DO IO Data cycle. To generate the actual value, a device-specific failure strategy may be implemented.

If the controller application does not recognise the expected numerical value after a parameterised time ( $T_{DLS} = n \times T_{DC}$ ;  $n$  may be parameterised or defined depending on the

manufacturer of the controller application), the affected Drive Axis is shut down by the controller application (possibly also other involved drives), and an appropriate fault is signalled to the user. The controller application then attempts to automatically re-synchronise itself to the Sign-Of-Life of the DO application. Depending on the particular application, a re-start may be required or it may be sufficient to acknowledge the fault.

Example reasons for the DO Sign-Of-Life to fail may be:

- Sign-Of-Life failure  
Failure of the DO application level (while DO IO Data transmission is still working)
- Isochroneous operation failure  
The DO IO Data from the device wasn't received correctly (corrupt frame) or was received too late (synchronisation lost)

EXAMPLE 1 Permanent LS failure (see Figure 69),  $T_{DLS} = 5 \times T_{DC}$ : the strategy of the Sign-Of-Life failure is explained in 6.3.12.4:

| IO Data cycle:     |            |   |    |    |    |               |    |    |    |    |
|--------------------|------------|---|----|----|----|---------------|----|----|----|----|
| DO LS (reference): | 1          | 2 | 3  | 4  | 5  | 6             | 7  | 8  | 9  | 10 |
| DO LS (actual):    | 1          | 2 | 2  | 2  | 2  | 2             | 2  | 2  | 2  | 2  |
| Failure counter:   | 0          | 0 | 10 | 20 | 30 | 40            | 50 | 50 | 50 | 50 |
| Response:          | -> Failure |   |    |    |    | -> Switch-off |    |    |    |    |

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**Figure 69 – Example: Permanent failure of the DO LS**

EXAMPLE 2 Temporary LS failure (see Figure 70 and Figure 71 ),  $T_{DLS} = 5 \times T_{DC}$ : the strategy of the Sign-Of-Life failure is explained in 6.3.12.4:

| IO Data cycle:     |            |   |    |    |    |    |    |    |    |    |
|--------------------|------------|---|----|----|----|----|----|----|----|----|
| DO LS (reference): | 1          | 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| DO LS (actual):    | 1          | 2 | 2  | 2  | 5  | 6  | 7  | 8  | 9  | 10 |
| Failure counter:   | 0          | 0 | 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 |
| Response:          | -> Failure |   |    |    |    |    |    |    |    |    |

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**Figure 70 – Example: Temporary failure of the DO LS (negative deviation)**

| IO Data cycle:     |            |   |    |    |    |    |    |    |    |    |
|--------------------|------------|---|----|----|----|----|----|----|----|----|
| DO LS (reference): | 1          | 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| DO LS (actual):    | 1          | 2 | 4  | 5  | 5  | 6  | 7  | 8  | 9  | 10 |
| Failure counter:   | 0          | 0 | 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 |
| Response:          | -> Failure |   |    |    |    |    |    |    |    |    |

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**Figure 71 – Example: Temporary failure of the DO LS (positive deviation; double step)**

NOTE A permanent skew of the Sign-Of-Life of the DO (failure of a sampling time) causes permanent LS failures and therefore delivers a LS fault.

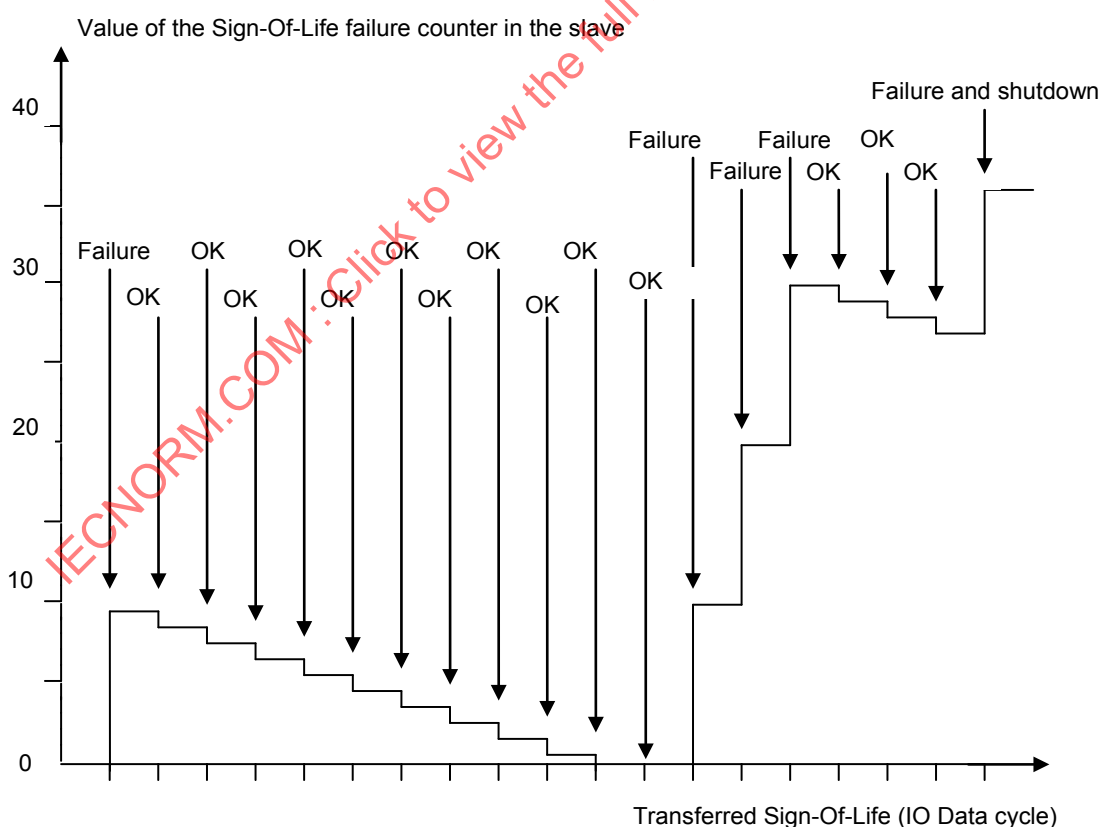
#### 6.3.12.4 Counting strategy for the Sign-Of-Life failure counter

The strategy which is applied in order to prevent fast shutdown for a sporadically faulted controller or DO application is described in the following text. This strategy guarantees that at least a specific percentage of the telegrams shall be valid before a Drive Axis is powered-down.

A counter is defined on the DO side in which for each deviation (independently of whether it is a positive or negative deviation) between the expected and actually transferred value for the controller Sign-Of-Life, it is incremented by ten. For each additional deviation, the counter is again incremented by ten. If a deviation between the expected and received controller Sign-Of-Life is not recognised, the counter is decreased by one. The minimum value which may then be counted down to is zero. This is simultaneously the value from which counting is started. This method ensures that more than 90 % of the telegrams transferred in continuous operation originate from an undisturbed controller application.

Profile parameter 925 (axis-specific, data type Unsigned16) may be used to set a maximum on how many consecutive controller Sign-Of-Life failures may occur (for an initial counter value of zero and without any intermediate valid sequences) without failure of a Drive Axis. Depending on the previous history, it is possible that just a few controller Sign-Of-Life failures are sufficient to cause a failure of a Drive Axis. If the Drive Axis is powered-down, the Sign-Of-Life failure counter maintains its value up to the start of the re-synchronisation operation.

In the example in Figure 72, the Sign-Of-Life failure counter in the Drive Axis is viewed over time with respect to the transferred controller Sign-Of-Life. The maximum number of controller Sign-Of-Life failures which may be tolerated was set to three in parameter 925.



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**Figure 72 – Value of the DO Sign-Of-Life failure counter (axis-specific) with respect to the transferred controller Sign-Of-Life**

The same strategy is recommended when monitoring the DO Sign-Of-Life in the controller. However, it has not been defined with which parameter the maximum number of tolerable DO Sign-Of-Life character failures may be parameterised.

### 6.3.13 Specified DO functions for the Application Classes

According to the definition of the Application Classes in 6.1.5, Table 128 specifies the DO functionality the drive shall support in order to match a specific Application Class.

- Application Class 1: Standard Drive
- Application Class 2: Standard drive with distributed technology controller
- Application Class 3: Single axis positioning drive, with local Motion Control
- Application Class 4: Motion Control with central interpolation and speed setpoint interface
- Application Class 5: Motion Control with central interpolation and position setpoint interface
- Application Class 6: Motion Control for clocked processes, or distributed angular synchronism

**Table 128 – Specified DO functions for the Application Classes**

[illegible]

| Functionality                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Application Classes |                |   |   |   |                | Cross-reference    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|---|---|---|----------------|--------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1                   | 2              | 3 | 4 | 5 | 6              |                    |
| Clock Synchronous Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | o                   | o              | o | m | m | m              | refer to 6.1.2.7.5 |
| P-Device-to-P-Device communication relationship                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | o                   | m <sup>h</sup> | o | o | o | m <sup>h</sup> | refer to 6.1.2.7.2 |
| m = mandatory<br>o = optional                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                |   |   |   |                |                    |
| <sup>a</sup> For this Application Class, the position feedback interface with one sensor is mandatory. Additional sensors are optional.<br><sup>b</sup> Only mandatory if optional functionality “DSC” is implemented.<br><sup>c</sup> Only for applications in the process technology operating mode.<br><sup>d</sup> Parameter 922 shall be implemented, at least readable.<br><sup>e</sup> For standard telegram 9, the DO IO Data normalisation is recommended.<br><sup>f</sup> For this Application Class, the minimum fault buffer is mandatory.<br><sup>g</sup> For this Application Class, the complete fault buffer is mandatory.<br><sup>h</sup> PROFIBUS DP: The publisher and subscriber functionality shall be supported.<br>PROFINET: M CR shall be supported.<br><sup>k</sup> For standard telegrams 2 and 9 the STW2/ZSW2 is required but if the device doesn't support clock synchronous operation, the sign of life counting and evaluation is omitted. |                     |                |   |   |   |                |                    |

## 6.4 Parameter definition

### 6.4.1 PROFIdrive Parameter listed by Function

#### 6.4.1.1 Life sign monitoring

Parameter P925 (see Table 129) is used for optional parameterisation of life sign monitoring.

**Table 129 – Parameter for “Life sign monitoring”**

| PNU | Significance                                        | Implementation | Validity range |
|-----|-----------------------------------------------------|----------------|----------------|
| 925 | Number of life sign failures that may be tolerated. | Optional       | DO-specific    |

#### 6.4.1.2 DO IO Data-Telegram selection and configuration

Parameter P922 is used to display the actual setting of the PROFIdrive telegram configuration in the DO. Optionally, the telegram configuration may also be set by use of P922. By use of the P915, P916 the free telegram configuration is possible (P922 set to 0, see Table 130).

**Table 130 – Parameter for “DO IO DATA-Telegram selection and configuration”**

| PNU | Significance                                   | Implementation | Validity range |
|-----|------------------------------------------------|----------------|----------------|
| 915 | DO IO Data configuring (setpoint telegram)     | Optional       | DO-specific    |
| 916 | DO IO Data configuring (actual value telegram) | Optional       | DO-specific    |
| 922 | Telegram number; 0=free configuration          | Mandatory      | DO-specific    |
| 923 | List of all parameters for signals             | Optional       | DO-specific    |

#### 6.4.1.3 Sensor interface

P979 (see Table 131) is the only parameter for the identification of the DO sensor interface and the related sensor. The sensor interface of a DO comprises a maximum of three channels which are all handled together in P979.

**Table 131 – Parameter for “Sensor interface”**

| PNU | Significance                                             | Implementation                           | Validity range |
|-----|----------------------------------------------------------|------------------------------------------|----------------|
| 979 | Structure for description of a maximum of three channels | Mandatory if sensor interface is present | DO-specific    |

**6.4.1.4 Fault buffer handling**

For the read out and management of the DO specific error management, the parameters from P944 up to P952 are used and together referred to as “Fault Buffer” (see Table 132).

**Table 132 – Parameter for “Fault buffer handling”**

| PNU           | Significance          | Implementation     | Validity range |
|---------------|-----------------------|--------------------|----------------|
| 944 up to 952 | Fault buffer handling | Refer to Table 114 | DO-specific    |

**6.4.1.5 Warning signals**

The parameters from P953 up to 960 are used to signal the actual present warning situations of the DO (see Table 133).

**Table 133 – Parameter for “Warning mechanism”**

| PNU           | Significance                | Implementation | Validity range |
|---------------|-----------------------------|----------------|----------------|
| 953 up to 960 | Read out of warning signals | Optional       | DO-specific    |

**6.4.1.6 Closed loop control operating mode**

P930 shows the actual interface mode configuration of the DO (see Table 134). The interface mode defines the impact of the bits in STW1 and ZSW1.

**Table 134 – Parameter for “Closed loop control operating mode”**

| PNU | Significance                          | Implementation                               | Validity range |
|-----|---------------------------------------|----------------------------------------------|----------------|
| 930 | Read out of configured interface mode | Mandatory, if DO supports more than one mode | DO-specific    |

**6.4.1.7 Set and store local parameter set**

P970 and P971 are used to set the default values of the local parameter set or to store the actual local parameter set in non volatile way (see Table 135).

**Table 135 – Parameter for “Set and store of the local parameter set”**

| PNU | Significance                                           | Implementation | Validity range |
|-----|--------------------------------------------------------|----------------|----------------|
| 970 | Set the local parameter set to default values          | Optional       | DO-specific    |
| 971 | Store the local parameter set to a non volatile memory | Optional       | DO-specific    |



#### 6.4.1.8 Set and store complete parameter set

P976 and P977 (see Table 136) are used to set the default values of the complete Drive Unit parameter set (global and all local) or to store the complete Drive Unit parameter set in a non volatile way. This functionality typically is used only while the drive commissioning work is done. It is recommended that this functionality not be used by the controller (controlling application process).

**Table 136 – Parameter for “Set and store complete parameter set”**

| PNU | Significance                                              | Implementation | Validity range |
|-----|-----------------------------------------------------------|----------------|----------------|
| 976 | Set the whole DU parameter set to default values          | Optional       | Global         |
| 977 | Store the whole DU parameter set to a non volatile memory | Optional       | Global         |

#### 6.4.1.9 Drive reset

P972 is used to reset the whole Drive Unit (see Table 137). This functionality typically is used only while the drive commissioning work is done. It is recommended that this functionality not be used by the controller (controlling application process).

**Table 137 – Parameter for “Drive reset”**

| PNU | Significance              | Implementation | Validity range |
|-----|---------------------------|----------------|----------------|
| 972 | Reset of whole Drive Unit | Optional       | Global         |

#### 6.4.1.10 Operation priority control

Control information about the actual authorisation for the write access on parameters may be handled by P927 (see Table 138).

**Table 138 – Parameter for “Operation priority for write parameters”**

| PNU | Significance                                                                | Implementation | Validity range |
|-----|-----------------------------------------------------------------------------|----------------|----------------|
| 927 | Vendor-specific coding of authorisation for the write access on parameters. | Optional       | DO-specific    |

#### 6.4.1.11 DO identification and setup

Parameters for the identification of DO specific type information are given in Table 139. P975 is used for the identification of the DO type. P962 und P969 define time scale factors used by the DO.

**Table 139 – Parameter for “DO identification and setup”**

| PNU | Significance                                                                 | Implementation                                                          | Validity range |
|-----|------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------|
| 919 | Vendor specific component ID (read only)                                     | Optional                                                                | DO-specific    |
| 974 | Identification data block for Base Mode Parameter Access service (read only) | Optional                                                                | DO-specific    |
| 975 | Identification data block for the DO (e.g. type information)                 | Mandatory                                                               | DO-specific    |
| 962 | Sampling time to convert the time parameters.                                | Mandatory if parameters of the data types D, T or R are used in this DO | DO-specific    |
| 969 | Actual time difference (operation time since last start-up)                  | Optional                                                                | DO-specific    |
| 965 | Profile Number                                                               | Mandatory                                                               | DO-specific    |

#### 6.4.1.12 Parameter database handling and identification

The parameters P980 to P999 contain two lists for the identification of all parameters the DO supports and the changed parameters compared to the factory default setting (see Table 140).

**Table 140 – Parameter for “Parameter set identification”**

| PNU           | Significance                                                                | Implementation | Validity range |
|---------------|-----------------------------------------------------------------------------|----------------|----------------|
| 980 up to 989 | Number list of defined parameter                                            | Mandatory      | DO-specific    |
| 990 up to 999 | Number list of changed parameters (compared to the factory/default setting) | Optional       | DO-specific    |

#### 6.4.1.13 Device identification

The parameters P964 and P978 (see Table 141) provide Drive Unit specific identification and configuration information (e.g. vendor, type, version, number of DOs, etc.).

Parameter P978 shows the complete Drive Unit DO configuration (for PROFIBUS DP devices) and also shows the association between the Slotnumber (Axis Number for PROFIBUS DP devices) and the corresponding DO-ID of the DO.

**Table 141 – Parameter for “Device identification”**

| PNU | Significance                                     | Implementation                                                                       | Validity range |
|-----|--------------------------------------------------|--------------------------------------------------------------------------------------|----------------|
| 964 | Drive Unit identification data block (read only) | Mandatory                                                                            | Global         |
| 978 | List of all DO-Ids (read only)                   | Mandatory if DO-ID is not equal to Slotnumber (Axis number for PROFIBUS DP devices). | Global         |

#### 6.4.1.14 Alternative Supervisor DO IO Data control channel

The optional parameters P900, P907 and P928 (see Table 142) are used for alternative control (DO IO Data) of an axis by the Supervisor.

**Table 142 – Parameter for “Alternative Supervisor DO IO Data control channel”**

| <b>PNU</b> | <b>Significance</b>                              | <b>Implementation</b> | <b>Validity range</b> |
|------------|--------------------------------------------------|-----------------------|-----------------------|
| 900        | Axis specific setpoint telegram (DO IO Data)     | Optional              | DO-specific           |
| 907        | Axis specific Actual value telegram (DO IO Data) | Optional              | DO-specific           |
| 928        | Management of DO IO Data control priority        | Optional              | DO-specific           |

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## 6.4.2 PROFIdrive Parameter listed by number

Parameter numbers 900 to 999 (decimal) and 60 000 to 65 335 (decimal) are defined and reserved in accordance with the profile (see Table 143). All non-defined parameter numbers in the range from 900 to 999 and from 60 000 to 65 335 are reserved in accordance with the profile. Communication system related parameters are defined in the IEC 61800-7-303:2015, 4.10.2 and IEC 61800-7-303:2015, 5.10.2.

**Table 143 – PROFIdrive Parameter listed by number**

| PNU        | Significance                                                 | Data type              | Implementation                                              | Validity range | Explanation                                                                                                                                                                                                                                                        | Reference                             |
|------------|--------------------------------------------------------------|------------------------|-------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 0 to 899   | Device specific                                              | ---                    | ---                                                         | ---            | These parameters may be defined by the vendor.                                                                                                                                                                                                                     | ---                                   |
| 900        | Setpoint telegram (DO IO Data)                               | OctetString            | Optional                                                    | Global         | Object to transfer control words and setpoints (Controller → DO) in the acyclic communication.<br>The length of the OctetString differs from manufacturer to manufacturer and corresponds to the maximum possible length of the setpoint.                          | ---                                   |
| 901 to 905 | Reserved for PROFIdrive                                      | ---                    | ---                                                         | ---            | These parameter numbers were defined in the PROFIdrive Profile Versions 1 and 2 and may no longer be used.                                                                                                                                                         | ---                                   |
| 906        | Reserved for PROFIdrive                                      | ---                    | ---                                                         | ---            | ---                                                                                                                                                                                                                                                                | ---                                   |
| 907        | Actual value telegram (DO IO DATA)                           | OctetString            | Optional                                                    | Global         | Object to transfer status words and actual values (DO → Controller) in the acyclic communication.<br>The length of the OctetString differs from manufacturer to manufacturer and corresponds to the maximum possible length of the actual value telegrams in bytes | ---                                   |
| 908 to 914 | Reserved for PROFIdrive                                      | ---                    | ---                                                         | ---            | These parameter numbers were defined in the PROFIdrive profile Versions 1 and 2 and may no longer be used.                                                                                                                                                         | ---                                   |
| 915        | Selection switch for DO IO Data in the setpoint telegram     | Array[n]<br>Unsigned16 | Optional; P915, P916 and P923 shall be implemented together | DO-specific    | The number n of array elements corresponds to the number of DO IO Data in the setpoint telegram.                                                                                                                                                                   | Refer to 6.3.4.4                      |
| 916        | Selection switch for DO IO Data in the actual value telegram | Array[n]<br>Unsigned16 | Optional; P915, P916 and P923 shall be implemented together | DO-specific    | The number n of the array elements corresponds to the number of DO IO Data in the actual value telegram.                                                                                                                                                           | Refer to 6.3.4.4                      |
| 917        | Reserved for PROFIdrive                                      | ---                    | ---                                                         | ---            | This parameter number was defined in the PROFIdrive Profile Versions 1 and 2 and may no longer be used.                                                                                                                                                            | ---                                   |
| 918        | Reserved for PROFIBUS communication interface                | ---                    | ---                                                         | ---            | ---                                                                                                                                                                                                                                                                | Refer to IEC 61800-7-303:2015, 4.10.2 |

| PNU      | Significance                                                      | Data type              | Implementation                                                                                                                                                                                                       | Validity range                                 | Explanation                                                                                                                                                                                                                               | Reference         |
|----------|-------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 919      | Device or Axis system number                                      | VisibleString16        | Optional                                                                                                                                                                                                             | DO-specific                                    | The Device or Axis system number is a manufacturer-specific system or component identifier.                                                                                                                                               | ---               |
| 920, 921 | reserved for PROFIdrive                                           | ---                    | ---                                                                                                                                                                                                                  | ---                                            | These parameter numbers were defined in the PROFIdrive Profile Versions 1 and 2 and may no longer be used.                                                                                                                                | ---               |
| 922      | Telegram selection                                                | Unsigned16             | Mandatory, readable                                                                                                                                                                                                  | DO-specific                                    | Using this parameter, as a minimum, the currently selected standard telegram may be read-out. In an expanded implementation, this parameter may be used to select a standard telegram.                                                    | Refer to 6.3.4.4  |
| 923      | List of all parameters for signals                                | Array[n]<br>Unsigned16 | Mandatory, if the DO IO Data normalisation is used and/or P915 and P916 are implemented.                                                                                                                             | DO-specific                                    | This parameter may be used to assign the internal parameter numbers to the signals (standard signals defined in the profile and device-specific signals).                                                                                 | Refer to 6.3.4.4  |
| 924      | Status word bit Pulses Enabled                                    | Array[2]<br>Unsigned16 | Optional                                                                                                                                                                                                             | DO-specific                                    | Read only; this parameter may be used to define the position of the bit "Pulses Enabled/Disabled" in a status word. If the parameter is implemented, the functionality is supported by the drive.                                         | Refer to 6.3.2.8  |
| 925      | Number of Controller Sign-Of-Life failures which may be tolerated | Unsigned16             | Optional, if this parameter is not implemented, then precisely one Controller Sign-Of-Life failure is tolerated. Optionally, with the value 0xFFFF, the life sign monitoring may be switched off (for test purpose). | DO-specific                                    | This parameter may be used to define in a user-specific manner, the number of Controller Sign-Of-Life failures which may be tolerated.                                                                                                    | Refer to 6.3.12.4 |
| 926      | Reserved for PROFIdrive                                           | ---                    | ---                                                                                                                                                                                                                  | ---                                            | ---                                                                                                                                                                                                                                       | ---               |
| 927      | Operation priority of parameters                                  | Manufacturer-specific  | Optional                                                                                                                                                                                                             | Global (PROFIBUS DP)/DO-specific (PROFINET IO) | This defines in a manufacturer-specific way which interfaces have the operation priority to set parameters. An error message is output if the Controller tries to write parameter values without operation priority.                      | Refer to 6.3.11   |
| 928      | Control priority DO IO Data                                       | Unsigned16             | Optional                                                                                                                                                                                                             | DO-specific                                    | This defines in a manufacturer-specific way, which interface has the control authority. A value = 1 signifies PROFIBUS interface 1; other values are manufacturer-specific. The Controller only takes control, if it is ready to do this. | Refer to 6.3.11   |
| 929      | Reserved                                                          | ---                    | ---                                                                                                                                                                                                                  | ---                                            | ---                                                                                                                                                                                                                                       | ---               |

| PNU        | Significance          | Data type                  | Implementation                                                                                                                           | Validity range | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Reference        |
|------------|-----------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 930        | Operating mode        | Unsigned16                 | Mandatory, if other modes than exclusively the speed control mode (PNU 930 = 1) have been implemented (also manufacturer-specific modes) | DO-specific    | This is used to designate the operating mode. Depending on the type of device, this parameter is preset by the manufacturer. A presetting of 1 means that the device supports the speed control mode and the speed setpoint channel comprises RFG functionality. A pre-assignment of 2 indicates that the device supports the positioning mode. A presetting of 3 means that the device supports the speed control mode and the speed setpoint channel does not support RFG functionality.<br>All numerical values with bit 15 (MSB) = 1 designate manufacturer-specific modes. If parameter 930 is implemented writable (device-specific), then the operating mode may be changed by writing this parameter (Caution: Different assignment of the control/status words). If a device does not have parameter 930, then it supports the speed control mode with RFG functionality (operating mode = 1) by default. | Refer to 6.3.3   |
| 931 to 943 | Reserved              | ---                        | ---                                                                                                                                      | ---            | These parameters were defined in PROFIdrive Profile Versions 1 and 2, and may no longer be used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ---              |
| 944        | Fault message counter | Unsigned16                 | Mandatory                                                                                                                                | DO-specific    | The fault message counter is incremented each time that the fault buffer changes. This means that it may be guaranteed that the fault buffer may be consistently read-out. Without this parameter, it is not guaranteed that the fault buffer had not changed while reading-out.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Refer to 6.3.8.3 |
| 945        | Fault code            | Array[n]<br>Unsigned16     | Optional                                                                                                                                 | DO-specific    | The fault code allows the manufacturer to systematically number the faults which may occur, from the user's perspective.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Refer to 6.3.8.3 |
| 946        | Fault code list       | Array[n]<br>Unsigned16     | Optional                                                                                                                                 | DO-specific    | Every fault number, defined in the device, is assigned a fault code by the fault code list. The fault number is the subindex of the fault code list. The number n of the array elements is manufacturer-specific. If implemented, the parameter shall be at least readable. Setting of the Fault code list may be done by writing of PNU946.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Refer to 6.3.8.3 |
| 947        | Fault number          | Array[n]<br>Unsigned16     | Mandatory                                                                                                                                | DO-specific    | The fault number contains the subindex to access the fault number list PNU 951. The fault number may be identical to the fault code. The fault number simultaneously contains the subindex to access the fault code list PNU 946. This means that it establishes the link between the fault number list and fault code list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Refer to 6.3.8.3 |
| 948        | Fault time            | Array[n]<br>TimeDifference | Optional                                                                                                                                 | DO-specific    | The fault time is the instant in time that the fault message occurred.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Refer to 6.3.8.3 |

| PNU        | Significance                                 | Data type                           | Implementation                                                                                                                    | Validity range                                 | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Reference        |
|------------|----------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 949        | Fault value                                  | Array[n]<br>(manufacturer-specific) | Optional                                                                                                                          | DO-specific                                    | The individual parameters of a drive may be assigned different data types. This means that the data type of Parameter 949 cannot be specified in detail. After the Parameter definition (refer to 6.2.1), an array consists of elements with the same data type, which means that it shall be defined in a manufacturer-specific way, of which data type parameter 949 is. For instance, if 16-bit variables are processed, then the data type Word shall be selected for parameter 949. When processing 32 bit values, the data types Double Word shall be selected. The quantitative significance of the fault value is not described in more detail in the profile, this shall be also defined and specified by the manufacturer. | Refer to 6.3.8.3 |
| 950        | Scaling of the fault buffer                  | Array [2]<br>Unsigned16             | Optional, if the parameter is not implemented, a fault buffer with eight fault situation each with eight fault message is assumed | DO-specific                                    | This parameter defines the number of fault situation (Subindex 0) and the number of fault messages in a fault situation (Subindex 1) of the fault buffer. The Parameter is only readable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Refer to 6.3.8.3 |
| 951        | Fault number list with text                  | Array[n]<br>Unsigned16              | Dependent on the fault buffer version                                                                                             | DO-specific                                    | The fault number list includes, for each fault message, defined in the device, a reference to the parameter number to which the fault value is assigned. An explanatory text is specified for each of the fault messages, defined in the device, in the additional text field of the fault number list (i.e. in IDENTIFIER, bit 10 is set). If a parameter cannot be assigned to a fault message for the particular fault value, then the fault number list has a value of zero under the appropriate entry. Generally, the fault number list for a device is permanent and does not change. The fault number list is consecutively assigned without any gap. The number n of the array elements is manufacturer-specific.           | Refer to 6.3.8.3 |
| 952        | Fault situation counter                      | Unsigned16                          | Dependent on the fault buffer version                                                                                             | DO-specific                                    | The parameter specifies the number of fault situations since the last reset. If this parameter is set to 0 (write), the complete fault buffer is deleted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Refer to 6.3.8.3 |
| 953 to 960 | Warning parameters                           | V2                                  | Optional                                                                                                                          | DO-specific                                    | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Refer to 6.3.8.2 |
| 961        | reserved for PROFIdrive                      | ---                                 | ---                                                                                                                               | ---                                            | The parameter number was defined in PROFIdrive Profile Versions 1 and 2, and may no longer be used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ---              |
| 962        | Sampling time to convert the time parameters | TimeDifference                      | Mandatory, if parameters of the data types D, T or R are used                                                                     | Global (PROFIBUS DP)/DO-specific (PROFINET IO) | Shortest sampling time of the device to calculate time parameters T, D, R.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ---              |

| PNU | Significance                                  | Data type              | Implementation                                                                                                                                                                                     | Validity range                                 | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reference                             |
|-----|-----------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 963 | Reserved for PROFIBUS communication interface | ---                    | ---                                                                                                                                                                                                | ---                                            | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Refer to IEC 61800-7-303:2015, 4.10.2 |
| 964 | Drive Unit identification                     | Array[n]<br>Unsigned16 | Indices 0 to 4 are mandatory; if the drive has several axes or manufacturer-specific data is implemented, then subindex 5 is also mandatory; the manufacturer-specific data starts with subindex 6 | Global                                         | All data for Drive Unit identification is included under this parameter, and is made available to the identify service.                                                                                                                                                                                                                                                                                                                                                                                                   | Refer to 6.3.9.1                      |
| 965 | Profile identification number                 | OctetString 2          | Mandatory                                                                                                                                                                                          | Global (PROFIBUS DP)/DO-specific (PROFINET IO) | The profile identification is saved here. Byte 1 includes the PNO Profile Number 3 (for PROFIdrive). Byte 2 identifies the version. The Version Number of this profile is 42.                                                                                                                                                                                                                                                                                                                                             | Refer to 6.3.9.2                      |
| 966 | Reserved for PROFIdrive                       | ---                    | ---                                                                                                                                                                                                | ---                                            | The parameter number was defined in PROFIdrive Profile Versions 1 and 2, and may no longer be used.                                                                                                                                                                                                                                                                                                                                                                                                                       | ---                                   |
| 967 | Control word 1                                | V2                     | Optional                                                                                                                                                                                           | DO-specific                                    | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Refer to 6.3.2.2                      |
| 968 | Status word 1                                 | V2                     | Optional                                                                                                                                                                                           | DO-specific                                    | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Refer to 6.3.2.5                      |
| 969 | Actual time difference                        | TimeDifference         | Optional                                                                                                                                                                                           | Global (PROFIBUS DP)/DO-specific (PROFINET IO) | The actual time difference refers to the last time that this time counter was preset or reset. The identification of parameter description of bit 13 is equal to 1 for this parameter.                                                                                                                                                                                                                                                                                                                                    | ---                                   |
| 970 | Load parameter set                            | Unsigned16             | Optional                                                                                                                                                                                           | DO-specific                                    | P0970 is used to reset the DO-specific parameters to the factory setting.<br>Value = 0: default;<br>Value = 1: load complete factory setting;<br>Value > 1: manufacturer-specific data set.<br>After execution of loading a parameter set, parameter 970 is reset to 0. The definition of parameter P970 in PROFIdrive Version 2 is also permitted:<br>Load data set: 0 is the factory setting.<br>Value > 0: Manufacturer-specific data set.<br>In new developments, it is recommended to use the new definition of P970 | Refer to 6.2.1.3; Table 18 Bit 12     |



| PNU | Significance                                      | Data type              | Implementation                                                                                                                                        | Validity range                                    | Explanation                                                                                                                                                                                                                                                                                                       | Reference        |
|-----|---------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 971 | Transfer into a non-volatile memory               | Unsigned16             | Optional                                                                                                                                              | DO-specific                                       | Parameters belonging to one axis and the global parameters are saved with this parameter.<br>Value = 0: default;<br>Value = 1: actual DO-specific parameter set is saved in a non-volatile way;<br>Value > 1: Manufacturer-specific data set.<br>After saving a data set parameter 971 is reset to 0.             | ---              |
| 972 | Drive reset                                       | Unsigned16             | Optional                                                                                                                                              | Global                                            | ---                                                                                                                                                                                                                                                                                                               | Refer to 6.3.10  |
| 973 | Reserved for PROFIdrive                           | ---                    | ---                                                                                                                                                   | ---                                               | This parameter number was defined in the PROFIdrive Profile Version 3 and may no longer be used.                                                                                                                                                                                                                  | ---              |
| 974 | Base Mode Parameter Access service identification | Array[n]<br>Unsigned16 | Optional                                                                                                                                              | DO-specific<br>(Global for Homogeneous F-Devices) | Description of the features of the Base Mode Parameter Access service                                                                                                                                                                                                                                             | Refer to 6.3.9.4 |
| 975 | DO identification                                 | Array[n]<br>Unsigned16 | This parameter is recommended for all classes of Drive Units. P975 is mandatory for a Drive Unit which supports P978 and for all PROFINET IO Devices. | DO-specific                                       | All data for DO identification is included under this parameter, and is made available to the identify service.                                                                                                                                                                                                   | Refer to 6.3.9.3 |
| 976 | Load device parameter set                         | Unsigned16             | Optional                                                                                                                                              | Global                                            | P0976 is used to reset all parameters to the factory setting.<br>Value = 0: default;<br>Value = 1: load complete factory setting;<br>Value > 1: manufacturer-specific data set.<br>After execution of loading a parameter set, parameter 976 is reset to 0.                                                       | ---              |
| 977 | Transfer in non-volatile memory (global)          | Unsigned 16            | Optional                                                                                                                                              | Global                                            | All parameters, i.e. parameters of all axes and the global parameters are saved with this parameter.<br>Value = 0: default;<br>Value = 1: actual parameters of the device are saved in a non-volatile way;<br>Value > 1: Manufacturer-specific data set.<br>After saving a data set, parameter 977 is reset to 0. | ---              |

| PNU                | Significance                         | Data type                                                                 | Implementation                                                                                                                                                                                                                                                                               | Validity range | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Reference        |
|--------------------|--------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 978                | List of all DO-IDs                   | Array[n]<br>Unsigned8; n =<br>0,...,<br>(maximum<br>number of DOs<br>+ 1) | Mandatory, if the<br>DO-ID numbers of<br>the Drive Unit are<br>not equal to the<br>corresponding<br>Slotnumber (for<br>PROFIBUS DP the<br>corresponding Axis<br>number). Mandatory,<br>for modular<br>PROFIBUS DP Drive<br>Units if here are DOs<br>which are not related<br>to a slot/axis. | Global         | P978 consists of the DO-IDs for all DOs in the PROFIDrive Drive Unit. The DO-IDs of the DOs may be independent from the Slotnumber (axis number for PROFIBUS DP device). The DO-ID may be a number from 1 to 254. Value 255 means that there is no DO assigned, the zero value is a delimiter. Entries which exist after the first zero-value indicate DO-IDs of DOs without IO Data (only used for PROFIBUS DP devices). The second zero value indicates the end of the list. A valid DO-ID list comprises as a minimum two zero values. P978 is only writeable during commissioning. The configuration telegram is dismissed if it is not compatible to P978.<br>The controller shall check if the parameter is implemented, and if it is, it shall read out the parameter values (DO-IDs to be used for the Base Mode Parameter Access to the DOs inside the Drive Unit). | Refer to 6.3.4.4 |
| 979                | Sensor format                        | Array[n]<br>Unsigned32                                                    | Mandatory, if the<br>position feedback<br>interface is realised.                                                                                                                                                                                                                             | DO-specific    | The number n of array elements is in this profile version 31. The parameter is only readable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Refer to 6.3.6   |
| 980 to<br>989      | Number list of defined<br>parameter  | Array[n]<br>Unsigned16                                                    | Mandatory                                                                                                                                                                                                                                                                                    | DO-specific    | The number n of array elements is manufacturer-specific.<br>All parameter numbers defined in a device are saved in parameters under the sub-indices (manufacturer-specific and profile parameters). The arrays shall be assigned in increasing sequence and consecutively. If a subindex contains zero, the end of the list of defined parameters has been reached. If a subindex contains the parameter number of the next list parameter, then the list is continued there. Therefore the PNU980 to 989 are omitted from the Number list of defined parameter. The number list of defined parameter shall be implemented for every DO. Parameters of the number list which are empty may not be implemented.                                                                                                                                                               | ---              |
| 990 to<br>999      | Number list of changed<br>parameters | Array[n]<br>Unsigned16                                                    | Optional                                                                                                                                                                                                                                                                                     | DO-specific    | The number n of array elements is manufacturer-specific.<br>All parameter numbers of the parameters (manufacturer-specific and profile parameters), which may be written and which are changed in respect to the factory setting, are saved under the sub-indices of these parameters. The arrays shall be assigned in increasing sequence and consecutively. If a subindex contains zero, the end of the list of changed parameters has been reached. If a subindex contains the parameter number of the next list parameter, the list is continued there. Parameters of the number list which are empty may not be implemented.                                                                                                                                                                                                                                            | ---              |
| 1 000 to<br>59 999 | Device specific                      | ---                                                                       | ---                                                                                                                                                                                                                                                                                          | ---            | These parameters may be defined by the vendor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ---              |

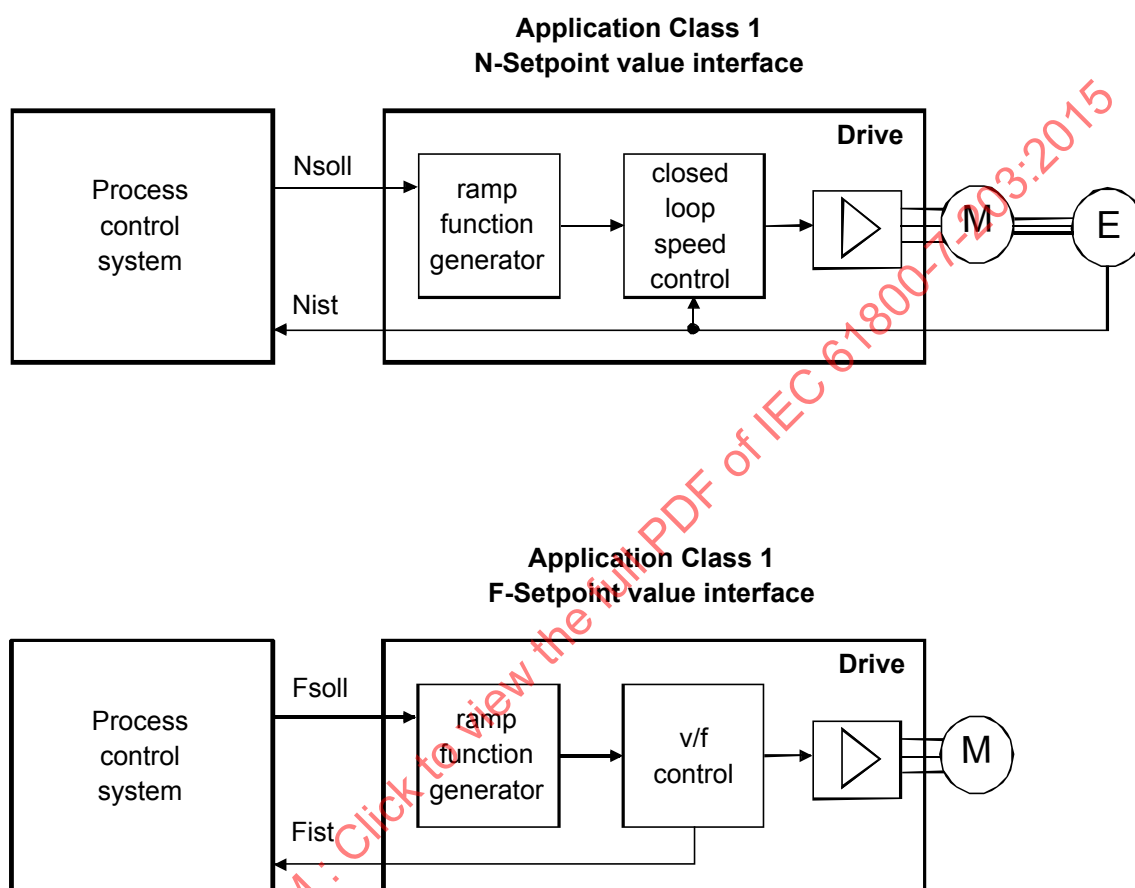
| PNU              | Significance                                                  | Data type | Implementation | Validity range | Explanation                                              | Reference                             |
|------------------|---------------------------------------------------------------|-----------|----------------|----------------|----------------------------------------------------------|---------------------------------------|
| 60 000 to 60 999 | Reserved for PROFIdrive                                       | ---       | ---            | ---            | Reserved for future extensions of the PROFIdrive profile | ---                                   |
| 61 000 to 63 999 | Reserved for PROFIdrive (PROFINET IO communication interface) | ---       | ---            | ---            | ---                                                      | Refer to IEC 61800-7-303:2015, 5.10.2 |
| 64 000 to 64 999 | Reserved for PROFIdrive                                       | ---       | ---            | ---            | ---                                                      | ---                                   |
| 65 000           | Preset value                                                  | Integer32 | Optional       | DO-specific    | ---                                                      | ---                                   |
| 65 001 to 65 535 | Reserved for ENCODER Profile                                  | ---       | ---            | ---            | ---                                                      | ---                                   |

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## 6.5 Integration of Drives in Process Technology (VIK<sup>17</sup>-NAMUR<sup>18</sup>)

### 6.5.1 General

This subclause shows the integration of drives in process technology according to the VIK-NAMUR guideline NE 37. The drive applications are realised only in open-loop (e.g. v/f control) or closed-loop speed control mode, therefore they belong to the PROFIdrive Application Class 1 (see Figure 73).



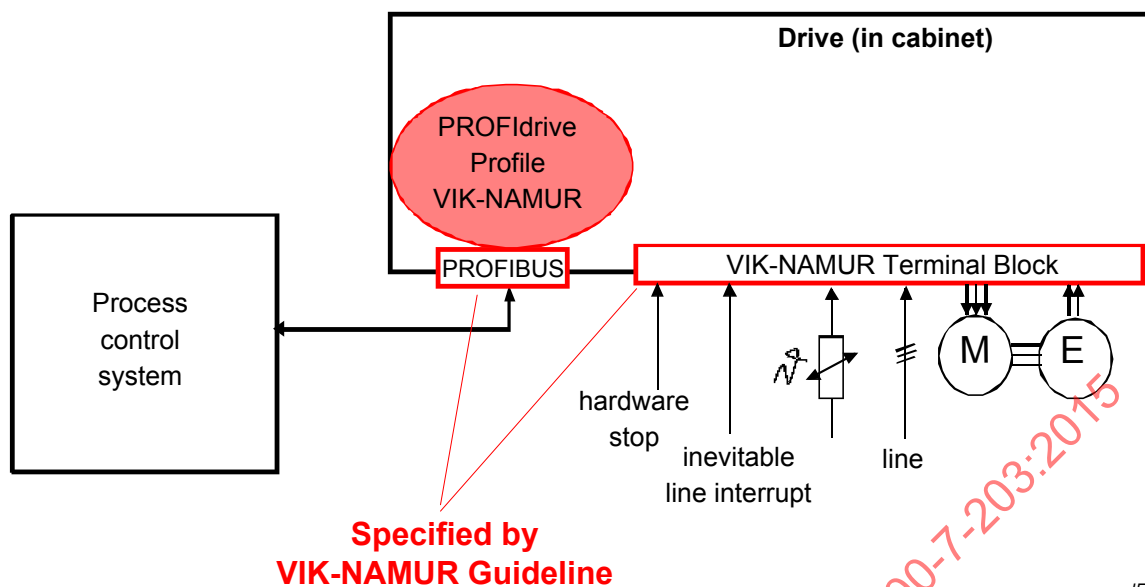
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**Figure 73 – Functionality and Interfaces for drive integration according to VIK-NAMUR**

The purpose of the VIK-NAMUR guideline for the integration of drives in the process technology industry is to specify a standard interface between drive and the process control system which offers the possibility to exchange the drive or drive system by another drive (even another vendor) without need of any change to the process control system. Therefore, for PROFIBUS, a special application-specific GSD is used and the drive shall be set up to act as a VIK-NAMUR drive with application-specific PROFIBUS Device “Ident\_Number = 0x3AA0”. The VIK-NAMUR guideline specifies the drive interface in hardware (VIK-NAMUR terminal block) and Software (PROFIdrive Interface VIK-NAMUR mode). The principle structure of the interface is shown in Figure 74.

<sup>17</sup> VIK = Association of the Industrial Customers and Industrial Power Producers.

<sup>18</sup> NAMUR = Standards Working Group for Instrumentation and Control in the Chemical Industry.



IEC

**Figure 74 – Principle structure of the drive interface according to VIK-NAMUR guideline**

## 6.5.2 Commands and Checkback Signals

### 6.5.2.1 General

For the VIK-NAMUR process technology operating mode the meaning of all bits of the control word1 (STW1, see Table 144), status word1 (ZSW1, see Table 145) and drive status/fault word (MELD\_NAMUR, see Table 146) are defined in the PROFdrive Profile Drive Technology. There are no vendor specific bit definitions.

### 6.5.2.2 Control word1

**Table 144 – Overview on the assignment of the bits of control word1 for the process technology operating mode**

| Bit | Process technology operating mode (VIK-NAMUR standard) |                                    |
|-----|--------------------------------------------------------|------------------------------------|
|     | Significance (Bit = true)                              | Significance (Bit = false)         |
| 0   | ON                                                     | OFF                                |
| 1   | No Coast Stop (No OFF2)                                | Coast Stop (OFF2)                  |
| 2   | No Quick Stop (No OFF3)                                | Quick Stop (OFF3)                  |
| 3   | Enable Operation                                       | Disable Operation                  |
| 4   | Enable Ramp Generator                                  | Reset Ramp Generator               |
| 5   | Unfreeze Ramp Generator                                | Freeze Ramp Generator              |
| 6   | Enable Setpoint                                        | Disable Setpoint                   |
| 7   | Fault Acknowledge (0 → 1)                              |                                    |
| 8   | Jog 1 ON <sup>a</sup>                                  | Jog 1 OFF <sup>a</sup>             |
| 9   | Jog 2 ON <sup>a</sup>                                  | Jog 2 OFF <sup>a</sup>             |
| 10  | Control By PLC                                         | No Control By PLC                  |
| 11  | Setpoint Inversion                                     | No Setpoint Inversion <sup>b</sup> |
| 12  | Reserved <sup>b</sup>                                  | Reserved <sup>b</sup>              |
| 13  | Reserved <sup>b</sup>                                  | Reserved <sup>b</sup>              |
| 14  | Reserved <sup>b</sup>                                  | Reserved <sup>b</sup>              |
| 15  | Parameter Set 2 <sup>b</sup>                           | Parameter Set 1 <sup>b</sup>       |

NOTE 1 Bit 0 to Bit 10 of the control word 1 are the same as in the control word 1 of the speed control operating mode.

NOTE 2 Further details on the control word bits can be found in 6.3.2.2.

<sup>a</sup> Optional.

<sup>b</sup> Deviations of the VIK-NAMUR Control Word 1 (STW1) from the standard PROFIdrive STW1.

It shall be possible to parameterise the converter/inverter with manufacturer-specific parameters in order to disable a certain direction of rotation.

### 6.5.2.3 Status word1

**Table 145 – Overview on the assignment of the bits of status word1 for the process technology operating mode**

| Bit | Process technology operating mode (VIK-NAMUR standard)                                                                           |                                                                                                                   |
|-----|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
|     | Significance (Bit = true)                                                                                                        | Significance (Bit = false)                                                                                        |
| 0   | Ready To Switch On                                                                                                               | Not Ready To Switch On                                                                                            |
| 1   | Ready To Operate                                                                                                                 | Not Ready To Operate                                                                                              |
| 2   | Operation Enabled (drive follows setpoint)                                                                                       | Operation Disabled                                                                                                |
| 3   | Fault Present                                                                                                                    | No Fault                                                                                                          |
| 4   | No OFF2<br>Coast Stop Not Activated or<br>Inevitable Line Interruption Not Activated or<br>Forced Inverter Inhibit Not Activated | OFF2<br>Coast Stop Activated or<br>Inevitable Line Interruption Activated or<br>Forced Inverter Inhibit Activated |
| 5   | No OFF3<br>Quick Stop Not Activated or<br>External Interlock Not Activated                                                       | OFF3<br>Quick Stop Activated or<br>External Interlock Activated                                                   |
| 6   | Switching On Inhibited                                                                                                           | Switching On Not Inhibited                                                                                        |
| 7   | Warning Present                                                                                                                  | No Warning                                                                                                        |
| 8   | Speed Error Within Tolerance Range                                                                                               | Speed Error Out Of Tolerance Range                                                                                |
| 9   | Control Requested                                                                                                                | No Control Requested                                                                                              |
| 10  | f Or n Reached Or Exceeded                                                                                                       | f Or n Not Reached                                                                                                |
| 11  | Adjustable Current Limit Or Torque Limit Not Reached <sup>a</sup>                                                                | Adjustable Current Limit Or Torque Limit Reached <sup>a</sup>                                                     |
| 12  | Reserved <sup>a</sup>                                                                                                            | Reserved <sup>a</sup>                                                                                             |
| 13  | Motor Overload Not Activated <sup>a</sup>                                                                                        | Motor Overload Activated <sup>a</sup>                                                                             |
| 14  | Positive Speed Direction <sup>a</sup>                                                                                            | No Positive Speed Direction <sup>a</sup>                                                                          |
| 15  | Parameter Set 2 active <sup>a</sup>                                                                                              | Parameter Set 1 active <sup>a</sup>                                                                               |

NOTE 1 Bit 0 to Bit 3 and Bit 6 to Bit 10 of the status word 1 are the same as in the status word 1 of the speed control operating mode.

NOTE 2 Further details to the status word bits can be found in 6.3.2.

<sup>a</sup> Deviations of the VIK-NAMUR Status Word 1 (ZSW1) from the standard PROFIdrive ZSW1.

### 6.5.2.4 Drive status/fault word

Table 146 shows the definition of the content for the MELD\_NAMUR signal.

**Table 146 – Overview on the assignment of the bits of drive status/fault word for the process technology operating mode**

| Bit | Significance (Bit = true)         | Significance (Bit = false)           |
|-----|-----------------------------------|--------------------------------------|
| 0   | Fault Control Electronic/Software | No Fault Control Electronic/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   | Earth Fault                       | No Earth 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  | Fault Auxiliary Device            | No Fault Auxiliary Device            |
| 13  | reserved                          | reserved                             |
| 14  | reserved                          | reserved                             |
| 15  | Miscellaneous Fault               | No Miscellaneous Fault               |

### 6.5.3 State diagrams

#### 6.5.3.1 General state diagram

The general state diagram (refer to 6.3.3.2) is also valid for applications in the process technology operating mode.

#### 6.5.3.2 Setpoint channel for VIK-NAMUR operating mode

In addition to the standard PROFIdrive setpoint channel (see 6.3.3.3.2), the setpoint inversion functionality controlled by STW1 bit 11 is defined for VIK-NAMUR according to Figure 75.



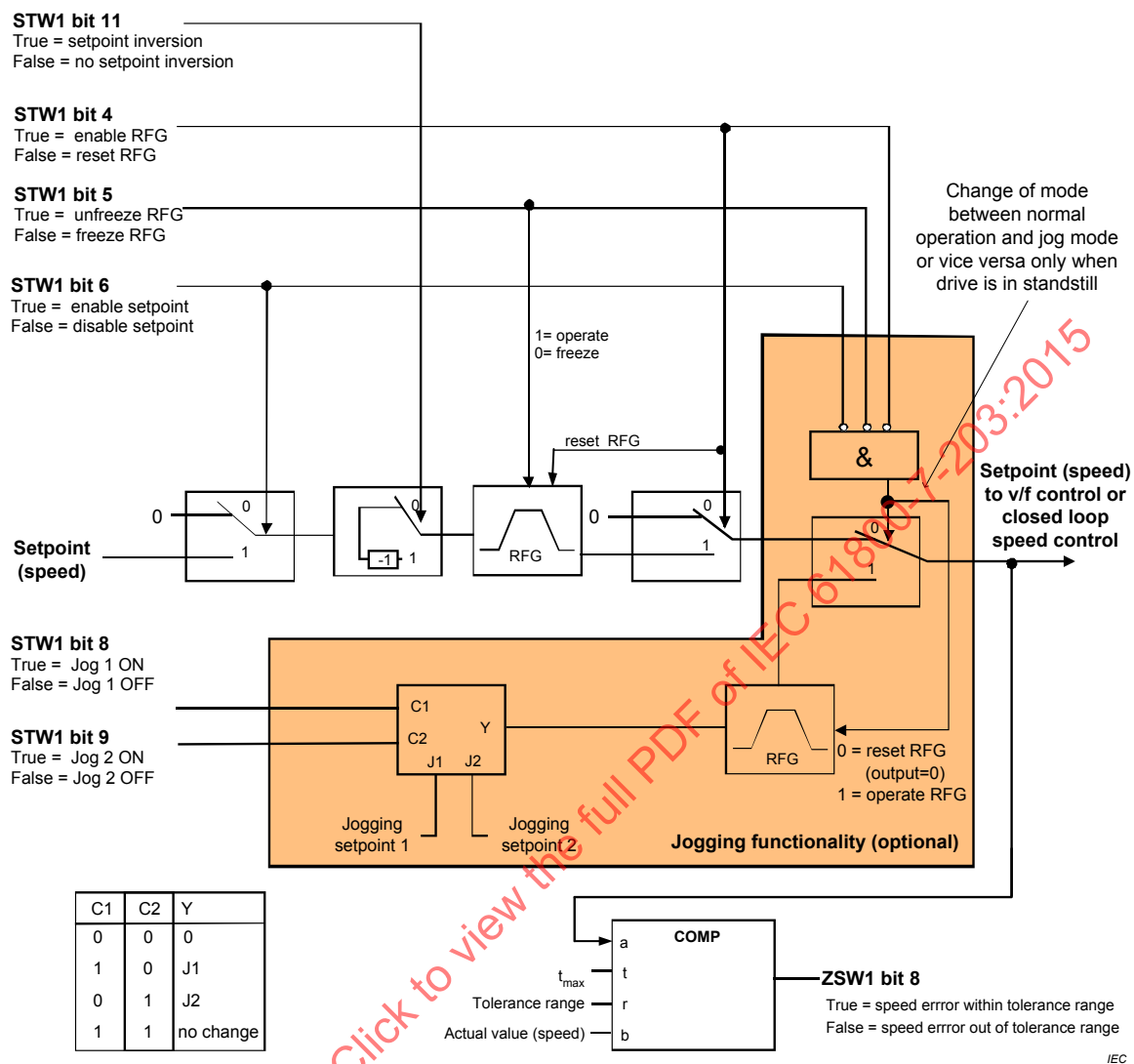


**Figure 75 – Speed setpoint channel for VIK-NAMUR process technology operating mode**

Additional monitoring functionality according to Figure 76 is also specified.

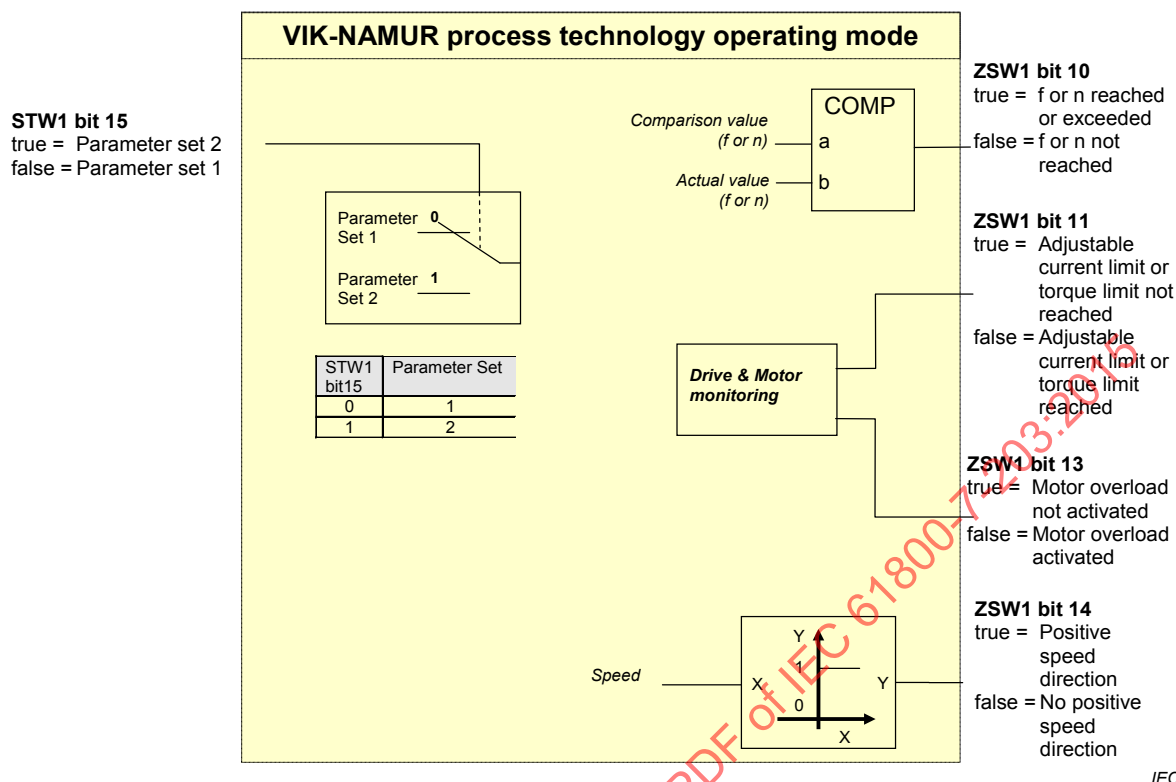


**Figure 76 – Process technology operating mode, control word 1 bit 15 and status word 1 bit 10,11,13,14**

#### STW1 bit15: Parameter Set

Parameter set1 may be switched over to parameter set2 and vice versa.

#### 6.5.4 Inevitable line interruption

This subclause describes the inevitable line interruption. The inevitable line interruption is connected to the NAMUR standard terminal block (input 17/18). With contact open between terminal 17 and 18, an inevitable line interrupt shall be performed in such a way that the inverter and the motor shall be secure separated from the line. The inevitable line interrupt may also be activated by an over temperature signal on the terminals 90/91 (see Figure 77). The signal for the inevitable line interrupt is also connected to a digital input of the drive. The input of the drive shall be parameterised in such a way that it causes a Coast Stop on the drive. One digital output of the drive shall also be parameterised with the status “Coast Stop Activated/Inevitable Line Interruption Activated” and this output shall also force the switch device to separate the drive secure from the line.

The application program in the PLC recognises an inevitable line interruption, if in the control word1 (STW1) sent by the PLC, the bit1 is “TRUE”, this means “No Coast Stop” and if in the status word1 (ZSW1), the bit4 is “FALSE”, this means “Coast Stop Activated/Inevitable Line Interruption Activated”. The inevitable line interruption shall be realised with applicable switch devices according to the VIK-NAMUR Guidelines.

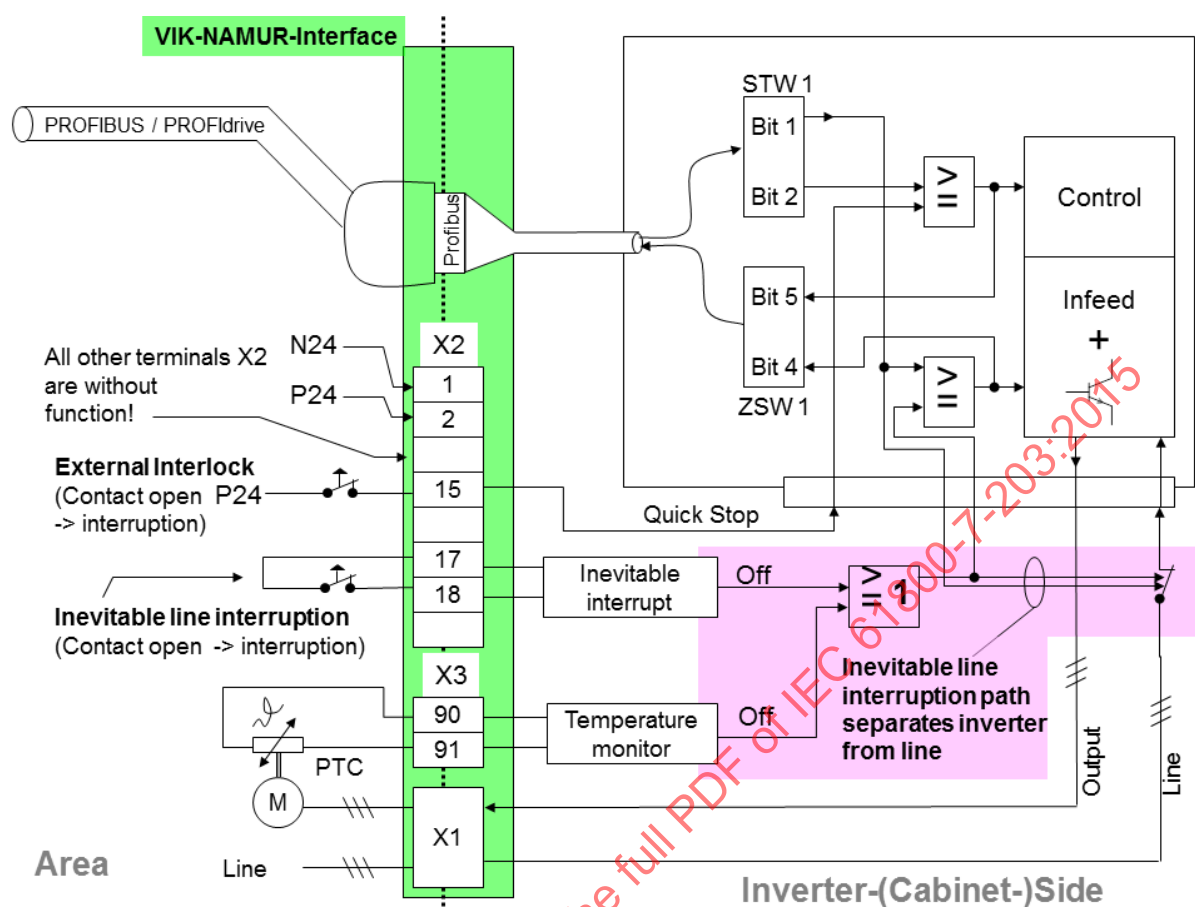


**Figure 77 – Process technology: operating mode with inevitable line interruption**

### 6.5.5 Forced inverter inhibit

This subclause describes the forced inverter inhibit function. The control signal for the forced inverter inhibit is connected to the NAMUR standard terminal block (input 17/18). With contact open between terminal 17 and 18, an forced inverter inhibit shall be performed in such a way that the inverter and the motor shall be secure separated from the line. The forced inverter inhibit may also be activated by an over temperature signal on the terminals 90/91 (see Figure 78). The signal for the forced inverter inhibit is also connected to a digital input of the drive. The input of the drive shall be parameterised in such a way that it causes a Coast Stop on the drive. One digital output of the drive shall also be parameterised with the status "Coast Stop Activated/Forced Inverter Inhibit Activated" and this output shall also force the power electronic switching device to separate the motor secure from the line.

The application program in the PLC recognises an Force Inverter Inhibit, if in the control word1 (STW1) sent by the PLC, the bit1 is “TRUE”, this means “No Coast Stop” and if in the status word1 (ZSW1), the bit4 is “FALSE”, this means “Coast Stop Activated/Forced Inverter Inhibit Activated”. The forced inverter inhibition shall be realised with applicable electronic power switching devices according to the VIK-NAMUR Guidelines.

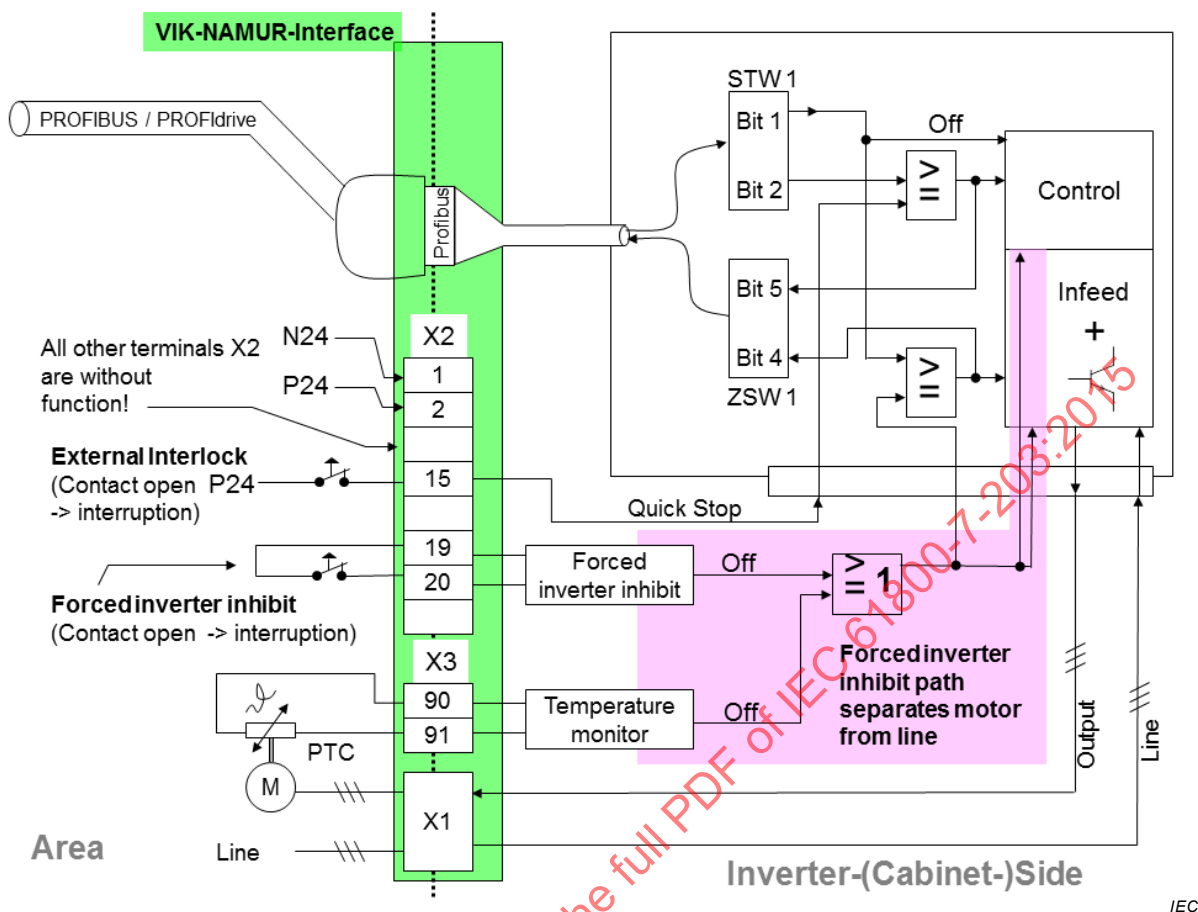


Figure 78 – Process technology operating mode with forced inverter inhibit

### 6.5.6 External interlock

The external interlock is connected to the NAMUR standard terminal block (input 15). The signal from this terminal is connected to a digital input of the drive. This digital input shall be parameterised with the function Quick Stop. In case of external interlock, the drive gets the information for a quick stop via the digital input. The converter/inverter stops the motor along the programmable current limit and then the output pulses are disabled and the inverter is separated from the line.

The application program in the PLC recognises an external interlock, if in the control word1 (STW1) sent by the PLC the bit2 is "TRUE", this means "No Quick Stop" and if in the status word1 (ZSW1) the bit5 is "FALSE", this means "Quick Stop Activated/External Interlock Activated".

### 6.5.7 Standard telegram

#### 6.5.7.1 General

Standard telegram 20 is defined for the process technology.

Further information to standard telegrams, signal numbers (see Table 86) and telegram selection may be found in 6.3.4. Information to standard telegram configuration for PROFIBUS DP may be found in IEC 61800-7-303:2015, 4.5.2.

#### 6.5.7.2 Standard telegram 20

Content: n-setpoint interface for the process technology, 16 bit

**Table 147 – Definition of standard telegram 20**

| DO IO DATA number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Setpoint                                 | Actual value                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----------------------------------------------------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | STW1                                     | ZSW1                                                |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | NSOLL_A <sup>a</sup> /FSOLL <sup>a</sup> | NIST_A_GLATT <sup>a</sup> /FIST_GLATT <sup>a</sup>  |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          | IAIST_GLATT                                         |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          | ITIST_GLATT <sup>b</sup> or MIST_GLATT <sup>b</sup> |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          | PIST_GLATT <sup>c</sup>                             |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          | MELD_NAMUR                                          |
| <p><sup>a</sup> The setpoint NSOLL_A and the actual value NIST_A in DO IO Data 2 are only for applications in the closed-loop speed control mode and the setpoint FSOLL and the actual value FIST in DO IO Data 2 are only for applications in v/f control mode.</p> <p><sup>b</sup> The actual value in DO IO Data 4 shall be configured with the process variable active current (ITIST) or torque actual value (MIST). If both process variables are not available, the DO IO Data 4 shall be zero.</p> <p><sup>c</sup> The actual value in DO IO Data 5 shall be configured with the process variable active power (PIST). If the process variable is not available, the DO IO Data 5 shall be zero.</p> |                                          |                                                     |

The signal numbers defined for the process technology are included in Table 86.

#### DO IO Data Normalisation:

The data type for DO IO Data (setpoints, actual values) is Integer16 (a signed 16 bit-value), except control word1 (STW1) and status word1 (ZSW1).

The scaling factor for all DO IO Data is defined as follows: 100 % corresponds to 0x4000. The value for this data ranges is from –200 % to +200 %. The DO IO Data normalisation shall be configured in the following way: normalisation bit 0-5 shall be set to 14 (bit 14 -> 0x4000) and normalisation valid bit 15 shall be set to 1 (YES) (refer to 6.2.1.3 and 6.3.4.5).

The DO IO Data in actual value-direction shall be filtered with a first order filter element and a constant filter time of approximately 100 ms, except control word1 (STW1) and status word1 (ZSW1). This is achieved by use of the special signals xxx\_GLATT.

There shall be a manufacturer-specific parameter, where it is defined which physical value represented by 100 %. The manufacturer-specific parameter shall not be a fixed value in the converter/inverter.

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<sup>19</sup> See also the IEC Multilingual Dictionary – Electricity, Electronics and Telecommunications.

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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**ENTRAÎNEMENTS ÉLECTRIQUES  
DE PUISSANCE À VITESSE VARIABLE –****Partie 7-203: Interface générique et utilisation de profils  
pour les entraînements électriques de puissance –  
Spécification de profil de type 3**

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Cette deuxième édition annule et remplace la première édition parue en 2007. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) mises à jour mineures du mécanisme d'accès aux paramètres du mode de base;
- b) mises à jour mineures et simplification de la définition de diagramme d'états de classe d'application 3.



Le texte de cette norme est issu des documents suivants:

| FDIS         | Rapport de vote |
|--------------|-----------------|
| 22G/309/FDIS | 22G/324/RVD     |

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

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## INTRODUCTION

### 0.1 Généralités

La série IEC 61800 est destinée à fournir un ensemble commun de spécifications dédiées aux entraînements électriques de puissance à vitesse variable.

L'IEC 61800-7 spécifie les profils dédiés aux entraînements électriques de puissance (PDS) et leur mise en correspondance avec les systèmes de communication existants grâce à un modèle d'interface générique.

L'IEC 61800-7 décrit une interface générique entre les systèmes de commande et les entraînements électriques de puissance. Cette interface peut être intégrée au système de commande. Le système de commande proprement dit peut également être situé dans le dispositif d'entraînement (parfois appelé "dispositif d'entraînement intelligent").

Il existe un grand nombre d'interfaces physiques disponibles (entrées et sorties analogiques et numériques, interfaces séries et parallèles, bus de terrain et réseaux). Les profils établis sur des interfaces physiques spécifiques sont déjà définis pour certains domaines d'application (par exemple, commande de mouvement) et certaines classes de dispositifs (par exemple, dispositifs d'entraînement classiques, positionneur). Les implémentations correspondantes des interfaces de programmes de commande et de programmeurs d'application associées sont de nature propriétaire et varient de manière importante.

L'IEC 61800-7 définit un ensemble de fonctions, paramètres et diagrammes d'états communs pour la commande d'entraînement ou une description des séquences d'opérations à mettre en correspondance avec les profils d'entraînement.

L'IEC 61800-7 fournit une procédure d'accès aux fonctions et données d'un dispositif d'entraînement, indépendante du profil d'entraînement et de l'interface de communication employés. Il s'agit de définir un modèle commun d'entraînement comportant des fonctions génériques et des objets pouvant être mis en correspondance avec des interfaces de communication différentes. Ceci permet de prévoir des implémentations communes de commande de mouvement (ou applications de commande de vitesse ou de commande d'entraînement) dans les contrôleurs sans aucune connaissance spécifique de la mise en œuvre du dispositif d'entraînement.

Il y a plusieurs raisons de définir une interface générique:

#### **Pour un constructeur de dispositif d'entraînement**

- assistance plus aisée des intégrateurs de systèmes;
- description plus aisée des fonctions d'entraînement du fait d'une terminologie commune;
- le choix des dispositifs d'entraînement ne dépend pas de la disponibilité d'une assistance spécifique.

#### **Pour un constructeur de dispositif de commande**

- aucune influence de la technologie de bus;
- intégration aisée des dispositifs;
- indépendance par rapport à un fournisseur de dispositifs d'entraînement.

#### **Pour un intégrateur de systèmes (modules de construction, machines, installations, etc.)**

- intégration plus aisée des dispositifs;
- méthode intelligible unique de modélisation;

– indépendance par rapport à la technologie de bus.

Concevoir une application de commande de mouvement avec plusieurs dispositifs d'entraînement différents et un système de commande spécifique nécessite un effort certain. Les tâches de mise en œuvre des logiciels systèmes et de compréhension de la description fonctionnelle des composants individuels peuvent conduire à l'épuisement des ressources d'un projet. Dans certains cas, les dispositifs d'entraînement ne partagent pas la même interface physique. Certains dispositifs de commande ne prennent en charge qu'une interface unique qui n'est pas prise en charge par un dispositif d'entraînement spécifique. D'autre part, les fonctions et les structures de données sont souvent spécifiées avec des incompatibilités. Cela exige de l'intégrateur de systèmes d'établir des interfaces spéciales pour le logiciel d'application alors que cette opération ne relève pas vraiment de sa responsabilité.

Certaines applications nécessitent de pouvoir échanger des dispositifs, voire intégrer de nouveaux dispositifs dans une configuration existante. Elles sont alors confrontées à différentes solutions incompatibles. Les efforts nécessaires pour adapter une solution relative à un profil d'entraînement et aux extensions spécifiques au constructeur peuvent se révéler inacceptables. Ceci réduit le degré de liberté concernant le choix d'un dispositif le mieux adapté à cette application à la simple sélection du dispositif disponible pour une interface physique spécifique et pris en charge par le contrôleur.

L'IEC 61800-7-1 est divisée en une partie générique et en plusieurs annexes comme le représente la Figure 1. Les types de profils d'entraînement pour CiA® 402<sup>1</sup>, CIP Motion™<sup>2</sup>, PROFIdrive<sup>3</sup> et SERCOS®<sup>4</sup> sont mis en correspondance avec l'interface générique de l'annexe correspondante. Les annexes ont été soumises par des organismes internationaux indépendants spécialisés dans les réseaux ou les bus de terrain, et responsables du contenu de l'annexe qui y est associée, ainsi que de l'utilisation des marques connexes.

La présente partie de l'IEC 61800-7 spécifie le profil de type 3 (PROFIdrive).

Les types de profils 1, 2 et 4 sont spécifiés dans l'IEC 61800-7-201, l'IEC 61800-7-202 et l'IEC 61800-7-204.

<sup>1</sup> CiA 402® est une marque déposée de CAN in Automation, e.V. (CiA). Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée CiA® 402. L'utilisation de la marque déposée CiA® 402 nécessite l'autorisation de CAN in Automation e.V. (CiA).

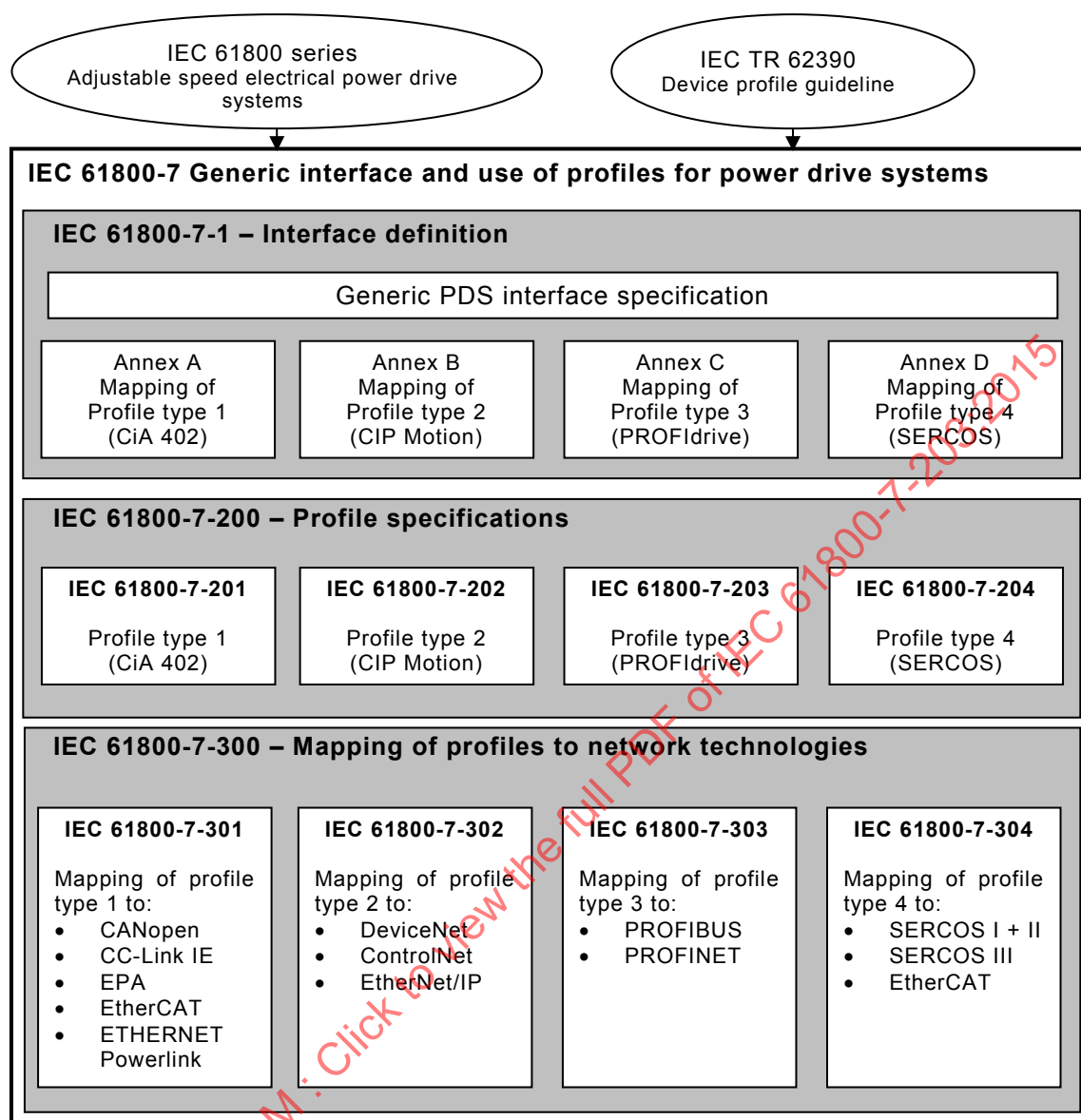
<sup>2</sup> CIP Motion™ est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque CIP Motion™. L'utilisation de la marque CIP Motion™ nécessite l'autorisation de ODVA, Inc.

<sup>3</sup> PROFIdrive est une marque de PROFIBUS & PROFINET International. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque PROFIdrive. L'utilisation de la marque PROFIdrive nécessite l'autorisation de PROFIBUS & PROFINET International.

<sup>4</sup> SERCOS® est une marque déposée de SERCOS International e.V. Cette information est fournie pour la commodité des utilisateurs de la présente Norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée SERCOS®. L'utilisation de la marque déposée SERCOS® nécessite l'autorisation de son détenteur.

L'IEC 61800-7-301, l'IEC 61800-7-302, l'IEC 61800-7-303 et l'IEC 61800-7-304 spécifient la ou les méthodes de mise en correspondance des types de profils 1, 2, 3 et 4 avec différentes technologies de réseaux (telles que CANopen<sup>5</sup>, CC-Link IE<sup>6</sup> Field Network<sup>6</sup>, EPA<sup>7</sup>, EtherCAT<sup>8</sup>, Ethernet Powerlink<sup>9</sup>, DeviceNet<sup>10</sup>, ControlNet<sup>11</sup>, EtherNet/IP<sup>12</sup>, PROFIBUS<sup>13</sup>, PROFINET<sup>14</sup> et SERCOS<sup>®</sup>).

- 5 CANopen<sup>®</sup> est une marque déposée de CAN in Automation, e.V. (CiA). Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée CANopen<sup>®</sup>. L'utilisation de la marque déposée CANopen<sup>®</sup> nécessite l'autorisation de CAN in Automation e.V. (CiA). CAN in Automation e.V. (CiA). CANopen<sup>®</sup> est un acronyme pour Controller Area Network *open* et est utilisé pour faire référence à l'EN 50325-4.
- 6 CC-Link IE<sup>®</sup> Field Network est une marque déposée de Mitsubishi Electric Corporation. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée CC-Link IE<sup>®</sup> Field Network. L'utilisation de la marque déposée CC-Link IE<sup>®</sup> Field Network nécessite l'autorisation de Mitsubishi Electric Corporation.
- 7 EPA<sup>™</sup> est une marque de SUPCON Group Co. Ltd. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque EPA<sup>™</sup>. L'utilisation de la marque EPA<sup>™</sup> nécessite l'autorisation de son détenteur.
- 8 EtherCAT<sup>®</sup> est une marque déposée de Beckhoff, Verl. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée EtherCAT<sup>®</sup>. L'utilisation de la marque déposée EtherCAT<sup>®</sup> nécessite l'autorisation de son détenteur.
- 9 Ethernet Powerlink<sup>™</sup> est une marque de Bernecker & Rainer Industrieelektronik Ges.m.b.H., le contrôle de son utilisation est confié à l'organisme à but non lucratif EPSG. Cette information est fournie pour la commodité des utilisateurs de la présente Norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque Ethernet Powerlink<sup>™</sup>. L'utilisation de la marque Ethernet Powerlink<sup>™</sup> nécessite l'autorisation de son détenteur.
- 10 DeviceNet<sup>™</sup> est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque DeviceNet<sup>™</sup>. L'utilisation de la marque DeviceNet<sup>™</sup> nécessite l'autorisation de ODVA, Inc.
- 11 ControlNet<sup>™</sup> est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque ControlNet<sup>™</sup>. L'utilisation de la marque ControlNet<sup>™</sup> nécessite l'autorisation de ODVA, Inc.
- 12 EtherNet/IP<sup>™</sup> est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque EtherNet/IP<sup>™</sup>. L'utilisation de la marque EtherNet/IP<sup>™</sup> nécessite l'autorisation de ODVA, Inc.
- 13 PROFIBUS est une marque de PROFIBUS & PROFINET International. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque PROFIBUS. L'utilisation de la marque PROFIBUS nécessite l'autorisation de PROFIBUS & PROFINET International.
- 14 PROFINET est une marque de PROFIBUS & PROFINET International. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque PROFINET. L'utilisation de la marque PROFINET nécessite l'autorisation de PROFIBUS & PROFINET International.



IEC

| Anglais                                                                   | Français                                                                                                  |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| IEC 61800 series Adjustable speed electrical power drive                  | Série IEC 61800 Entraînement électrique de puissance à vitesse variable                                   |
| IEC/TR 62390 Device profile guideline                                     | IEC TR 62390 Device profile guideline (disponible en anglais seulement)                                   |
| IEC 61800-7 Generic interface and use of profiles for power drive systems | IEC 61800-7 Interface générique et utilisation de profils pour les entraînements électriques de puissance |
| IEC 61800-7-1 Interface definition                                        | IEC 61800-7-1 Définition de l'interface                                                                   |
| Generic PDS interface specification                                       | Spécification d'interface PDS générique                                                                   |
| Annex A, Mapping of Profile type 1 (CiA 402)                              | Annexe A, Mise en correspondance du profil de type 1 (CiA 402)                                            |
| Annex B, Mapping of Profile type 2 (CIP Motion)                           | Annexe B, Mise en correspondance du profil de type 2 (CIP Motion)                                         |
| Annex C, Mapping of Profile type 3 (PROFIdrive)                           | Annexe C, Mise en correspondance du profil de type 3 (PROFIdrive)                                         |
| Annex D, Mapping of Profile type 4 (SERCOS)                               | Annexe D, Mise en correspondance du profil de type 4 (SERCOS)                                             |
| IEC 61800-7-200 – Profile specifications                                  | IEC 61800-7-200 – Spécifications des profils                                                              |

| Anglais                                                                                                              | Français                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| IEC 61800-7-201<br>Profile type 1 (CiA 102)                                                                          | IEC 61800-7-201<br>Profil de type 1 (CiA 102)                                                                                           |
| IEC 61800-7-202<br>Profile type 2 (CIP Motion)                                                                       | IEC 61800-7-202<br>Profil de type 2 (CIP Motion)                                                                                        |
| IEC 61800-7-203<br>Profile type 3 (PROFIdrive)                                                                       | IEC 61800-7-203<br>Profil de type 3 (PROFIdrive)                                                                                        |
| IEC 61800-7-204<br>Profile type 4 (PROFIdrive)                                                                       | IEC 61800-7-204<br>Profil de type 4 (SERCOS)                                                                                            |
| IEC 61800-7-300 – Mapping of profiles to network technologies                                                        | IEC 61800-7-300 – Mise en correspondance des profils avec les technologies de réseaux                                                   |
| IEC 61800-7-301<br>Mapping of profile type 1 to<br>CANopen<br>CC-Link IE<br>EPA<br>EtherCAT<br>ETHERNET<br>Powerlink | IEC 61800-7-301<br>Mise en correspondance du profil de type 1 avec<br>CANopen<br>CC-Link IE<br>EPA<br>EtherCAT<br>ETHERNET<br>Powerlink |
| IEC 61800-7-302<br>Mapping of profile type 2 to<br>DeviceNet<br>ControlNet<br>EtherNet/IP                            | IEC 61800-7-302<br>Mise en correspondance du profil de type 2 avec<br>DeviceNet<br>ControlNet<br>EtherNet/IP                            |
| IEC 61800-7-303<br>Mapping of profile type 3 to<br>PROFIBUS<br>PROFINET                                              | IEC 61800-7-303<br>Mise en correspondance du profil de type 3 avec<br>PROFIBUS<br>PROFINET                                              |
| IEC 61800-7-304<br>Mapping of profile type 4 to<br>SERCOS I + II<br>SERCOS III<br>EtherCAT                           | IEC 61800-7-304<br>Mise en correspondance du profil de type 4 avec<br>SERCOS I + II<br>SERCOS III<br>EtherCAT                           |

Figure 1 – Structure de l'IEC 61800-7

## 0.2 Déclaration de propriété

La Commission électrotechnique internationale (IEC) attire l'attention sur le fait qu'il est déclaré que la conformité avec les dispositions du présent document peut impliquer l'utilisation d'un brevet intéressant ce qui suit.

| Publication /<br>Numéro de série de<br>l'application | Détenteur | Intitulé                                                                                                                                                                                                | Numéro<br>d'accès<br>Derwent | Publication<br>Derwent                                                                 |
|------------------------------------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------|
| EP844542                                             | [SI]      | Méthode de commande numérique et structure de commande pour la commande de mouvements d'objets lorsque la commande de vitesse est effectuée à un taux supérieur à celui de l'asservissement de position | 1998-274369                  | EP844542-A1<br>27.05.1998;<br>DE59603496-G<br>02.12.1999;<br>EP844542-B1<br>27.10.1999 |

L'IEC ne prend pas position quant à la preuve, à la validité et à la portée de ces droits de propriété.

Le détenteur de ces droits de propriété a donné l'assurance à l'IEC qu'il consent à négocier des licences avec des demandeurs du monde entier, à des termes et conditions raisonnables et non discriminatoires. À ce propos, la déclaration du détenteur des droits de propriété est enregistrée à l'IEC. Des informations peuvent être demandées à

|      |                                                                                                                                                            |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [SI] | Siemens AG<br>Service de la propriété intellectuelle de l'Entreprise<br>Octroi de licences & Transactions<br>Otto-Hahn-Ring 6<br>81730 Munich<br>Allemagne |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------|

L'attention est d'autre part attirée sur le fait que certains des éléments du présent document peuvent faire l'objet de droits de propriété intellectuelle autres que ceux identifiés ci-dessus. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de propriété et de ne pas avoir signalé leur existence.

L'ISO ([www.iso.org/patents](http://www.iso.org/patents)) et l'IEC (<http://patents.iec.ch>) tiennent à jour des bases de données en ligne des brevets et droits de propriété applicables à leurs normes. Les utilisateurs sont encouragés à consulter les bases de données pour obtenir les informations les plus récentes concernant les brevets ou droits de propriété.

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## **ENTRAÎNEMENTS ÉLECTRIQUES DE PUISSANCE À VITESSE VARIABLE –**

### **Partie 7-203: Interface générique et utilisation de profils pour les entraînements électriques de puissance – Spécification de profil de type 3**

#### **1 Domaine d'application**

La présente partie de l'IEC 61800 spécifie le type de profil 3 pour les entraînements électriques de puissance (PDS). Le type de profil 3 peut être mis en correspondance avec différentes technologies de réseau de communication.

Les fonctions spécifiées dans la présente partie de l'IEC 61800 ne sont pas destinées à assurer la sécurité fonctionnelle. Ceci exige l'application de mesures supplémentaires conformes aux normes, conventions et lois pertinentes.

#### **2 Références normatives**

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61158-5-3, *Réseaux de communication industriels – Spécifications des bus de terrain – Partie 5-3: Définition des services de la couche application – Éléments de type 3*

IEC 61158-5-10, *Réseaux de communication industriels – Spécifications des bus de terrain – Partie 5-10: Définition des services de la couche application – Éléments de type 10*

IEC 61158-6-3, *Réseaux de communication industriels – Spécifications des bus de terrain – Partie 6-3: Spécification du protocole de la couche application – Éléments de type 3*

IEC 61158-6-10, *Réseaux de communication industriels – Spécifications des bus de terrain – Partie 6-10: Spécification du protocole de la couche application – Éléments de type 10*

IEC 61800-7-1:2015, *Entraînements électriques de puissance à vitesse variable – Partie 7-1: Interface générique et utilisation de profils pour les entraînements électriques de puissance – Définition de l'interface*

IEC 61800-7-303:2015, *Entraînements électriques de puissance à vitesse variable – Partie 7-303: Interface générique et utilisation de profils pour les entraînements électriques de puissance – Mise en correspondance du profil de type 3 avec les technologies de réseaux*

#### **3 Termes, définitions et abréviations**

##### **3.1 Termes et définitions**

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.



**3.1.1****valeur instantanée**

valeur d'une grandeur variable à un instant déterminé

Note 1 à l'article: La valeur instantanée est utilisée dans le présent document comme données d'entrée du programme de commande d'application pour superviser les variables du PDS (par exemple, variables de réaction).

[SOURCE: IEC 61800-7-1:2015, 3.3.1.1]

**3.1.2****algorithme**

séquence finie d'opérations complètement déterminée par laquelle la valeur des données de sortie peut être calculée à partir de la valeur des données d'entrée

[SOURCE: IEC 61800-7-1:2015, 3.2.1]

**3.1.3****application**

élément fonctionnel logiciel spécifique à la résolution d'un problème en termes de mesure et de commande de procédés industriels

Note 1 à l'article: Une application peut être répartie entre les ressources, et peut communiquer avec d'autres applications.

[SOURCE: IEC 61800-7-1:2015, 3.2.2]

**3.1.4****mode d'application**

type d'application pouvant être sollicité par un PDS

Note 1 à l'article: Les différents modes d'application reflètent la boucle d'asservissement dédiée à l'asservissement de couple ou de position, à la commande de vitesse ou à d'autres applications telles que le retour à la position de référence.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.2]

**3.1.5****attribut**

propriété ou caractéristique d'une entité

[SOURCE: IEC 61800-7-1:2015, 3.2.3]

**3.1.6****axe**

élément logique interne à un système d'automatisation (par exemple, système de commande de mouvement) qui représente une certaine forme de mouvement

Note 1 à l'article: Les axes peuvent être rotatifs ou linéaires, physiques ou virtuels, commandés ou simplement observés.

Note 2 à l'article: Un axe physique peut comprendre un ou plusieurs des composants suivants: un capteur de mouvement, un système de commande de mouvement, un amplificateur de puissance et un actionneur de mouvement.

[SOURCE: IEC 61800-7-1:2015, 3.2.4, modifiée – Une note à l'article est ajoutée]

**3.1.7****classe**

description d'un ensemble d'objets qui partagent les mêmes attributs, opérations, méthodes, relations et sémantique

[SOURCE: IEC 61800-7-1:2015, 3.2.5]

### 3.1.8

#### **application synchrone de cycle d'horloge**

synchronisation des durées d'échantillonnage et de cycle dans le logiciel de commande en boucle fermée dans des dispositifs d'entraînement numériques et des systèmes de commande

### 3.1.9

#### **commandes consignes**

ensemble de commandes entre le programme de commande d'application et le PDS permettant de contrôler le comportement du PDS ou les éléments fonctionnels de celui-ci

Note 1 à l'article: Les états ou les modes de fonctionnement reflètent le comportement.

Note 2 à l'article: Les différentes commandes peuvent être représentées par un bit chacune.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.3]

### 3.1.10

#### **commande régulation**

action délibérée sur (ou dans) un processus, en vue d'atteindre des objectifs définis

[SOURCE: IEC 61800-7-1:2015, 3.2.6]

### 3.1.11

#### **dispositif de commande/régulation**

unité physique contenant – dans un module/sous-ensemble ou dispositif – un programme d'application de commande du PDS

[SOURCE: IEC 61800-7-1:2015, 3.2.7]

### 3.1.12

#### **type de données**

ensemble de valeurs associé à un ensemble d'opérations autorisées

[SOURCE: IEC 61800-7-1:2015, 3.2.8]

### 3.1.13

#### **dispositif**

dispositif de terrain

<blocs de fonction> entité physique indépendante en réseau dans un système d'automatisation industriel, capable d'accomplir des fonctions spécifiées dans un contexte particulier et délimitée par ses interfaces

[SOURCE: IEC 61800-7-1:2015, 3.2.9]

### 3.1.14

#### **dispositif**

dispositif de terrain

<intégration système> entité qui permet le contrôle, la servocommande et/ou la détection et s'interface à d'autres entités de ce type à l'intérieur d'un système d'automatisation

[SOURCE: IEC 61800-7-1:2015, 3.2.10]

**3.1.15****profil de dispositif**

représentation d'un dispositif en termes de ses paramètres, ensembles de paramètres et comportement selon un modèle de dispositif qui décrit les données et le comportement du dispositif tel que perçus par l'intermédiaire d'un réseau, indépendamment de toute technologie de réseau

[SOURCE: IEC 61800-7-1:2015, 3.2.11]

**3.1.16****données E-S de DO**

ensemble de toutes les données d'entrée et de sortie (transmission cyclique) d'un objet d'entraînement (axe d'entraînement)

**3.1.17****objet d'entraînement**

élément fonctionnel d'une unité d'entraînement

**3.1.18****communication entre dispositifs d'entraînement**

communication (cyclique) entre les dispositifs d'entraînement du point de vue de l'utilisateur

**3.1.19****unité d'entraînement**

dispositif logique qui comprend tous les éléments fonctionnels liés à une unité de traitement centrale

**3.1.20****élément fonctionnel**

entité de logiciel ou logiciel combiné au matériel, capable d'accomplir une fonction spécifiée d'un dispositif

Note 1 à l'article: Un élément fonctionnel comporte une interface et des associations à d'autres éléments fonctionnels et fonctions.

Note 2 à l'article: Un élément fonctionnel peut être constitué de bloc(s) de fonctions, d'objet(s) ou de liste(s) de paramètres.

[SOURCE: IEC 61800-7-1:2015, 3.2.13]

**3.1.21****données d'entrée**

données à envoyer de manière cyclique du dispositif au contrôleur

**3.1.22****interface**

frontière partagée entre deux unités, définie par des caractéristiques fonctionnelles, des caractéristiques de signal ou d'autres caractéristiques appropriées

[SOURCE: IEC 61800-7-1:2015, 3.2.15]

**3.1.23****données E-S**

données d'entrée et données de sortie d'un dispositif

**3.1.24****mode isochrone**

service de synchronisme de cycle d'horloge d'un système de communication qui génère un cycle de bus constant (synchronisation) avec un signal de cycle d'horloge au début du cycle

### **3.1.25**

#### **modèle**

représentation mathématique ou physique d'un système ou d'un processus, basée, avec une précision suffisante, sur des lois connues, sur une identification ou sur des hypothèses spécifiées

[SOURCE: IEC 61800-7-1:2015, 3.2.17]

### **3.1.26**

#### **mode de fonctionnement**

caractérisation de la manière et du degré avec lequel l'opérateur humain intervient sur l'équipement de commande

[SOURCE: IEC 61800-7-1:2015, 3.2.18]

### **3.1.27**

#### **données de sortie**

données à envoyer de manière cyclique du contrôleur au dispositif

### **3.1.28**

#### **paramètre**

élément de donnée qui représente les informations d'un dispositif qui peuvent être lues ou saisies dans un dispositif, par exemple, par le biais du réseau ou d'une IHM locale

Note 1 à l'article: Un paramètre est caractérisé généralement par son nom, le type de données et la direction d'accès.

[SOURCE: IEC 61800-7-1:2015, 3.2.20]

### **3.1.29**

#### **données de processus**

données relatives au processus de commande, par exemple le facteur de gain et les variables d'état, généralement mises en correspondance avec les paramètres

### **3.1.30**

#### **profil**

représentation d'une interface PDS en termes de ses paramètres, ensembles de paramètres et comportement selon un profil de communication et un profil de dispositif

[SOURCE: IEC 61800-7-1:2015, 3.2.21, modifiée – La Note 1 à l'article est supprimée]

### **3.1.31**

#### **point de consigne**

valeur ou variable utilisée comme donnée de sortie du programme de commande d'application afin de commander le PDS

### **3.1.32**

#### **état**

#### **statut**

ensemble d'informations entre le PDS et le programme de commande d'application, qui reflète l'état ou le mode du PDS ou un élément fonctionnel de ce dernier

Note 1 à l'article: Les différentes informations d'état peuvent être codées avec un bit chacune.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.6]

**3.1.33****fonctions technologiques**

contrôles en boucle fermée et contrôles en séquence pour l'automatisation de processus spécifiques à l'application

**3.1.34****type**

élément matériel ou logiciel qui spécifie les attributs communs partagés par toutes les instances du type

[SOURCE: IEC 61800-7-1:2015, 3.2.23]

**3.1.35****cas d'application**

spécification de classe d'une séquence d'actions, y compris les variantes, qu'un système (ou autre entité) peut exécuter, en interaction avec les acteurs du système

[SOURCE: IEC 61800-7-1:2015, 3.2.24]

**3.1.36****variable**

entité logique qui peut prendre différentes valeurs, mais une seule valeur à la fois

Note 1 à l'article: Les valeurs d'une variable, ainsi que d'un paramètre, se limitent habituellement à un certain type de données.

[SOURCE: IEC 61800-7-1:2015, 3.2.25]

**3.2 Abréviations**

|             |                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| AC          | PROFIdrive Application Class (Classe d'application PROFIdrive)                                                                          |
| BERO        | proximity Switch (interrupteur de proximité)                                                                                            |
| CO          | Communication Object (Objet de communication)                                                                                           |
| CR          | communication relationship (relation de communication)                                                                                  |
| C-LS        | Controller's Sign-Of-Life (Signe de vie du contrôleur)                                                                                  |
| DO          | Drive Object (Objet d'entraînement)                                                                                                     |
| DO-LS       | Drive Object Sign-Of-Life (Signe de vie de l'objet d'entraînement)                                                                      |
| DP          | Decentralised (distributed) Periphery (Périphérie décentralisée (répartie))                                                             |
| DSC         | Dynamic Servo Control (Commande asservie dynamique)                                                                                     |
| DU          | Drive Unit (Unité d'entraînement)                                                                                                       |
| DX          | Data_Exchange (échange de données)                                                                                                      |
| f           | fréquence                                                                                                                               |
| GSD         | General Station Description (Description de station générale) (description de dispositif, entrée pour un outil de configuration du bus) |
| IHM         | Interface homme-machine                                                                                                                 |
| ID          | identificateur                                                                                                                          |
| Données E-S | Données E-S; transmises de façon cyclique                                                                                               |
| E/S         | entrée/sortie                                                                                                                           |
| $K_V$       | facteur de gain de commande en boucle de position fermée                                                                                |
| $k_{PC}$    | facteur de gain de commande en boucle de position fermée                                                                                |
| LS          | Sign-Of-Life (Signe de vie)                                                                                                             |
| LSB         | least significant bit (bit de poids faible)                                                                                             |

|                  |                                                                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MSB              | most significant bit (bit de poids fort)                                                                                                                                                  |
| M CR             | Multicast CR (Relation de communication (CR) multidestinataire (multidiffusion))                                                                                                          |
| MDI              | Manual Data Input (Entrée de données manuelle)                                                                                                                                            |
| NAMUR            | Standards Working Group for Instrumentation and Control in the Chemical Industry (Groupe de travail normatif pour l'instrumentation de mesure et de régulation dans l'industrie chimique) |
| NC               | numerical control system with a numeric control command set (système de commande numérique avec ensemble de commandes de contrôle numérique)                                              |
| Pxxx             | paramètre (identifié par le numéro xxx)                                                                                                                                                   |
| PAP              | Parameter Access Point (Point d'accès aux paramètres)                                                                                                                                     |
| PBE              | description de paramètre                                                                                                                                                                  |
| Dispositif P     | dispositif périphérique (modèle de base PROFIdrive)                                                                                                                                       |
| PDS              | power drive system (entraînement électrique de puissance)                                                                                                                                 |
| PI               | PROFIBUS & PROFINET international                                                                                                                                                         |
| PLC              | programmable logic controller without a motion control command set (automate programmable sans ensemble de commandes de mouvement)                                                        |
| PLL              | phase locked loop (boucle à verrouillage de phase) phase control loop (boucle à commande de phase)                                                                                        |
| PNO              | PROFIBUS User Organisation (Organisme utilisateur PROFIBUS)                                                                                                                               |
| PNU              | parameter number (numéro de paramètre)                                                                                                                                                    |
| PROFIBUS         | bus de terrain de processus tel que défini dans l'IEC 61158-5-3 et l'IEC 61158-6-3                                                                                                        |
| PROFINET         | bus de terrain de processus tel que défini dans l'IEC 61158-5-10 et l'IEC 61158-6-10                                                                                                      |
| PWE              | parameter value (valeur de paramètre)                                                                                                                                                     |
| RFG              | Ramp Function Generator (Générateur de fonction de rampe)                                                                                                                                 |
| RMS              | root mean square value (valeur efficace) true root mean square value (valeur efficace vraie)                                                                                              |
| SN               | signe                                                                                                                                                                                     |
| STW              | control word (mot de commande)                                                                                                                                                            |
| T <sub>a</sub>   | temps d'échantillonnage                                                                                                                                                                   |
| T <sub>DC</sub>  | Data-Cycle-Time (Durée de cycle de données)                                                                                                                                               |
| T <sub>DX</sub>  | Data_Exchange-Time (Temps d'échange de données)                                                                                                                                           |
| T <sub>M</sub>   | Master-Time (Temps du maître)                                                                                                                                                             |
| T <sub>CAC</sub> | Controller_Application_Cycle-Time (Durée de cycle d'application du Contrôleur)                                                                                                            |
| T <sub>CLS</sub> | Controller_Life_Sign-Time (Temps de signe de vie du Contrôleur)                                                                                                                           |
| T <sub>O</sub>   | Output-Time (Temps de sortie)                                                                                                                                                             |
| T <sub>PC</sub>  | temps d'échantillonnage du contrôleur de position                                                                                                                                         |
| T <sub>SC</sub>  | temps d'échantillonnage du contrôleur de vitesse                                                                                                                                          |
| T <sub>DLS</sub> | DO_Life_Sign-Time (Temps de signe de vie de l'objet d'entraînement)                                                                                                                       |
| VIK              | Association of the Industrial Customers and Industrial Power Producers (Association des clients industriels et producteurs industriels d'énergie)                                         |
| x <sub>err</sub> | écart du système de commande en boucle fermée                                                                                                                                             |
| ZSW              | status word (mot d'état)                                                                                                                                                                  |

## 4 Généralités

### 4.1 Présentation générale

Le profil PROFIdrive a été créé par l'organisme utilisateur PROFIBUS & PROFINET de PROFIBUS & PROFINET international (PI). Il définit un comportement de dispositif unifié et une technique d'accès aux données du dispositif d'entraînement.

Pour l'utilisateur, cela signifie que les coûts techniques sont diminués lors de la planification et de la mise en œuvre des installations et des systèmes, dans la mesure où les différents dispositifs d'entraînement réagissent de la même façon aux instructions de commande.

L'utilisation de blocs de programme normalisés dans les systèmes de commande en boucle fermée et en boucle ouverte afin de contrôler le dispositif d'entraînement permet de réduire significativement les coûts de programmation. Pour les constructeurs de dispositifs d'entraînement, suite à la définition du profil, les coûts de développement sont réduits et la mise en œuvre de l'interface normalisée non exclusive améliore les chances de réussite sur le marché.

La mise en correspondance avec l'interface générique est donnée à l'Annexe C de l'IEC 61800-7-1:2015.

### 4.2 Exigences

Actuellement, les systèmes d'entraînement électriques à vitesse variable, allant des convertisseurs d'entraînement à courant alternatif de base aux contrôleurs asservis de performances dynamiques élevées, sont de plus en plus connectés à des systèmes de commande en boucle ouverte et en boucle fermée de plus haut niveau dans des installations et des systèmes automatisés via des interfaces numériques.

Dans les systèmes actuels, c'est l'interface de vitesse qui est la plus répandue. Le point de consigne de vitesse est déterminé à partir d'un système d'automatisation de plus haut niveau qui contrôle le dispositif d'entraînement. De manière générale, la valeur instantanée de vitesse est renvoyée au système d'automatisation afin de surveiller le dispositif d'entraînement.

Afin que l'interface du bus de terrain numérique dans les concepts d'automatisation répartis puisse aussi être utilisée dans le domaine de la commande de mouvement avec plusieurs axes d'entraînement, les bus de terrain normalisés produits actuellement doivent être enrichis de caractéristiques spécifiques. Cela implique de satisfaire aux exigences suivantes.

**Synchronisme de cycle d'horloge:** Si un contrôleur de mouvement central est utilisé qui traite l'interpolation et l'asservissement de position en boucle fermée, la boucle d'asservissement doit être fermée via le bus. Le point de consigne de vitesse est transféré vers le dispositif d'entraînement dans la direction du point de consigne. Dans la direction de la valeur instantanée, le dispositif d'entraînement fournit une valeur instantanée de position. Afin de mettre en œuvre des gains en boucle suffisamment élevés pour satisfaire aux exigences de performances dynamiques, les délais doivent être réduits au minimum et il est particulièrement important que ces délais soient parfaitement constants. Si la tâche de commande de mouvement exige de coordonner plusieurs axes, les valeurs instantanées de position doivent être acquises précisément en même temps et évaluées de façon synchrone dans le contrôleur de mouvement. De plus, les points de consigne doivent prendre effet précisément au même moment dans les axes. L'acquisition des valeurs instantanées, le transfert et l'activation du point de consigne sont en synchronisme de cycle d'horloge avec le contrôleur de position en boucle fermée.

**Communication entre dispositifs d'entraînement:** des solutions d'automatisation d'état de l'art avec des unités d'entraînement numériques utilisent aussi des concepts répartis dans lesquels les tâches de commande en boucle ouverte et en boucle fermée, précédemment

prises en œuvre de façon centrale, sont décalées sur des dispositifs d'entraînement intelligents. Des dispositifs d'entraînement de positionnement à un seul axe ou des dispositifs d'entraînement à logiciel intégré pour des fonctions d'enroulement ou des applications de fonctionnement synchrone peuvent être cités comme exemples.

Si des fonctions d'automatisation sont à décentraliser et à répartir, les données doivent être directement transférées entre les dispositifs d'entraînement, qui, dans l'exemple d'un arbre électronique, doivent être en synchronisme angulaire précis et aussi en synchronisme de cycle d'horloge.

Communication acyclique: Les services de communication acyclique sont sollicités pour transférer les demandes de paramètre pour la commande de l'opérateur et la surveillance des dispositifs d'entraînement parallèlement à l'échange de données cycliques.

Les profils d'automatisation modernes impliquent de satisfaire à l'exigence de prise en charge de systèmes de communication de pointe.

### **4.3 Objectifs du profil PROFIdrive**

Afin de protéger les investissements placés dans des outils techniques, des bibliothèques de programmes d'automatisation et la formation du personnel, il est important de disposer d'une fonctionnalité de profil d'application générique stable qui migre vers les futurs systèmes de bus de terrain renforcés en conservant la stabilité de son interface de plate-forme d'application.

## **5 Type de données**

### **5.1 Présentation générale des types de données**

Les types de données spécifiques au profil correspondant aux exigences particulières de dispositif d'entraînement sont définis. Les types de données spécifiques au profil sont définis individuellement en 5.3. Les types normalisés sont définis dans l'IEC 61158-5-10. Une présentation générale de tous les types de données autorisés (types de données normalisés et types de données spécifiques au profil) est donnée dans le Tableau 1 et dans le Tableau 2.

Il est fortement recommandé d'utiliser les types de données normalisés et spécifiques au profil du Tableau 1 et du Tableau 2 pour tous les paramètres de dispositif d'entraînement. De plus, compte tenu de la compatibilité avec les anciens systèmes, toutes les mises en œuvre de Contrôleur et de Dispositif doivent également prendre en charge les types de données de base Byte (octet), Word (mot), Double word (double mot) définis dans le Tableau 31. Pour de plus amples informations sur la gestion des types de données dans l'accès aux paramètres du mode de base de PROFIdrive, voir 6.2.3.8.

### **5.2 Types de données normalisés**

Le Tableau 1 montre les références des types de données utilisés dans ce profil et les définitions connexes.



**Tableau 1 – Types de données normalisés**

| Types de données utilisés dans le profil PROFIdrive                                                                                                                                                                                                                                                                                                                                                                                         | Référence de la définition             | Identificateur numérique de type de données |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------------|
| Boolean                                                                                                                                                                                                                                                                                                                                                                                                                                     | Boolean (voir l'IEC 61158-5-10)        | 1                                           |
| Integer8                                                                                                                                                                                                                                                                                                                                                                                                                                    | Integer8 (voir l'IEC 61158-5-10)       | 2                                           |
| Integer16                                                                                                                                                                                                                                                                                                                                                                                                                                   | Integer16 (voir l'IEC 61158-5-10)      | 3                                           |
| Integer32                                                                                                                                                                                                                                                                                                                                                                                                                                   | Integer32 (voir l'IEC 61158-5-10)      | 4                                           |
| Integer64                                                                                                                                                                                                                                                                                                                                                                                                                                   | Integer64 (voir l'IEC 61158-5-10)      | 55                                          |
| Unsigned8                                                                                                                                                                                                                                                                                                                                                                                                                                   | Unsigned8 (voir l'IEC 61158-5-10)      | 5                                           |
| Unsigned16                                                                                                                                                                                                                                                                                                                                                                                                                                  | Unsigned16 (voir l'IEC 61158-5-10)     | 6                                           |
| Unsigned32                                                                                                                                                                                                                                                                                                                                                                                                                                  | Unsigned32 (voir l'IEC 61158-5-10)     | 7                                           |
| Unsigned64                                                                                                                                                                                                                                                                                                                                                                                                                                  | Unsigned64 (voir l'IEC 61158-5-10)     | 56                                          |
| FloatingPoint                                                                                                                                                                                                                                                                                                                                                                                                                               | Float32 (voir l'IEC 61158-5-10)        | 8                                           |
| FloatingPoint64                                                                                                                                                                                                                                                                                                                                                                                                                             | Float64 (voir l'IEC 61158-5-10)        | 15                                          |
| VisibleString                                                                                                                                                                                                                                                                                                                                                                                                                               | VisibleString (voir l'IEC 61158-5-10)  | 9                                           |
| OctetString                                                                                                                                                                                                                                                                                                                                                                                                                                 | OctetString (voir l'IEC 61158-5-10)    | 10                                          |
| UNICODEString                                                                                                                                                                                                                                                                                                                                                                                                                               | UNICODEString (voir l'IEC 61158-5-10)  | 39                                          |
| TimeOfDay (avec indication de date)                                                                                                                                                                                                                                                                                                                                                                                                         | TimeOfDay (voir l'IEC 61158-5-10)      | 12                                          |
| TimeDifference (ne pas utiliser) <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                                                               | TimeDifference (voir l'IEC 61158-5-10) | 13                                          |
| Date                                                                                                                                                                                                                                                                                                                                                                                                                                        | BinaryDate (voir l'IEC 61158-5-10)     | 50                                          |
| TimeOfDay sans indication de date                                                                                                                                                                                                                                                                                                                                                                                                           | TimeOfDay (voir l'IEC 61158-5-10)      | 52                                          |
| TimeDifference avec indication de date                                                                                                                                                                                                                                                                                                                                                                                                      | TimeDifference (voir l'IEC 61158-5-10) | 53                                          |
| TimeDifference sans indication de date                                                                                                                                                                                                                                                                                                                                                                                                      | TimeDifference (voir l'IEC 61158-5-10) | 54                                          |
| <sup>a</sup> Il convient de ne pas utiliser le type de données TimeDifference pour de nouvelles mises en œuvre de dispositif. Pour la mise en œuvre de dispositif, utiliser à la place les types de données TimeDifference avec indication de date et TimeDifference sans indication de date. Pour des raisons de compatibilité, les trois types de données TimeDifference doivent être pris en charge par une mise en œuvre de Contrôleur. |                                        |                                             |

### 5.3 Types de données spécifiques au profil

#### 5.3.1 Généralités

Tous les types de données spécifiques au profil (voir le Tableau 2) peuvent être mis en œuvre dans le dispositif d'entraînement (types de données facultatifs).

**Tableau 2 – Types de données spécifiques au profil**

| Types de données utilisés dans le profil PROFIdrive | Référence de la définition    | Identificateur numérique de type de données |
|-----------------------------------------------------|-------------------------------|---------------------------------------------|
| Valeur normalisée N2 (16 bits)                      | 5.3.2, Tableau 3 et Tableau 4 | 113                                         |
| Valeur normalisée N4 (32 bits)                      | 5.3.2, Tableau 3 et Tableau 4 | 114                                         |
| Séquence de bits V2                                 | 5.3.6, et Tableau 10          | 115                                         |
| Quartet L2                                          | 5.3.7, et Tableau 11          | 116                                         |
| Constante de temps réciproque R2                    | 5.3.10, et Tableau 14         | 117                                         |
| Constante de temps T2 (16 bits)                     | 5.3.8, et Tableau 12          | 118                                         |
| Constante de temps T4 (32 bits)                     | 5.3.8, et Tableau 12          | 119                                         |
| Constante de temps D2                               | 5.3.9, et Tableau 13          | 120                                         |
| Valeur du point fixe E2 (16 bits)                   | 5.3.4, Tableau 7 et Tableau 8 | 121                                         |
| Valeur du point fixe C4 (32 bits)                   | 5.3.5, et Tableau 9           | 122                                         |
| Valeur normalisée X2, variable (16 bits)            | 5.3.3, Tableau 5 et Tableau 6 | 123                                         |
| Valeur normalisée X4, variable (32 bits)            | 5.3.3, Tableau 5 et Tableau 6 | 124                                         |

Il est fortement recommandé d'utiliser les types de données spécifiques au profil pour optimiser la correspondance avec l'application. Pour la compatibilité avec les anciennes applications de dispositif d'entraînement sans aucun type de données spécifique au profil:

- Au lieu de N2, N4 ou X2, X4, utiliser Integer16, Integer32 avec normalisation facultative.

### 5.3.2 Valeur normalisée: N2, N4

#### Signification

Valeur normalisée linéaire. 0 % correspond à 0 (0x0), 100 % correspond à  $2^{14}$  (0x4000) pour N2 ou  $2^{30}$  (0x40000000) pour N4.

**Tableau 3 – N2, N4-Plage des valeurs**

| Codage | Type de données | Plage des valeurs                      | Résolution                        | Longueur |
|--------|-----------------|----------------------------------------|-----------------------------------|----------|
| 113    | N2              | $-200 \% \leq i \leq (200-2^{-14}) \%$ | $2^{-14} = 0,006 \text{ 1 } \%$   | 2 Octets |
| 114    | N4              | $-200 \% \leq i \leq (200-2^{-30}) \%$ | $2^{-30} = 9,3 \times 10^{-8} \%$ | 4 Octets |

#### Codage

- Représentation en complément à deux, le MSB (bit de poids fort) est le bit après le bit de signe (SN) du premier octet.
- SN = 0: nombres positifs y compris zéro
- SN = 1: nombres négatifs

**Tableau 4 – N2, N4-Codage**

| Octet | Bit       |           |           |           |           |           |           |           |
|-------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|       | 8         | 7         | 6         | 5         | 4         | 3         | 2         | 1         |
| 1     | SN        | $2^0$     | $2^{-1}$  | $2^{-2}$  | $2^{-3}$  | $2^{-4}$  | $2^{-5}$  | $2^{-6}$  |
| 2     | $2^{-7}$  | $2^{-8}$  | $2^{-9}$  | $2^{-10}$ | $2^{-11}$ | $2^{-12}$ | $2^{-13}$ | $2^{-14}$ |
| 3     | $2^{-15}$ | $2^{-16}$ | $2^{-17}$ | $2^{-18}$ | $2^{-19}$ | $2^{-20}$ | $2^{-21}$ | $2^{-22}$ |
| 4     | $2^{-23}$ | $2^{-24}$ | $2^{-25}$ | $2^{-26}$ | $2^{-27}$ | $2^{-28}$ | $2^{-29}$ | $2^{-30}$ |

### 5.3.3 Valeur normalisée (normalisation variable): X2, X4

#### Signification

Valeur normalisée linéaire. 0 % correspond à 0 (0x0), 100 % correspond à  $2^x$ . La structure est la même que pour les types de données N2 et N4 mais la normalisation (100 %) ne fait pas automatiquement référence respectivement au bit 14 ou au bit 30, elle est variable. Le bit de normalisation est codé dans l'élément de description des paramètres "normalisation de données E-S de DO" (se reporter à 6.2.1.3).

**Tableau 5 – X2, X4-Plage des valeurs**

| Codage | Type de données                 | Plage des valeurs                              | Résolution | Longueur |
|--------|---------------------------------|------------------------------------------------|------------|----------|
| 123    | X2 (par exemple avec $x = 12$ ) | $-800 \% \leq i \leq (800 \cdot 2^{-12}) \%$   | $2^{-12}$  | 2 Octets |
| 124    | X4 (par exemple avec $x = 28$ ) | $-800 0 \% \leq i \leq (800 \cdot 2^{-28}) \%$ | $2^{-28}$  | 4 Octets |

#### Codage

- Représentation en complément à deux, le MSB (bit de poids fort) est le bit après le bit de signe (SN) du premier octet.
- SN = 0: nombres positifs y compris zéro
- SN = 1: nombres négatifs

**Tableau 6 – X2, X4-Codage (exemple  $x=12/28$ )**

| Octet | Bit       |           |           |           |           |           |           |           |
|-------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|       | 8         | 7         | 6         | 5         | 4         | 3         | 2         | 1         |
| 1     | SN        | $2^2$     | $2^1$     | $2^0$     | $2^{-1}$  | $2^{-2}$  | $2^{-3}$  | $2^{-4}$  |
| 2     | $2^{-5}$  | $2^{-6}$  | $2^{-7}$  | $2^{-8}$  | $2^{-9}$  | $2^{-10}$ | $2^{-11}$ | $2^{-12}$ |
| 3     | $2^{-13}$ | $2^{-14}$ | $2^{-15}$ | $2^{-16}$ | $2^{-17}$ | $2^{-18}$ | $2^{-19}$ | $2^{-20}$ |
| 4     | $2^{-21}$ | $2^{-22}$ | $2^{-23}$ | $2^{-24}$ | $2^{-25}$ | $2^{-26}$ | $2^{-27}$ | $2^{-28}$ |

### 5.3.4 Valeur du point fixe: E2

#### Signification

La valeur linéaire du point fixe avec sept positions binaires après la virgule. 0 correspond à 0 (0x0), 128 correspond à  $2^{14}$  (0x4000).

**Tableau 7 – E2-Plage des valeurs**

| Codage | Type de données | Plage des valeurs                    | Résolution               | Longueur |
|--------|-----------------|--------------------------------------|--------------------------|----------|
| 121    | E2              | $-256+2^{-7} \leq i \leq 256-2^{-7}$ | $2^{-7} = 0,007\ 812\ 5$ | 2 Octets |

#### Codage

- Représentation en complément à deux, le MSB (bit de poids fort) est le bit après le bit de signe (SN) du premier octet.
- SN = 0: nombres positifs y compris zéro
- SN = 1: nombres négatifs

**Tableau 8 – E2-Codage**

| Octet | Bit   |          |          |          |          |          |          |          |
|-------|-------|----------|----------|----------|----------|----------|----------|----------|
|       | 8     | 7        | 6        | 5        | 4        | 3        | 2        | 1        |
| 1     | SN    | $2^7$    | $2^6$    | $2^5$    | $2^4$    | $2^3$    | $2^2$    | $2^1$    |
| 2     | $2^0$ | $2^{-1}$ | $2^{-2}$ | $2^{-3}$ | $2^{-4}$ | $2^{-5}$ | $2^{-6}$ | $2^{-7}$ |

#### 5.3.5 Valeur du point fixe: C4

##### Signification

La valeur linéaire du point fixe avec quatre décimales. 0 correspond à 0 (0x0), 0,0001 correspond à  $2^0$  (0x0000 0001).

**Tableau 9 – C4-Plage des valeurs**

| Codage | Type de données | Plage des valeurs                        | Résolution              | Longueur |
|--------|-----------------|------------------------------------------|-------------------------|----------|
| 122    | C4              | $-214748\ 3648 \leq i \leq 214748\ 3647$ | $10^{-4} = 0,000\ 1\ 5$ | 4 Octets |

#### Codage

Comme pour Integer<sub>32</sub>, la pondération des bits a été réduite par un facteur de 10 000.

#### 5.3.6 Séquence de bits: V2

##### Signification

Séquence de bits permettant de contrôler et de représenter les fonctions d'application. 16 variables booléennes sont combinées en deux octets. (Codage: 115)

**Tableau 10 – E2-Codage**

| Octet | Bit |    |    |    |    |    |   |   |
|-------|-----|----|----|----|----|----|---|---|
|       | 8   | 7  | 6  | 5  | 4  | 3  | 2 | 1 |
| 1     | 15  | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| 2     | 7   | 6  | 5  | 4  | 3  | 2  | 1 | 0 |

### 5.3.7 Quartet: L2

#### Signification

Un quartet est formé de quatre bits associés. Quatre quartets sont représentés en deux octets.

La définition du quartet n'est pas spécifiée. (Codage: 116)

**Tableau 11 – L2-Codage**

| Octet | Bit       |   |   |   |           |   |   |   |
|-------|-----------|---|---|---|-----------|---|---|---|
|       | 8         | 7 | 6 | 5 | 4         | 3 | 2 | 1 |
| 1     | Quartet 3 |   |   |   | Quartet 2 |   |   |   |
| 2     | Quartet 1 |   |   |   | Quartet 0 |   |   |   |

Commentaire sur les paramètres temporels

La valeur de paramètre temporel des types D2, T2, T4, R2 fait toujours référence au temps d'échantillonnage constant spécifié  $T_a$ . Le temps d'échantillonnage associé (valeur du paramètre de profil 962) est exigé afin d'interpréter la valeur interne.

### 5.3.8 Constante de temps: T2, T4

#### Signification

Données temporelles considérées comme un multiple du temps d'échantillonnage constant  $T_a$ .

**Tableau 12 – T2, T4-Plage des valeurs**

| Codage | Type de données | Plage des valeurs                           | Résolution | Longueur |
|--------|-----------------|---------------------------------------------|------------|----------|
| 118    | T2              | $0 \leq i \leq 32\,767 \times T_a$          | $T_a$      | 2 Octets |
| 119    | T4              | $0 \leq i \leq 4\,294\,967\,295 \times T_a$ | $T_a$      | 4 Octets |

Valeur interprétée = valeur interne  $\times T_a$

#### Codage de valeur interne

- T2: Comme pour Unsigned16 avec une plage des valeurs limitée  $0 \leq x \leq 32\,767$ . Après interprétation, les valeurs internes hors de cette plage sont fixées à 0.
- T4: Comme pour Unsigned32.

### 5.3.9 Constante de temps: D2

#### Signification

Données temporelles considérées comme une fraction du temps d'échantillonnage constant  $T_a$ .

**Tableau 13 – D2-Plage des valeurs**

| Codage | Type de données | Plage des valeurs                            | Résolution           | Longueur |
|--------|-----------------|----------------------------------------------|----------------------|----------|
| 120    | D2              | $0 \leq i \leq (2 \cdot 2^{-14}) \times T_a$ | $2^{-14} \times T_a$ | 2 Octets |

Valeur interprétée = valeur interne  $\times T_a / 16\,384$

#### Codage de valeur interne

Comme pour Unsigned16 avec une plage des valeurs limitée  $0 \leq x \leq 32\,767$ .

Après interprétation, les valeurs internes hors de cette plage sont fixées à 0.

#### 5.3.10 Constante de temps réciproque: R2

##### Signification

Données temporelles considérées comme un multiple réciproque du temps d'échantillonnage constant  $T_a$ .

**Tableau 14 – R2-Plage des valeurs**

| Codage | Type de données | Plage des valeurs                             | Résolution | Longueur |
|--------|-----------------|-----------------------------------------------|------------|----------|
| 117    | R2              | $1 \times T_a \leq i \leq 16\,384 \times T_a$ | $T_a$      | 2 Octets |

Valeur interprétée =  $16\,384 \times T_a / \text{valeur interne}$

#### Codage de valeur interne

Comme pour Unsigned16 avec une plage des valeurs limitée  $1 \leq x \leq 16\,384$ .

Après interprétation, les valeurs internes hors de cette plage sont fixées à 16 384.

## 6 Spécifications

### 6.1 Intégration des dispositifs d'entraînement dans des systèmes d'automatisation

#### 6.1.1 Généralités

Cet article spécifie la modélisation abstraite et les différentes variantes pour l'intégration de l'axe d'entraînement PROFIdrive dans des systèmes d'automatisation. Ce modèle PROFIdrive est généralement indépendant du système de communication utilisé comme plate-forme réseau (PROFIBUS, PROFINET). En fonction du système de communication, les limitations au modèle général et à la fonctionnalité générale peuvent être possibles.

#### 6.1.2 Modèle de base

##### 6.1.2.1 Dispositifs de communication

Le modèle de base PROFIdrive définit les trois classes de dispositifs suivantes comme éléments de base:

**Contrôleur**

Le Contrôleur est un dispositif de commande associé à un ou plusieurs dispositifs d'entraînement (axes). Lié au système d'automatisation, le contrôleur héberge le mécanisme d'automatisation général.

**Dispositif P**

Le Dispositif P (périphérique) est un dispositif de terrain qui héberge (hôte) les dispositifs d'entraînement (commande en boucle fermée, convertisseur). Généralement, le dispositif P est associé à un ou plusieurs contrôleurs.

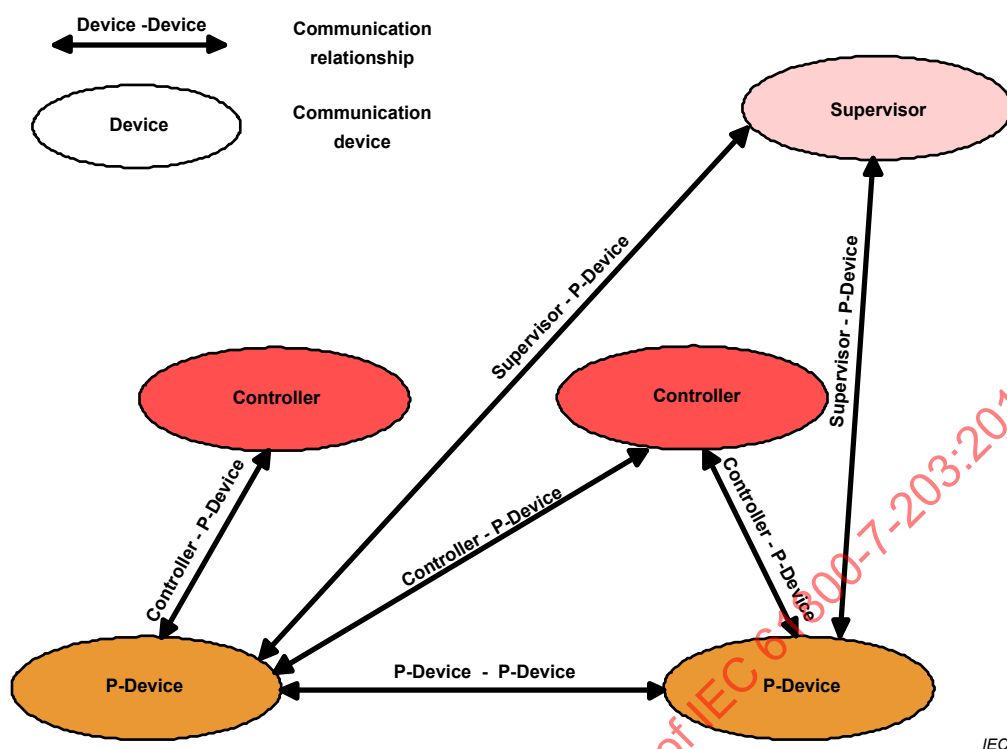
**Superviseur**

Le Superviseur est généralement un dispositif technique qui gère les données de configuration (ensembles de paramètres) et les ensembles de données de diagnostic fournies par les dispositifs P et/ou les contrôleurs.

**6.1.2.2 Relation de communication**

Le modèle de base PROFIdrive définit les types suivants des relations de communication entre les dispositifs:

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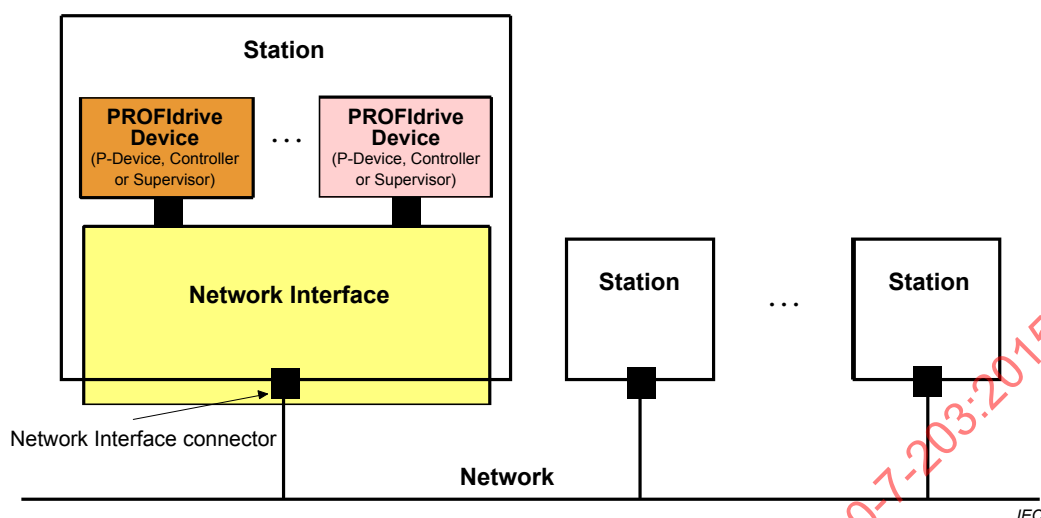
| Anglais                    | Français                    |
|----------------------------|-----------------------------|
| Device-Device              | Dispositif- Dispositif      |
| Communication relationship | Relation de communication   |
| Device                     | Dispositif                  |
| Communication device       | Dispositif de communication |
| Supervisor                 | Superviseur                 |
| Controller                 | Contrôleur                  |
| P-Device                   | Dispositif P                |
| Controller-P-Device        | Contrôleur – Dispositif P   |
| Supervisor-P-Device        | Superviseur – Dispositif P  |
| P-Device – P-Device        | Dispositif P – Dispositif P |

**Figure 2 – Dispositifs PROFIdrive et leur relation**

La Figure 2 montre les dispositifs PROFIdrive et les relations définies entre eux dans le contexte du modèle de base PROFIdrive.



### 6.1.2.3 Réseau de communication



| Anglais                                                | Français                                                        |
|--------------------------------------------------------|-----------------------------------------------------------------|
| Station                                                | Station                                                         |
| PROFIdrive Device (P-Device, Controller or Supervisor) | Dispositif PROFIdrive (Dispositif P, Contrôleur ou Superviseur) |
| Network Interface                                      | Interface réseau                                                |
| Network Interface Connector                            | Connecteur d'interface réseau                                   |
| Network                                                | Réseau                                                          |

**Figure 3 – Modèle général de communication d'un système d'automatisation PROFIdrive**

La Figure 3 montre l'architecture générale du système d'automatisation et l'emplacement des dispositifs PROFIdrive en tant que composants de la Station. Le modèle physique est généralement constitué de stations physiques intégrées dans un système de réseau de communication. Ainsi chaque station comprend un connecteur d'interface réseau permettant de connecter physiquement la station au réseau et une fonctionnalité d'interface réseau, qui fournit le service de communication aux dispositifs.

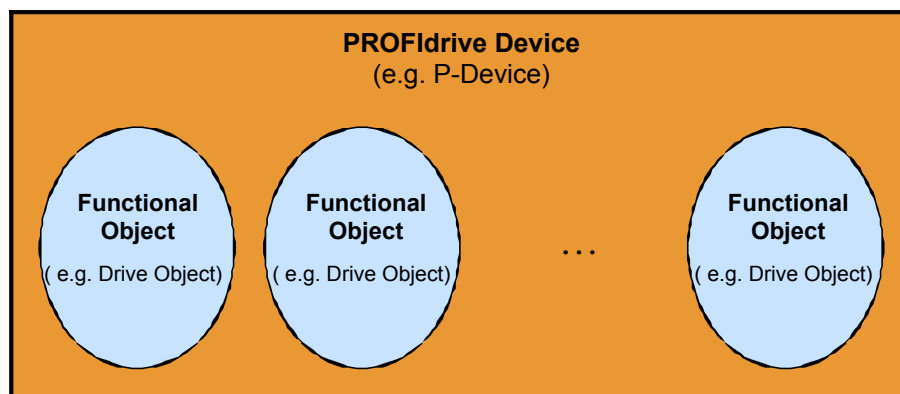
Le dispositif PROFIdrive est donc précisément défini par les informations d'adresse suivantes:

- Réseau,
- Station (Identificateur pour la station à l'intérieur du réseau),
- Dispositif (Identificateur pour le dispositif à l'intérieur de la station).

### 6.1.2.4 Objet fonctionnel

Le dispositif PROFIdrive comprend un ou plusieurs objets fonctionnels. Les objets fonctionnels sont des objets logiques qui représentent une fonctionnalité spéciale interne au système d'automatisation. La Figure 4 montre l'architecture générale du dispositif PROFIdrive comprenant des objets fonctionnels.

Si le dispositif est du type dispositif P, les objets fonctionnels internes à ce dispositif sont alors du type Objet d'entraînement (voir la Figure 4). La fonctionnalité typique de l'objet d'entraînement est la fonctionnalité du dispositif d'entraînement elle-même (moteur, étage de convertisseur, contrôle de courant et commande de vitesse en boucle fermée, fonctionnalité d'entrée et de sortie). Par exemple, un axe d'entraînement est lié à un objet d'entraînement.



| Anglais                               | Français                                             |
|---------------------------------------|------------------------------------------------------|
| PROFIdrive Device (e.g. P-Device)     | Dispositif PROFIdrive (par exemple Dispositif P)     |
| Functional Object (e.g. Drive Object) | Objet fonctionnel (par exemple Objet d'entraînement) |

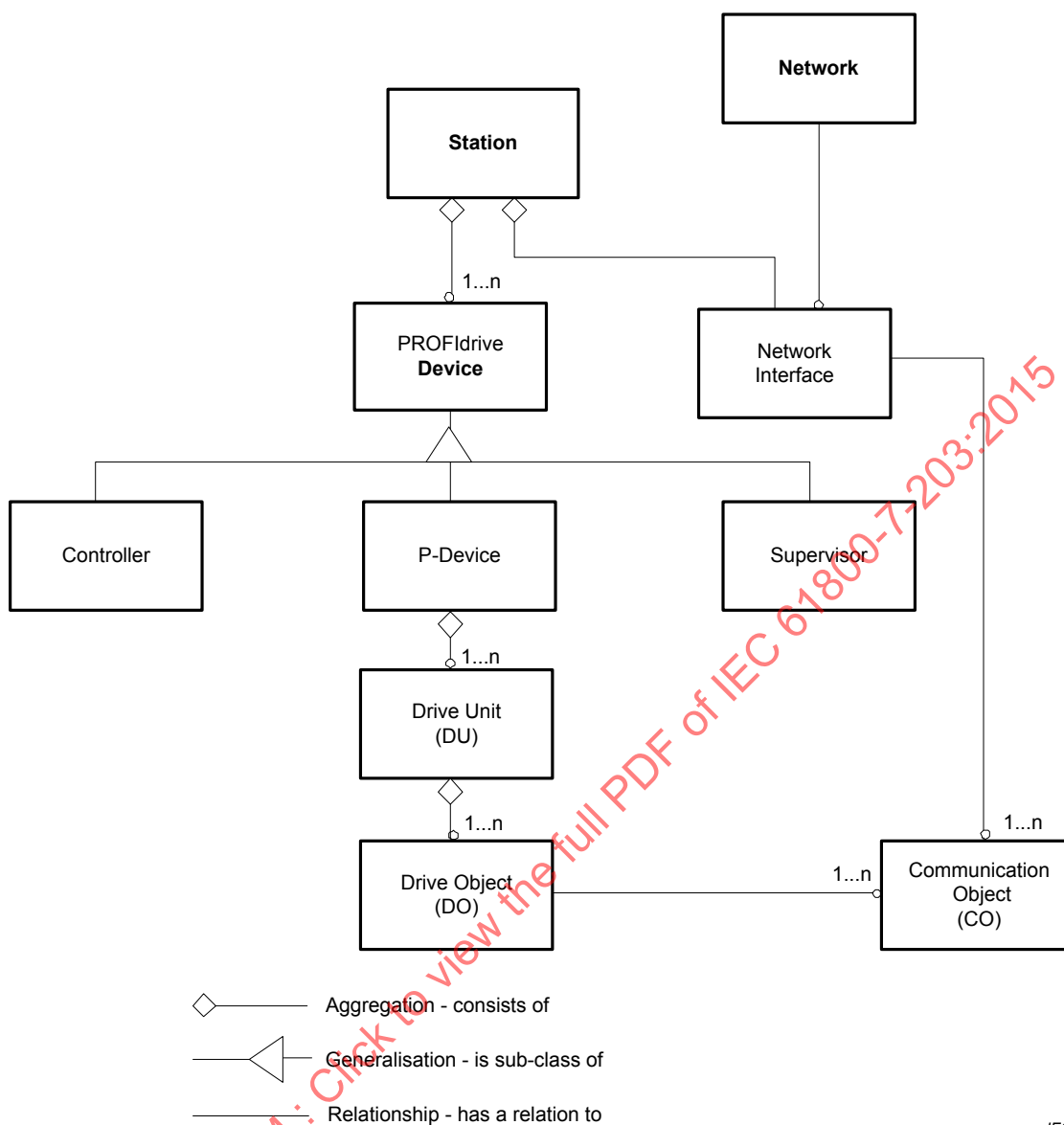
**Figure 4 – Dispositif PROFIdrive  
(comprend un ou plusieurs objets fonctionnels)**

#### 6.1.2.5 Modèle d'objet

Établis sur les objets définis dans le modèle de base, l'ordre hiérarchique et les dépendances entre ces objets sont présentés dans le modèle d'objet (voir la Figure 5).

Chaque station est constituée de l'interface réseau et d'un ou plusieurs dispositifs. L'interface réseau est liée au réseau auquel la station est connectée. Les dispositifs sont classés en trois types: contrôleur, dispositif P et superviseur. Si le dispositif est de type dispositif P, le dispositif P est constitué d'une ou de plusieurs unités d'entraînement (DU) qui comprennent un ou plusieurs objets d'entraînement (DO). L'agrégation des objets d'entraînement en unités d'entraînement (DU) peut être utilisée pour définir l'affiliation des objets d'entraînement à une unité de commande d'entraînement physique (CPU) ou à un agrégat physique. L'unité d'entraînement exprime de façon certaine le domaine de validité des paramètres globaux.

De plus, l'"objet de communication" (CO) qui est lié à l'interface réseau et aussi à l'objet fonctionnel (par exemple l'objet d'entraînement) est défini. L'objet de communication vise à être une extrémité de communication adressable par le système de communication, qui peut être associée à un objet fonctionnel.

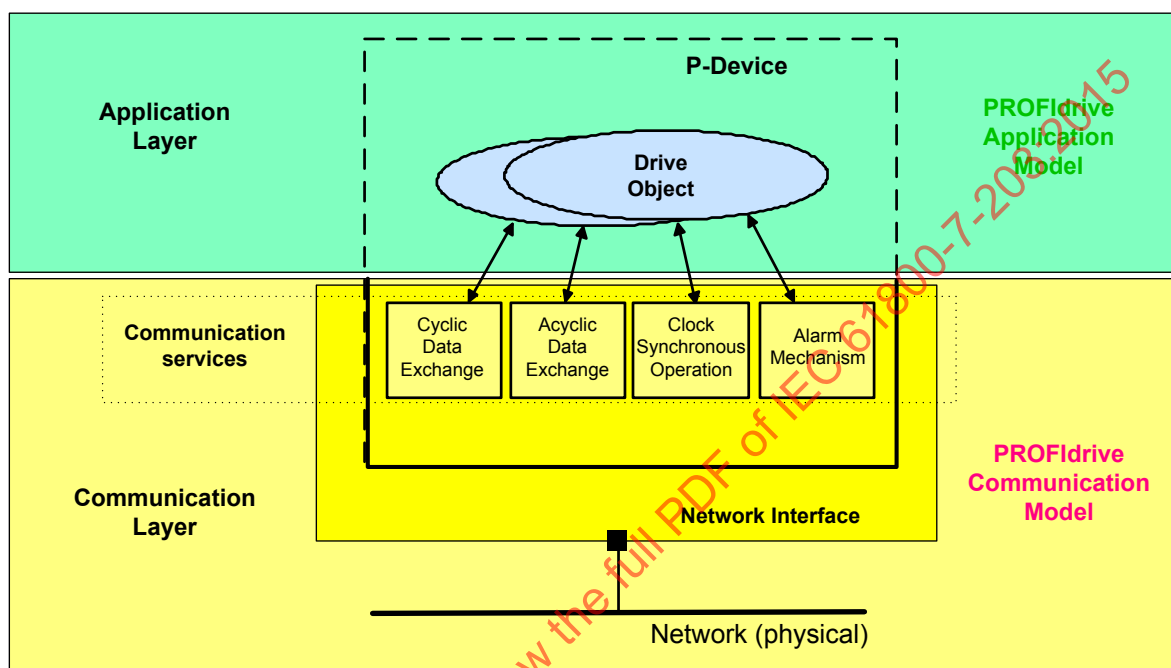


| Anglais                          | Français                                |
|----------------------------------|-----------------------------------------|
| Station                          | Station                                 |
| Network                          | Réseau                                  |
| PROFdrive Device                 | Dispositif PROFdrive                    |
| Network Interface                | Interface réseau                        |
| Controller                       | Contrôleur                              |
| P-Device                         | Dispositif P                            |
| Supervisor                       | Superviseur                             |
| Drive Unit (DU)                  | Unité d'entraînement (DU)               |
| Drive Object (DO)                | Objet d'entraînement (DO)               |
| Communication Object (CO)        | Objet de communication (CO)             |
| Aggregation – consists of        | Agrégation – constituée de              |
| Generalisation – is sub-class of | Généralisation – est une sous-classe de |
| Relationship – has a relation to | Relation – a une relation avec          |

Figure 5 – Ordre hiérarchique dans le modèle d'objet

### 6.1.2.6 Modèle à couches

La séparation des objets dans le modèle de base selon les aspects d'application et de communication aboutit au modèle à couches selon la Figure 6. Dans ce cas, la couche Application ne contient que les aspects fonctionnels du système d'automatisation, indépendamment de la répartition des éléments fonctionnels entre les stations et les dispositifs physiques. L'aspect de répartition est représenté par la couche Communication qui spécifie les composants du réseau physique et l'affectation des objets fonctionnels aux composants.



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| Anglais                        | Français                              |
|--------------------------------|---------------------------------------|
| Application Layer              | Couche Application                    |
| P-Device                       | Dispositif P                          |
| Drive Object                   | Objet d'entraînement                  |
| PROFIdrive Application Model   | Modèle d'application PROFIdrive       |
| Communication services         | Services de communication             |
| Cyclic Data Exchange           | Échange de données cycliques          |
| Acyclic Data Exchange          | Échange de données acycliques         |
| Clock Synchronous Operation    | Fonctionnement synchrone de l'horloge |
| Alarm Mechanism                | Mécanisme d'alarme                    |
| Communication Layer            | Couche Communication                  |
| Network Interface              | Interface réseau                      |
| PROFIdrive Communication Model | Modèle de communication PROFIdrive    |
| Network (physical)             | Réseau (physique)                     |

**Figure 6 – Modèle de base PROFIdrive contenant la couche Application et la couche Communication**

### **6.1.2.7 Services de communication**

#### **6.1.2.7.1 Généralités**

Le modèle de base PROFIdrive définit les services de communication suivants. Les services de communication sont fournis par le dispositif et sont ceux de l'objet fonctionnel.

La représentation des données doit être au format gros-boutiste.

#### **6.1.2.7.2 Échange de données cycliques**

Une communication cyclique signifie le simple transfert de données E/S de taille prédéfinie dans un créneau réservé. Dans une communication cyclique, les données E/S critiques eu égard au temps sont échangées entre le contrôleur et le dispositif ou entre les dispositifs. Généralement, ces données contiennent des valeurs de point de consigne et des valeurs instantanées, ainsi que des informations de commande et d'état. Le service Échange de données cycliques est affecté à la relation "Contrôleur – Dispositif P" et "Dispositif P – Dispositif P". Un canal d'échange de données cycliques est lié à un objet de communication à ses extrémités.

#### **6.1.2.7.3 Échange de données acycliques**

Par comparaison avec la communication cyclique, l'échange de données est acyclique uniquement si nécessaire. Une communication acyclique permet le transfert des données non critiques, par exemple, le téléchargement des données de micrologiciel ou de paramètres. Le service Échange de données acycliques est affecté à la relation "Contrôleur – Dispositif P" et "Superviseur – Dispositif P". Un canal d'échange de données acycliques est lié à un objet de communication à ses extrémités.

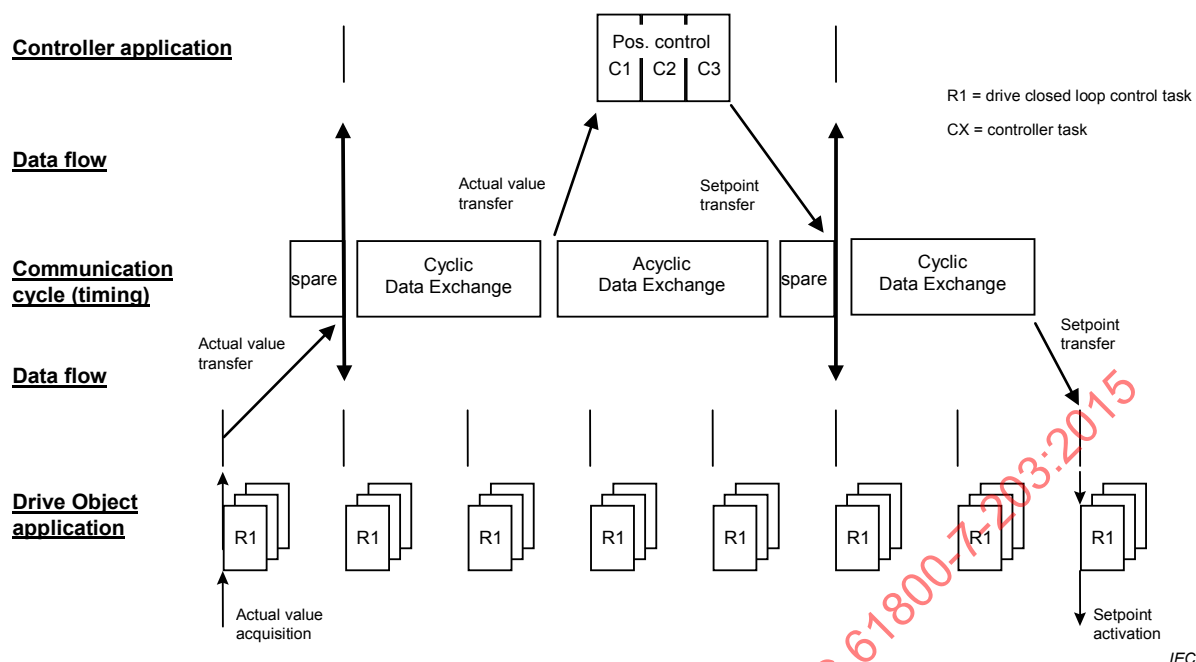
#### **6.1.2.7.4 Mécanisme d'alarme**

Le service Mécanisme d'alarme informe en temps réel le dispositif de commande de l'existence d'informations d'alarme et de situations d'exception. Le service fonctionne selon la demande afin de maintenir à jour l'image de statut d'exception de l'objet fonctionnel dans le contrôleur. Ce service permet au contrôleur de réagir le plus rapidement possible à l'occurrence d'un événement dans le dispositif d'entraînement sans interroger de façon permanente les informations d'état du dispositif d'entraînement. Le service Mécanisme d'alarme est affecté à la relation "Contrôleur – Dispositif P".

#### **6.1.2.7.5 Fonctionnement synchrone de l'horloge**

Le service Fonctionnement synchrone de l'horloge garantit le commencement simultané de tâches avec différents dispositifs de communication ou objets fonctionnels avec une instabilité (spécifiée) minimale (par exemple, processus d'échantillonnage et de sortie). Ce service implique également la transmission certaine de paquets de données cycliques dédiés jusqu'à un certain moment du cycle de communication.

Pour la technologie de dispositif d'entraînement, la communication synchrone du cycle d'horloge constitue la base de la synchronisation du dispositif d'entraînement. Non seulement l'échange de messages sur le système de bus est mis en œuvre sur une base de temps isochrone, mais les algorithmes de contrôle interne – tels que les contrôleurs de vitesse et de courant en boucle fermée du dispositif d'entraînement, ou les contrôleurs du système d'automatisation de niveau supérieur – sont également synchronisés (voir la Figure 7).



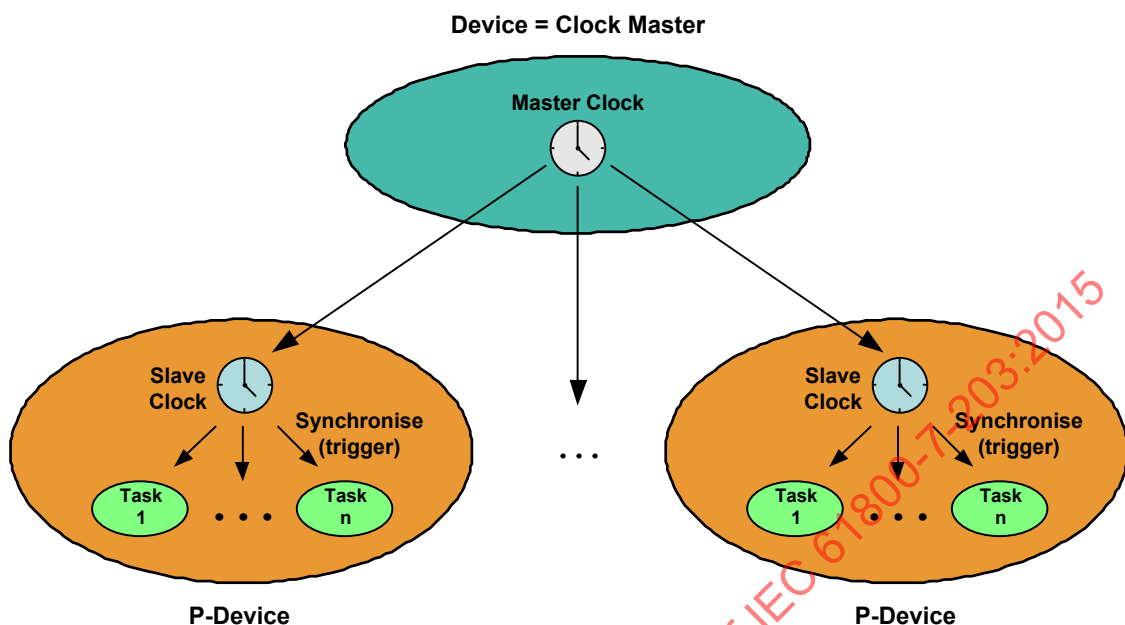
| Anglais                             | Français                                               |
|-------------------------------------|--------------------------------------------------------|
| Controller application              | Application du contrôleur                              |
| Data flow                           | Flux de données                                        |
| Communication cycle (timing)        | Cycle de communication (synchronisation)               |
| Drive Object application            | Application d'objet d'entraînement                     |
| Actual value transfer               | Transfert de valeur instantanée                        |
| Actual value acquisition            | Acquisition de valeur instantanée                      |
| Spare                               | Disponible                                             |
| Cyclic Data Exchange                | Échange de données cycliques                           |
| Acyclic Data Exchange               | Échange de données acycliques                          |
| Pos. Control                        | Asservissement de position                             |
| Setpoint transfer                   | Transfert de point de consigne                         |
| R1 = drive closed loop control task | R1 = tâche de commande en boucle fermée d'entraînement |
| CX = controller task                | CX = tâche du contrôleur                               |
| Setpoint activation                 | Activation du point de consigne                        |

**Figure 7 – Cas d'application typique du fonctionnement synchrone de l'horloge**

Le modèle général du service de fonctionnement synchrone de l'horloge est défini selon la Figure 8. Le modèle est basé sur les horloges locales qui sont liées à tous les dispositifs prenant en charge le service de fonctionnement synchrone de l'horloge. Ces horloges locales sont synchronisées avec une horloge maîtresse dédiée. Après le démarrage du mécanisme de fonctionnement synchrone de l'horloge, toutes les horloges esclaves sont synchrones avec l'horloge maîtresse avec une instabilité maximale définie de 1  $\mu$ s. Le mécanisme de démarrage et de synchronisation des horloges esclaves avec l'horloge maîtresse est lié au système de communication (qui fait partie de la couche Communication).

Le dispositif qui comprend l'horloge maîtresse est désigné horloge maîtresse. En fonction de l'application, les tâches d'application peuvent être déclenchées par l'horloge esclave du dispositif. Par exemple, en ce qui concerne un contrôleur d'axe, l'échantillonnage des valeurs

d'entrée et la sortie du courant du moteur sont déclenchés de façon externe à l'horloge esclave et sont donc synchrones avec tous les autres processus liés à l'horloge maîtresse.



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| Anglais               | Français                       |
|-----------------------|--------------------------------|
| Device = Clock Master | Dispositif = horloge maîtresse |
| Master Clock          | Horloge maîtresse              |
| Slave Clock           | Horloge esclave                |
| Task 1                | Tâche 1                        |
| Task n                | Tâche n                        |
| Synchronise (trigger) | Synchroniser (déclencher)      |
| P-Device              | Dispositif P                   |

**Figure 8 – Modèle général du fonctionnement synchrone de l'horloge**

#### 6.1.2.7.6 Diagramme d'états du modèle de base

Pour le modèle de base (voir la Figure 9), les états suivants liés au processus d'exécution de la communication et de l'application sont définis:

##### Hors ligne

En général, aucun service de communication ne fonctionne.

##### Préparation

Dans cet état, le service Échange de données acycliques et le mécanisme d'alarme fonctionnent. Cela signifie que les informations de configuration peuvent être transmises du contrôleur à l'unité d'entraînement et que l'accès aux paramètres est possible. De plus, les alarmes sont acheminées. Le service Échange de données cycliques peut ne pas être disponible ou les données transmises ne sont pas valides. Le système de communication tente de synchroniser toutes les horloges esclaves sur l'horloge maîtresse.

### **Synchronisation**

Dans cet état, l'échange de données acycliques, l'échange de données cycliques et le mécanisme d'alarme fonctionnent et les données cycliques transmises sont valides. Les processus d'application tentent de synchroniser leurs tâches entre eux (synchronisation sur l'horloge esclave locale et synchronisation des trains de données via les canaux de communication cyclique).

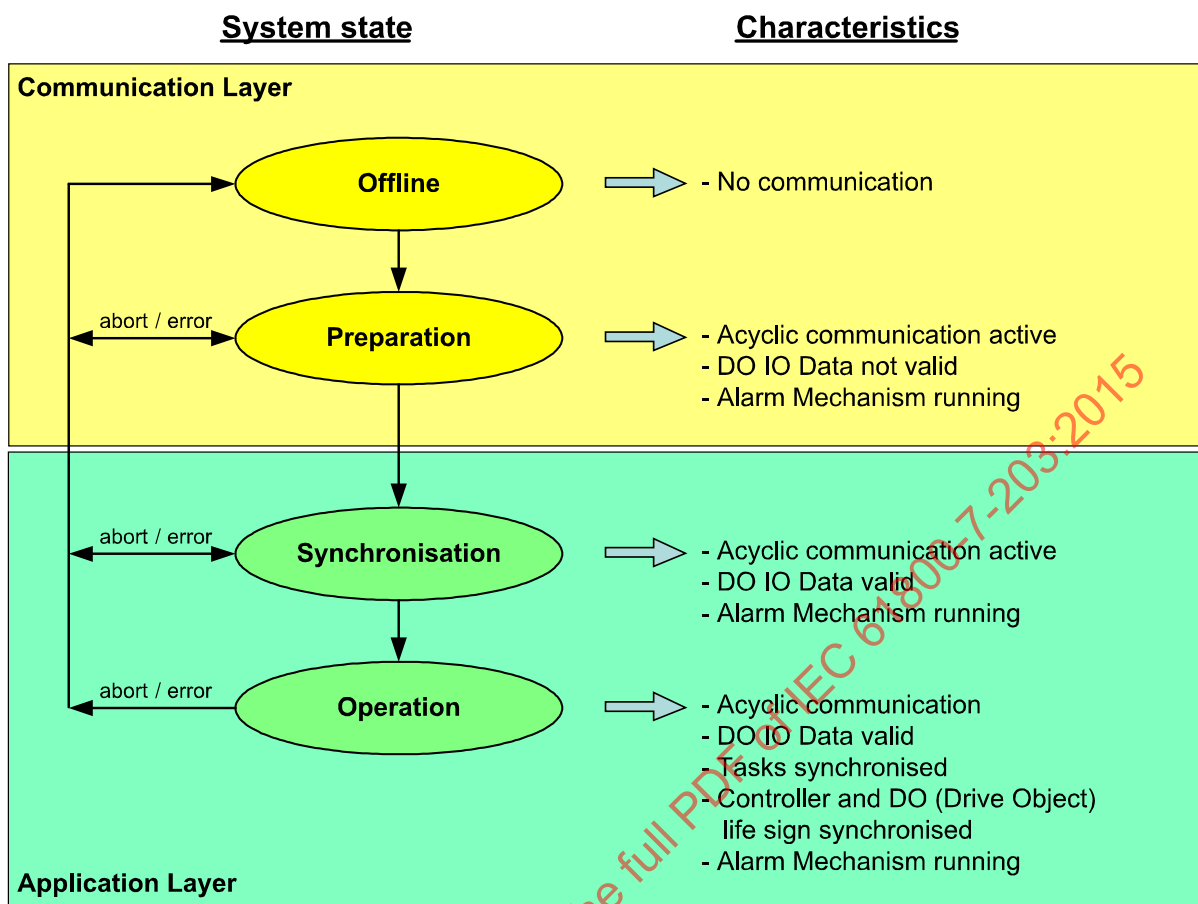
### **Fonctionnement**

Dans cet état, les processus d'application sont aussi synchronisés et l'application entière est prête à fonctionner (tâche de production).

Si, dans l'un de ces états, des exceptions se produisent et font perdre au système une ou plusieurs des caractéristiques liées à l'état réel, les dispositifs liés sont contraints de revenir à un état précédent correspondant, afin de procéder à nouveau au changement vers le niveau suivant supérieur, si c'est possible et autorisé.

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| Anglais                                                 | Français                                                             |
|---------------------------------------------------------|----------------------------------------------------------------------|
| System state                                            | État du système                                                      |
| Characteristics                                         | Caractéristiques                                                     |
| Communication Layer                                     | Couche Communication                                                 |
| Offline                                                 | Hors-ligne                                                           |
| No communication                                        | Pas de communication                                                 |
| Abort/error                                             | Abandon/erreur                                                       |
| Preparation                                             | Préparation                                                          |
| Acyclic communication active                            | Communication acyclique active                                       |
| DO IO data not valid                                    | Données E-S du DO non valides                                        |
| Alarm Mechanism running                                 | Exécution du mécanisme d'alarme                                      |
| Synchronisation                                         | Synchronisation                                                      |
| Operation                                               | Fonctionnement                                                       |
| Acyclic communication                                   | Communication acyclique                                              |
| DO IO data valid                                        | Données E-S du DO valides                                            |
| Tasks synchronised                                      | Tâches synchronisées                                                 |
| Controller and DO (drive object) life sign synchronized | Contrôleur et DO (objet d'entraînement) synchronisé par signe de vie |
| Application Layer                                       | Couche Application                                                   |

Figure 9 – Diagramme d'états de modèle de base

### 6.1.3 Modèle d'entraînement

#### 6.1.3.1 Généralités

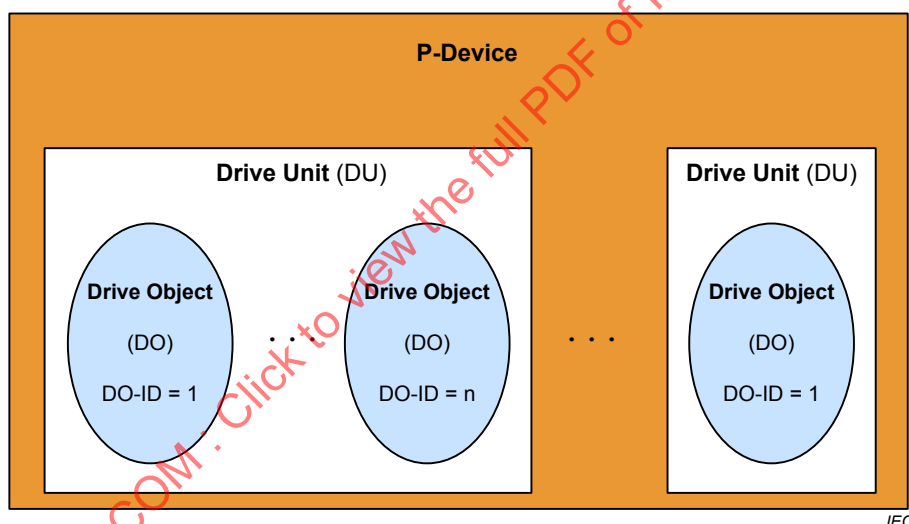
Sur la base du type de dispositif Dispositif P, défini précédemment dans le modèle de base, le présent paragraphe définit l'architecture du Dispositif P plus en détail.

#### 6.1.3.2 Dispositif P

Ce profil de technique d'entraînement définit un dispositif PROFIdrive de type dispositif P selon la Figure 10 comme un dispositif P contenant exactement une ou plusieurs unités d'entraînement (DU). Le dispositif P peut aussi contenir d'autres objets qui ne sont pas des unités d'entraînement. Voir également la Figure 5.

#### 6.1.3.3 Unité d'entraînement

Ce profil de technique d'entraînement définit une unité d'entraînement PROFIdrive selon la Figure 10 comme partie intégrante d'un dispositif P contenant exactement un ou plusieurs objets d'entraînement (DO). L'identification sans équivoque d'un objet d'entraînement au sein d'une unité d'entraînement est effectuée par l'ID de l'objet d'entraînement (ID de DO) qui est affecté à chaque DO d'une DU. L'unité d'entraînement contient uniquement des objets d'entraînement. Voir également la Figure 5.



| Anglais                      | Français                                  |
|------------------------------|-------------------------------------------|
| P-Device                     | Dispositif P                              |
| Drive Unit (DU)              | Unité d'entraînement (DU)                 |
| Drive Object (DO)<br>DO-ID=1 | Objet d'entraînement (DO)<br>ID de DO = 1 |
| Drive Object (DO)<br>DO-ID=n | Objet d'entraînement (DO)<br>ID de DO = n |

Figure 10 – Modèle général d'unité d'entraînement

#### 6.1.3.4 Objet d'entraînement

La Figure 11 montre l'architecture générale d'un objet d'entraînement (DO). L'élément central du DO est la tâche de commande de processus en charge de la fonctionnalité d'automatisation du DO. Les propriétés du DO et la tâche de commande de processus sont représentées et contrôlées par les paramètres. Les paramètres sont gérés dans la base de données de paramètres. Pour accéder aux paramètres du DO, le service d'échange de

données acycliques est utilisé. Pour le transport périodique de valeurs de point de consigne vers le DO et de valeurs instantanées à partir du DO, le service d'échange de données cycliques est utilisé. Si le DO est de type axe (se référer à 6.1.3.5), le DO comprend un diagramme d'états général qui contrôle et représente les états de la tâche de commande de processus de l'entraînement. Il peut y avoir des exceptions par rapport au comportement normalisé dans la tâche de commande de processus ou dans le diagramme d'états général. Ces exceptions peuvent être signalées au dispositif de commande par le mécanisme d'alarme.

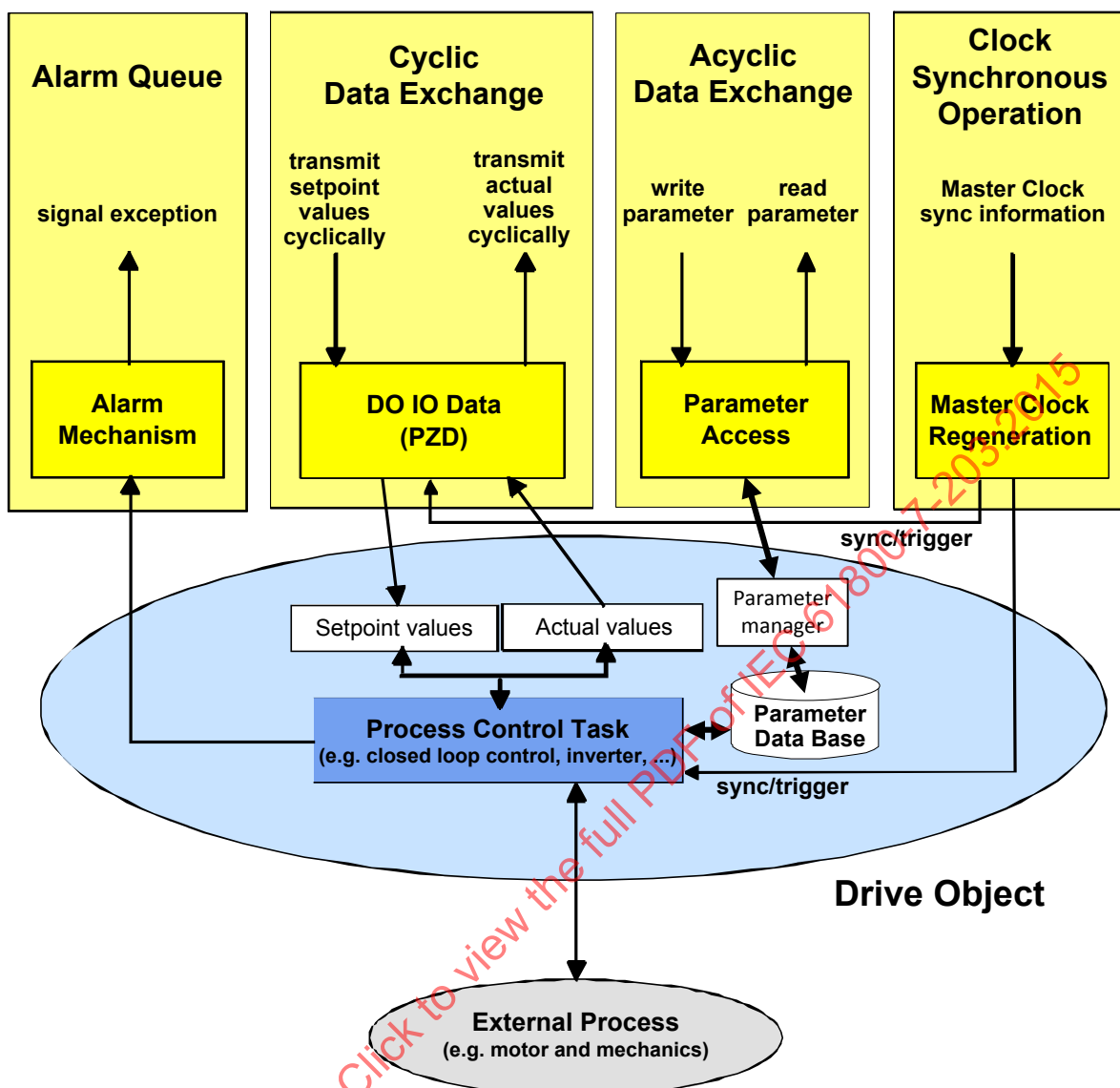
En termes de fonctionnalité obligatoire minimale, le DO doit comprendre:

- les paramètres

En termes de fonctionnalité facultative, le DO peut comprendre:

- la tâche de commande de processus,
- les données E-S de DO (valeur de point de consigne, valeurs instantanées),
- le diagramme d'états général (obligatoire pour le DO de type axe),
- la prise en charge du mécanisme d'alarme.

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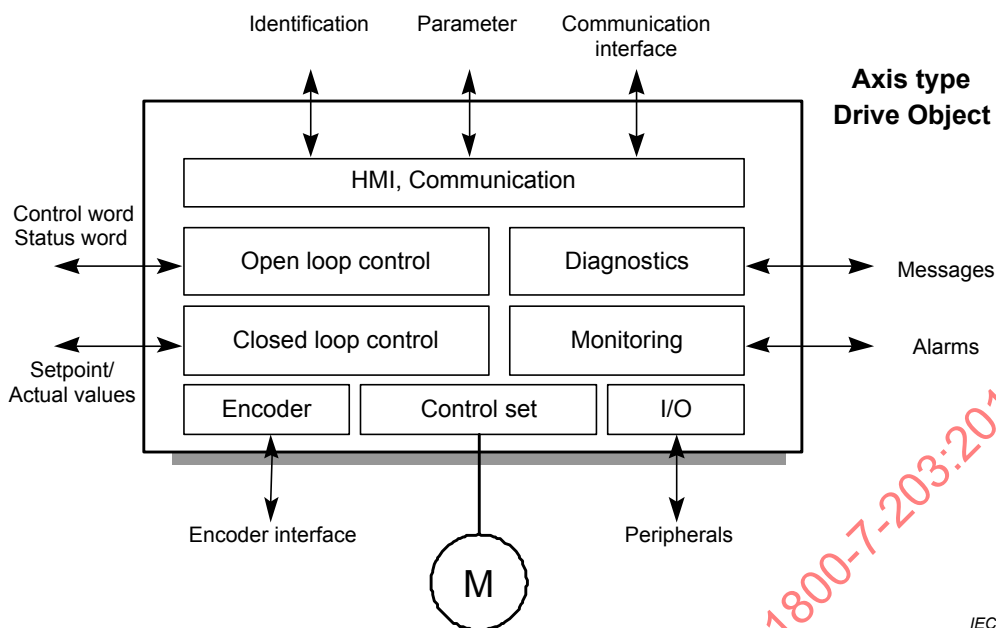
| Anglais                             | Français                                                       |
|-------------------------------------|----------------------------------------------------------------|
| Alarm Queue                         | File d'attente alarme                                          |
| Signal exception                    | Exception de signal                                            |
| Alarm mechanism                     | Mécanisme d'alarme                                             |
| Cyclic data exchange                | Échange de données cycliques                                   |
| Transmit setpoint values cyclically | Transmettre les valeurs de point de consigne de façon cyclique |
| Transmit actual values cyclically   | Transmettre les valeurs instantanées de façon cyclique         |
| DO IO Data (PZD)                    | Données E-S de DO (PZD)                                        |
| Acyclic Data Exchange               | Échange de données acycliques                                  |
| Write parameter                     | Paramètre d'écriture                                           |
| Read parameter                      | Paramètre de lecture                                           |
| Parameter Access                    | Accès aux paramètres                                           |
| Clock synchronous operation         | Fonctionnement synchrone de l'horloge                          |

| Anglais                                                           | Français                                                                              |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Master Clock sync information                                     | Informations sur la synchronisation de l'horloge maîtresse                            |
| Master Clock Regeneration                                         | Régénération de l'horloge maîtresse                                                   |
| Sync/trigger                                                      | Synchroniser/déclencher                                                               |
| Setpoint values                                                   | Valeurs de point de consigne                                                          |
| Actual values                                                     | Valeurs instantanées                                                                  |
| Parameter manager                                                 | Gestionnaire de paramètres                                                            |
| Parameter Data Base                                               | Base de données de paramètres                                                         |
| Process Control Task<br>(e.g. closed loop control, inverter, ...) | Tâche de contrôle de processus (par exemple commande en boucle fermée, onduleur, ...) |
| Drive Object                                                      | Objet d'entraînement                                                                  |
| External Process<br>(e.g. motor and mechanics)                    | Processus externe<br>(par exemple moteur et mécanique)                                |

**Figure 11 – Architecture générale d'objet d'entraînement**

#### 6.1.3.5 Objet d'entraînement de type Axe

Les DO peuvent être de type différent. Le type axe est un type dédié qui est d'importance générale dans ce profil d'entraînement; il est généralement relié à un moteur (axe d'entraînement) et est spécifié en détail en 6.3.



| Anglais                     | Français                                  |
|-----------------------------|-------------------------------------------|
| Parameter                   | Paramètre                                 |
| Communication interface     | Interface de communication                |
| Control word<br>Status word | Mot de commande<br>Mot d'état             |
| Setpoint/actual values      | Valeurs de point de consigne/instantanées |
| HMI, Communication          | IHM, Communication                        |
| Open loop control           | Commande en boucle ouverte                |
| Closed loop control         | Commande en boucle fermée                 |
| Encoder                     | Codeur                                    |
| Encoder interface           | Interface de codeur                       |
| Control set                 | Ensemble de commandes                     |
| Monitoring                  | Surveillance                              |
| I/O                         | E/S                                       |
| Peripherals                 | Périphériques                             |
| Axis type Drive Object      | Objet d'entraînement de type axe          |
| Alarms                      | Alarmes                                   |

**Figure 12 – Modèle fonctionnel de base d'un objet d'entraînement de type axe**

La Figure 12 montre la fonctionnalité de base d'un DO de type axe. Le DO axe est constitué de nombreux modules de fonction fonctionnant ensemble en interne et il représente donc l'intelligence du DO de type axe.

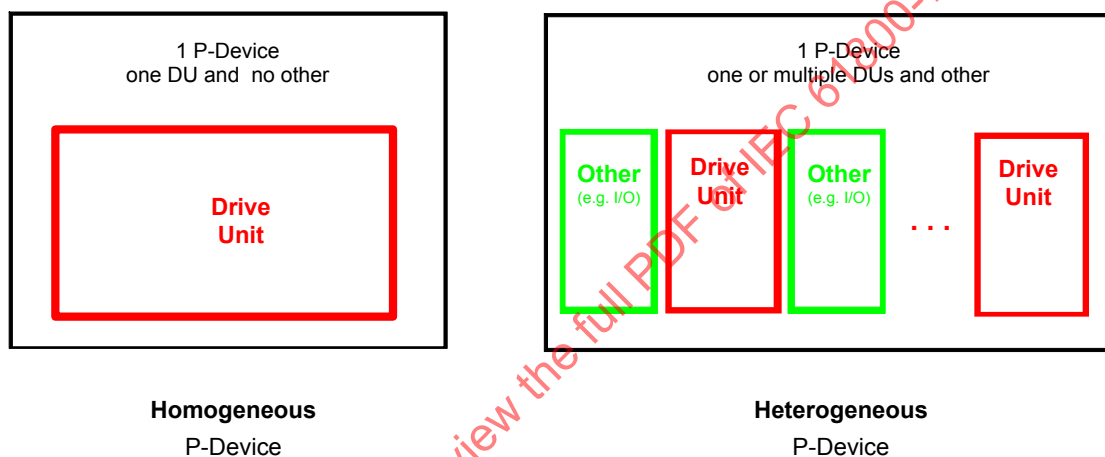
Les objets logiques suivants sont compris dans un DO axe:

- objets pour l'identification de DO;
- paramètres d'accès aux informations et paramétrages des modules de fonctions individuelles;
- objets de définition de l'interface de communication (par exemple, interface PROFIdrive);

- objets pour la commande d'entraînement (par exemple, mots de commande et mots d'état);
- objets pour le traitement des points de consigne (par exemple, valeurs de point de consigne et valeurs instantanées);
- objets pour diagnostic et surveillance (par exemple, messages, alarmes, défauts);
- objets pour interface(s) de détection intégrée(s);
- objets pour fonctions périphériques intégrées (E/S intégrées).

#### 6.1.3.6 Classification des dispositifs P

La Figure 13 montre les deux classes de dispositifs P PROFIdrive. Alors que le type homogène est un dispositif P contenant uniquement une unité d'entraînement PROFIdrive (et rien d'autre), le dispositif P hétérogène contient au moins une unité d'entraînement PROFIdrive et d'autres objets de cette couche d'abstraction qui ne sont pas spécifiés dans PROFIdrive (ils peuvent appartenir à d'autres profils d'application).



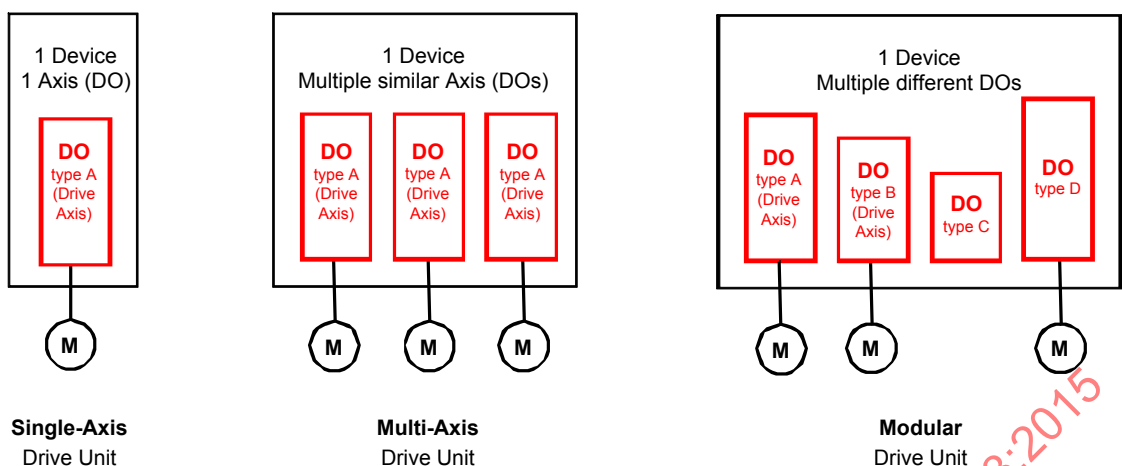
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| Anglais                                    | Français                                       |
|--------------------------------------------|------------------------------------------------|
| 1 P-Device<br>one DU and no other          | 1 Dispositif P<br>une DU et rien d'autre       |
| Drive Unit                                 | Unité d'entraînement                           |
| Homogeneous P-device                       | Dispositif P homogène                          |
| 1 P-Device<br>one or multiple DU and other | 1 Dispositif P<br>une ou plusieurs DU et autre |
| Other (e.g. I/O)                           | Autre (par exemple E/S)                        |
| Heterogeneous P-device                     | Dispositif P hétérogène                        |

Figure 13 – Classes de dispositifs P PROFIdrive

#### 6.1.3.7 Classification des unités d'entraînement

La Figure 14 montre les trois classes de base des unités d'entraînement PROFIdrive. Alors que le type à un seul axe est un dispositif physique avec un seul DO de type axe, le type multiaxe est constitué de plusieurs DO similaires de type axe. Le type modulaire fournit une flexibilité maximale et comprend un ou plusieurs DO qui peuvent être de type différent.



| Anglais                                 | Français                                |
|-----------------------------------------|-----------------------------------------|
| 1 Device<br>1 Axis (DO)                 | 1 dispositif<br>1 axe (DO)              |
| DO<br>type A<br>(drive axis)            | DO<br>type A<br>(axe d'entraînement)    |
| Single-Axis Drive Unit                  | Unité d'entraînement à un seul axe      |
| 1 Device<br>Multiple similar axis (DOs) | 1 dispositif<br>multiaxe similaire (DO) |
| Multi-Axis Drive Unit                   | Unité d'entraînement multiaxe           |
| 1 Device<br>Multiple different DOs      | 1 dispositif<br>DO multiples différents |
| DO<br>type B<br>(drive axis)            | DO<br>type B<br>(axe d'entraînement)    |
| Modular Drive Unit                      | Unité d'entraînement modulaire          |

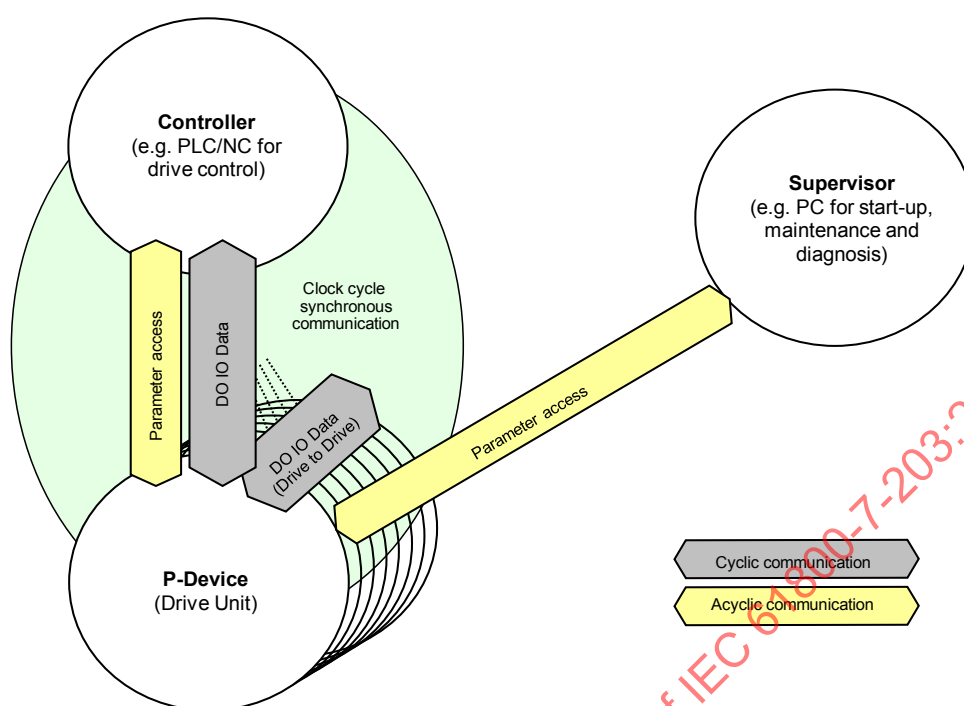
**Figure 14 – Classes d'unités d'entraînement PROFIdrive**

#### 6.1.4 Modèle de communication de dispositif P

La Figure 15 représente les différents canaux de communication disponibles entre le dispositif P et les autres dispositifs. La couleur indique le service de communication lié au canal de communication.

Le fonctionnement synchrone de l'horloge ainsi que le transfert de données E/S de DO sont disponibles entre le dispositif P et le contrôleur et entre les dispositifs P eux-mêmes (communication entre dispositifs d'entraînement). L'accès aux paramètres du dispositif P est possible à partir de tous les autres contrôleurs et superviseurs.





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| Anglais                                                      | Français                                                               |
|--------------------------------------------------------------|------------------------------------------------------------------------|
| Controller (e.g. PLC/NC for drive control)                   | Contrôleur (par exemple PLC/NC pour la commande d'entraînement)        |
| Supervisor (e.g. PC for start-up, maintenance and diagnosis) | Superviseur (par exemple PC pour démarrage, maintenance et diagnostic) |
| Clock cycle synchronous communication                        | Communication synchrone de cycle d'horloge                             |
| Parameter access                                             | Accès aux paramètres                                                   |
| DO IO data                                                   | Données E-S de DO                                                      |
| DO IO data (drive to drive)                                  | Données E-S de DO (entre dispositifs d'entraînement)                   |
| P-device (Drive Unit)                                        | Dispositif P (unité d'entraînement)                                    |
| Cyclic communication                                         | Communication cyclique                                                 |
| Acyclic communication                                        | Communication acyclique                                                |

**Figure 15 – Présentation générale des services de communication disponibles entre les dispositifs PROFIdrive**

## 6.1.5 Modèle d'application et classes d'application

### 6.1.5.1 Généralités

Actuellement, les applications d'entraînement sont réalisées de multiples façons. Le Tableau 15 définit les différentes classes d'application où sont utilisés les dispositifs d'entraînement. Les classes d'application (AC) sont des exemples typiques du domaine complet de l'ingénierie des dispositifs d'entraînement électrique. Les classes d'application comprennent la fonctionnalité donnée par les modes d'application dans l'IEC 61800-7-1.

Le modèle d'application fait partie de la couche Application et est donc lié uniquement aux aspects fonctionnels (objets fonctionnels), indépendamment de la répartition des objets fonctionnels entre les dispositifs. Le type de classe d'application prédéfinit donc le contenu des objets fonctionnels et le type des données (information) à transporter entre les objets

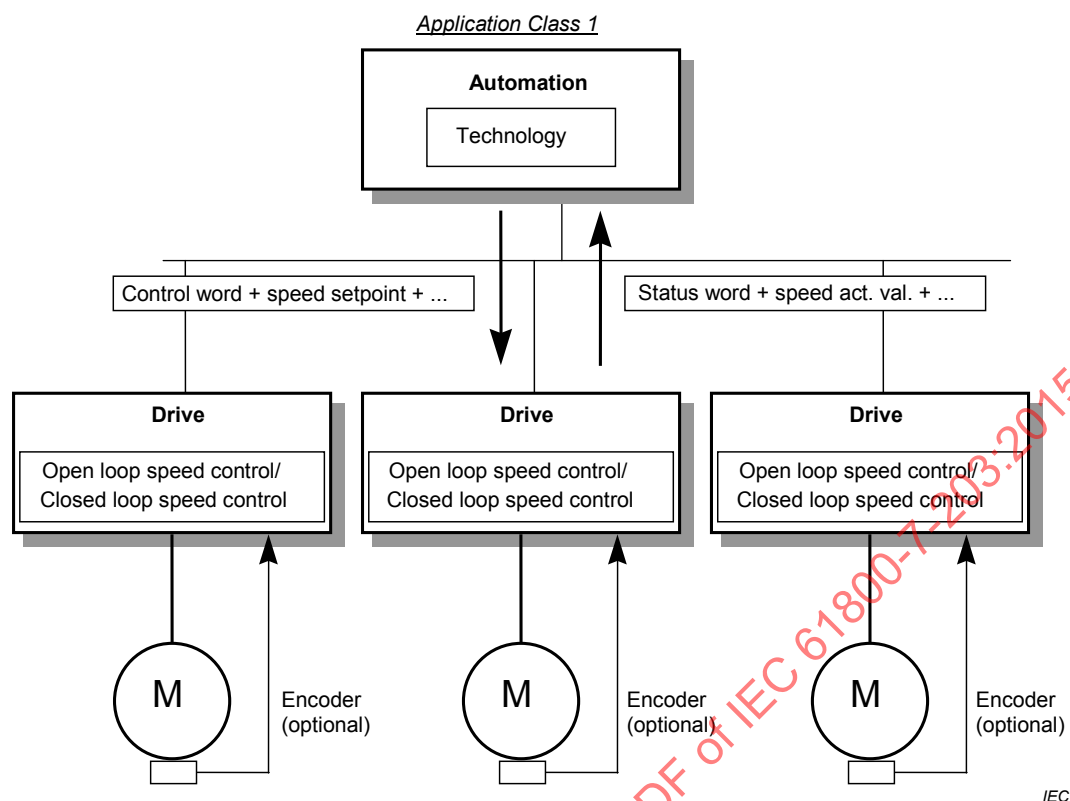
fonctionnels (interface). Les classes d'application définies dans le Tableau 15 sont des fonctions de profil affectées en 6.3.13, qu'un constructeur de dispositif d'entraînement doit mettre en œuvre s'il souhaite être conforme à la classe d'application particulière.

**Tableau 15 – Classes d'application**

| No.                                                                                                                                                                                                                        | Classe d'application                                                                                                                               | Interface                                                                                   | Fonctions <sup>b</sup>                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 1                                                                                                                                                                                                                          | Dispositif d'entraînement classique                                                                                                                | point de consigne n,<br>point de consigne de couple,<br>point de consigne de courant        | Interface de données E-S cycliques <sup>a</sup>                                                                           |
| 2                                                                                                                                                                                                                          | Dispositif d'entraînement classique avec contrôleur technologique réparti (processus continu)                                                      | Point de consigne technologique-valeurs instantanées (variables de consigne)                | Interface de données E-S cycliques avec communication entre dispositifs d'entraînement <sup>a</sup>                       |
| 3                                                                                                                                                                                                                          | Entraînement de positionnement à un seul axe, avec commande de mouvement locale                                                                    | point de consigne-pos<br>demandes d'exécution                                               | Interface de données E-S cycliques <sup>a</sup>                                                                           |
| 4                                                                                                                                                                                                                          | Commande de mouvement avec interpolation centrale et interface de point de consigne de vitesse<br>Facultatif:<br>DSC (commande asservie dynamique) | point de consigne n<br>x-réelle<br>De plus, pour DSC:<br>$\Delta x (x_{err}), K_V (k_{PC})$ | Interface de données E-S cycliques, fonctionnement synchrone de l'horloge, DSC (se référer à 6.3.5)                       |
| 5                                                                                                                                                                                                                          | Commande de mouvement avec interpolation centrale et interface de point de consigne de position                                                    | point de consigne x                                                                         | Interface de données E-S cycliques, fonctionnement synchrone de l'horloge <sup>c</sup>                                    |
| 6                                                                                                                                                                                                                          | Commande de mouvement pour processus cadencés ou synchronisme angulaire réparti                                                                    | Variables de consigne,<br>instructions de mouvement                                         | Interface de données E-S cycliques, fonctionnement synchrone de l'horloge, Communication entre dispositifs d'entraînement |
| <sup>a</sup> L'interface cyclique peut aussi être utilisée en fonctionnement synchrone avec l'horloge si, par exemple, il est question de synchronisation des actions dans le cas de plusieurs dispositifs d'entraînement. |                                                                                                                                                    |                                                                                             |                                                                                                                           |
| <sup>b</sup> Pour toutes les classes d'application: interface acyclique pour paramètres, diagnostics, identification.                                                                                                      |                                                                                                                                                    |                                                                                             |                                                                                                                           |
| <sup>c</sup> Cette classe d'application n'est pas décrite dans cette édition du profil. Les caractéristiques dynamiques de la classe d'application 5 sont obtenues avec la classe d'application 4 associée à un DSC.       |                                                                                                                                                    |                                                                                             |                                                                                                                           |

#### 6.1.5.2 AC 1: Dispositif d'entraînement classique

Dans le cas le plus simple, le dispositif d'entraînement est contrôlé via un point de consigne primaire (par exemple, point de consigne de vitesse) (voir la Figure 16). La commande de vitesse est entièrement régie dans le contrôleur d'entraînement. Le PLC comprend toutes les fonctions technologiques pour le processus d'automatisation. Le bus de terrain est simplement le support de transmission entre le système d'automatisation et le contrôleur d'entraînement. Le service de communication d'échange de données cycliques est utilisé. Ce type d'application est utilisé principalement dans le domaine de l'ingénierie de dispositif d'entraînement classique (par exemple, systèmes transporteurs). Un PLC est généralement utilisé comme système d'automatisation. Le fonctionnement synchrone de l'horloge peut être utilisé mais cela n'est généralement pas nécessaire pour cette classe d'application.



| Anglais                                               | Français                                                                       |
|-------------------------------------------------------|--------------------------------------------------------------------------------|
| Application Class 1                                   | Classe d'application 1                                                         |
| Automation                                            | Automatisation                                                                 |
| Technology                                            | Technologie                                                                    |
| Control word + speed setpoint + ...                   | Mot de commande + point de consigne de vitesse + ...                           |
| Status word + speed act. Val. + ...                   | Mot d'état + valeur instantanée de vitesse + ...                               |
| Drive                                                 | Dispositif d'entraînement                                                      |
| Open loop speed control/<br>closed loop speed control | Commande de vitesse en boucle ouverte/<br>Commande de vitesse en boucle fermée |
| Encoder (optional)                                    | Codeur (facultatif)                                                            |

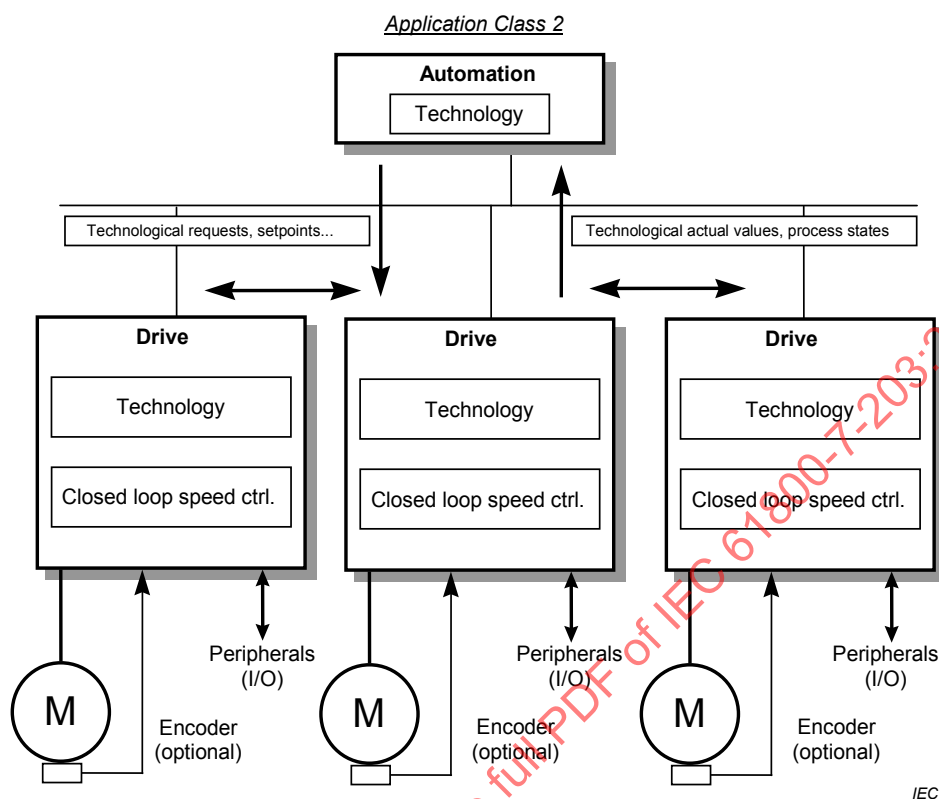
**Figure 16 – Classe d'application 1**

#### 6.1.5.3 AC 2: Dispositif d'entraînement classique avec contrôleur technologique réparti

La classe d'application 2 constitue une version très flexible de la mise en œuvre des applications d'entraînement (voir la Figure 17). Dans cette version, le processus d'automatisation est décomposé en plusieurs sous-processus de petite taille.

Les fonctions technologiques ne sont plus exclusivement dans le PLC central mais sont aussi réparties dans les dispositifs d'entraînement. L'interface de communication sert d'interface technologique. Les données échangées via le système de bus entre les composants individuels d'automatisation et les contrôleurs d'entraînement peuvent être définies individuellement. Cette variante suppose toutefois que la communication est assurée dans toutes les directions; c'est-à-dire qu'il convient que le transfert des données E-S de DO soit possible aussi entre les objets d'entraînement (Axe). Pour réaliser des applications comme des cascades de point de consigne, des enrouleurs et un synchronisme de vitesse, il convient

que le fonctionnement synchrone de l'horloge soit possible. Les fonctions technologiques sont réalisées dans le dispositif d'entraînement.

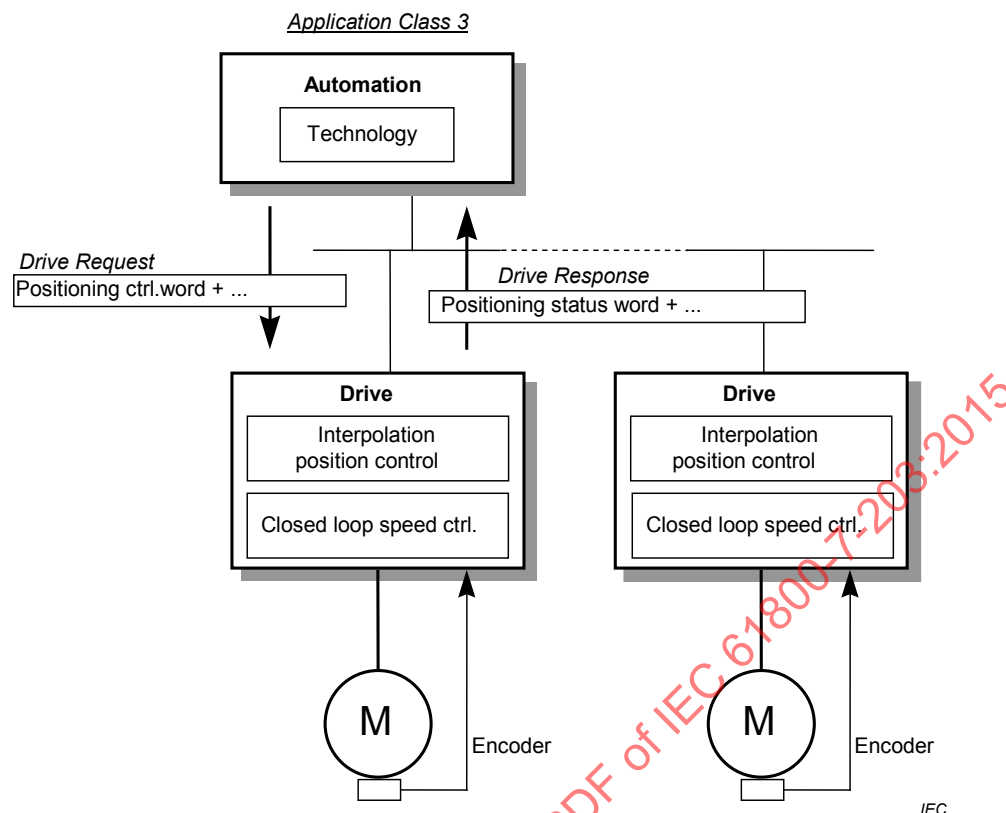


| Anglais                                     | Français                                                |
|---------------------------------------------|---------------------------------------------------------|
| Application Class 2                         | Classe d'application 2                                  |
| Automation                                  | Automatisation                                          |
| Technology                                  | Technologie                                             |
| Technological requests, setpoints...        | Demandes technologiques, points de consigne             |
| Technological actual values, process states | Valeurs instantanées technologiques, états de processus |
| Drive                                       | Dispositif d'entraînement                               |
| Closed loop speed ctrl.                     | Commande de vitesse en boucle fermée                    |
| Peripherals (I/O)                           | Périphériques (E/S)                                     |
| Encoder (optional)                          | Codeur (facultatif)                                     |

**Figure 17 – Classe d'application 2**

#### 6.1.5.4 AC 3: Dispositif d'entraînement de positionnement à un seul axe, avec commande de mouvement locale

Dans la classe d'application 3 (voir la Figure 18), seules les fonctions technologiques pour le processus d'automatisation sont encore dans le PLC. Les demandes de positionnement sont archivées dans le dispositif d'entraînement. Une demande de positionnement unique est lancée via une commande à partir du contrôleur (par exemple PLC). Le contrôle de l'interpolation et l'asservissement de position ainsi que la commande de vitesse sont mis en œuvre directement dans le dispositif d'entraînement. Dans la mesure où dans cette variante, tous les algorithmes de contrôle critiques dans le temps sont dissimulés dans le contrôleur d'entraînement, le fonctionnement synchrone de l'horloge n'est nécessaire que si la localisation complexe pour des axes multiples doit être coordonnée.



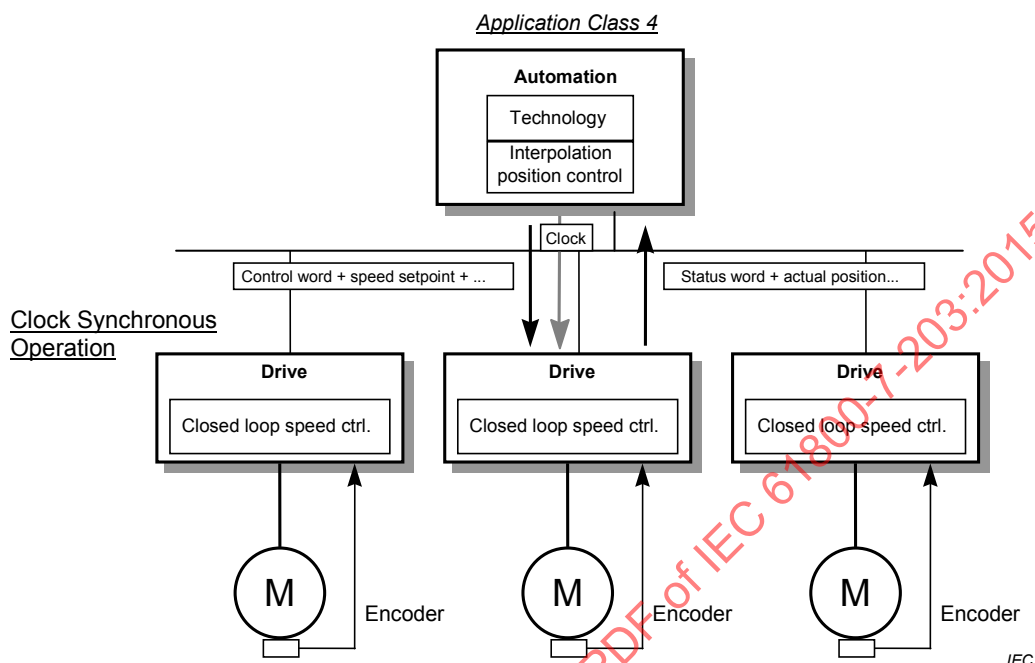
| Anglais                        | Français                                   |
|--------------------------------|--------------------------------------------|
| Application Class 3            | Classe d'application 3                     |
| Automation                     | Automatisation                             |
| Technology                     | Technologie                                |
| Drive request                  | Demande d'entraînement                     |
| Positioning ctrl.word + ...    | Mot de commande de positionnement + ...    |
| Drive response                 | Réponse du dispositif d'entraînement       |
| Positioning status word + ...  | Mot d'état de positionnement + ...         |
| Drive                          | Dispositif d'entraînement                  |
| Interpolation position control | Asservissement de position d'interpolation |
| Closed loop speed Ctrl.        | Commande de vitesse en boucle fermée       |
| Encoder                        | Codeur                                     |

**Figure 18 – Classe d'application 3**

#### 6.1.5.5 AC 4: Commande de mouvement avec interpolation centrale et interface de point de consigne de vitesse

La classe d'application 4 (voir la Figure 19) montre la commande en boucle fermée de position fermée via le système de communication. Les dispositifs d'entraînement pour les applications télécommandées et robotiques exigent souvent une séquence de mouvement coordonnée de plusieurs systèmes d'entraînement. La commande de mouvement est principalement mise en œuvre via une unité d'automatisation centrale (NC). Pour chaque dispositif d'entraînement, ces contrôleurs calculent les profils spéciaux de point de consigne. En coordonnant plusieurs dispositifs d'entraînement (par exemple pour l'axe XYZ), certaines trajectoires peuvent être appliquées. En plus des fonctions technologiques exigées pour le processus d'automatisation, le système d'automatisation comprend aussi les fonctions pour l'interpolation et l'asservissement de position du dispositif d'entraînement. Les valeurs de point de consigne de vitesse et les valeurs instantanées ainsi que la valeur instantanée de position sont transférées via l'échange de données cycliques. Le contrôleur d'entraînement comprend pour l'essentiel seulement les algorithmes utilisés pour la commande de vitesse en

boucle fermée et l'acquisition en position réelle. Dans la mesure où la position est contrôlée via le système de bus, le fonctionnement synchrone de l'horloge est nécessaire et doit être très précis. De plus, la fonctionnalité DSC peut être utilisée pour augmenter la rigidité et la réponse dynamique de la boucle d'asservissement.

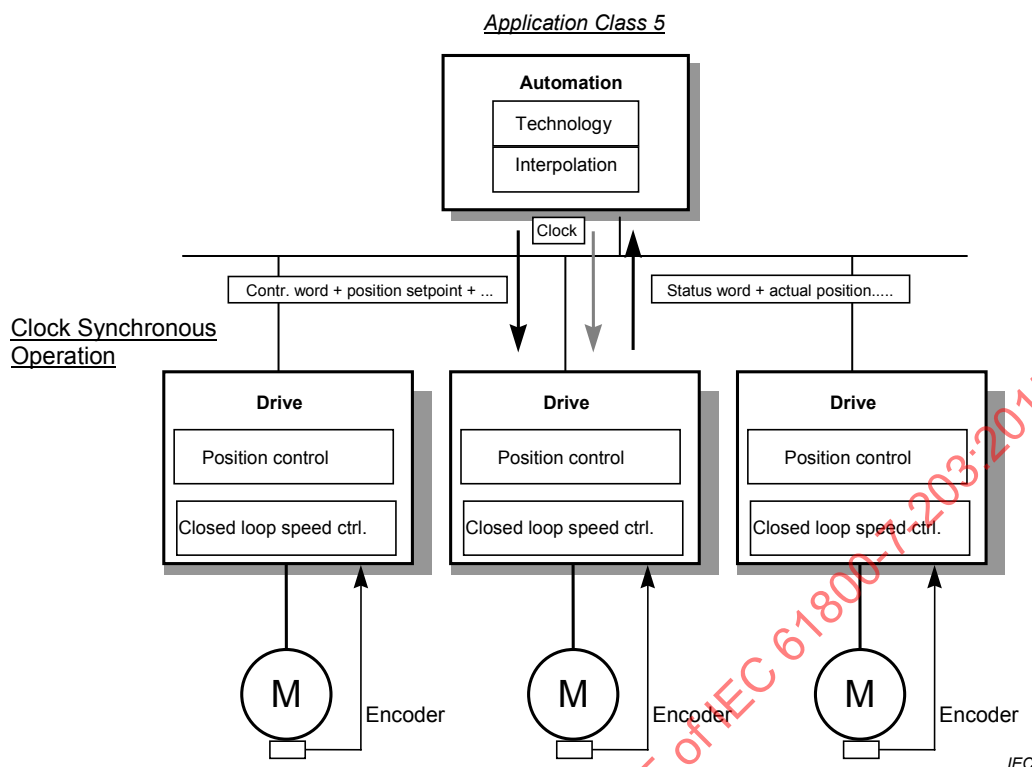


| Anglais                             | Français                                             |
|-------------------------------------|------------------------------------------------------|
| Application Class 4                 | Classe d'application 4                               |
| Automation                          | Automatisation                                       |
| Technology                          | Technologie                                          |
| Interpolation position control      | Asservissement de position d'interpolation           |
| Clock                               | Horloge                                              |
| Clock Synchronous Operation         | Fonctionnement synchrone de l'horloge                |
| Control word + speed setpoint + ... | Mot de commande + point de consigne de vitesse + ... |
| Status word + actual position...    | Mot d'état + position réelle...                      |
| Drive                               | Entraînement                                         |
| Closed loop speed Ctrl.             | Commande de vitesse en boucle fermée                 |
| Encoder                             | Codeur                                               |

**Figure 19 – Classe d'application 4**

#### 6.1.5.6 AC 5: Commande de mouvement avec interpolation centrale et interface de point de consigne de position

La classe d'application 5 (voir la Figure 20) n'est pas traitée dans cette version du profil PROFIdrive. Les caractéristiques dynamiques de la classe d'application 5 peuvent être obtenues avec la classe d'application 4 associée à un DSC.

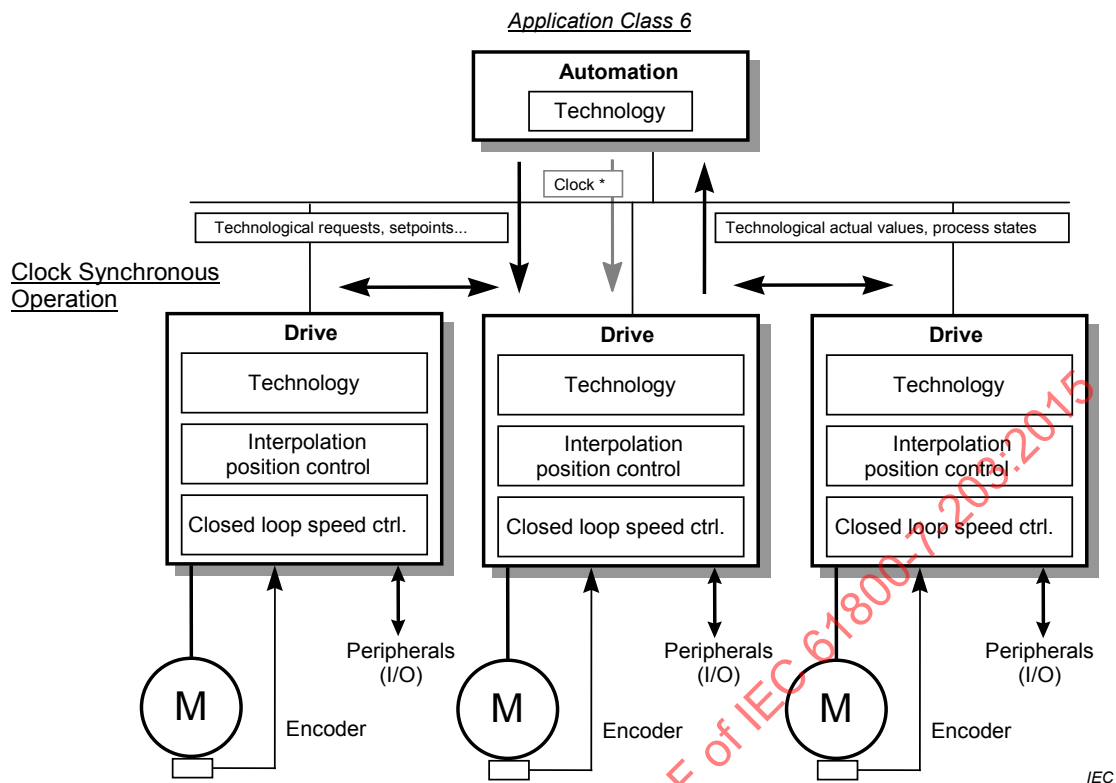


| Anglais                                | Français                                              |
|----------------------------------------|-------------------------------------------------------|
| Application Class 5                    | Classe d'application 5                                |
| Automation                             | Automatisation                                        |
| Technology                             | Technologie                                           |
| Clock                                  | Horloge                                               |
| Clock Synchronous Operation            | Fonctionnement synchrone de l'horloge                 |
| Control word + position setpoint + ... | Mot de commande + point de consigne de position + ... |
| Status word + actual position...       | Mot d'état + position réelle...                       |
| Drive                                  | Dispositif d'entraînement                             |
| Closed loop speed Ctrl.                | Commande de vitesse en boucle fermée                  |
| Encoder                                | Codeur                                                |
| Position control                       | Asservissement de position                            |

Figure 20 – Classe d'application 5

#### 6.1.5.7 AC 6: Commande de mouvement pour processus cadencés ou synchronisme angulaire réparti

Pour réaliser des applications comme un engrenage électrique, un disque à came, un fonctionnement synchrone angulaire, une coupe à la volée, un échange de données cycliques et un fonctionnement synchrone de l'horloge entre les dispositifs sont nécessaires. Ces applications sont normalement réalisées avec un dispositif d'entraînement maître et plusieurs dispositifs d'entraînement esclaves (voir la Figure 21). Le terme "dispositif d'entraînement maître" signifie dans ce contexte qu'un axe d'entraînement fournit les informations de processus (par exemple, une valeur instantanée de position) aux autres dispositifs d'entraînement. À ce sujet, les dispositifs d'entraînement esclaves coordonnent leur propre processus de mouvement avec les informations de processus du dispositif d'entraînement maître.



| Anglais                                     | Français                                                |
|---------------------------------------------|---------------------------------------------------------|
| Application Class 6                         | Classe d'application 6                                  |
| Automation                                  | Automatisation                                          |
| Technology                                  | Technologie                                             |
| Clock                                       | Horloge                                                 |
| Clock Synchronous Operation                 | Fonctionnement synchrone de l'horloge                   |
| Technological requests, setpoints...        | Demandes technologiques, points de consigne...          |
| Technological actual values, process states | Valeurs instantanées technologiques, états de processus |
| Drive                                       | Dispositif d'entraînement                               |
| Closed loop speed Ctrl.                     | Commande de vitesse en boucle fermée                    |
| Encoder                                     | Codeur                                                  |
| Interpolation position control              | Asservissement de position d'interpolation              |
| Peripherals (I/O)                           | Périphériques (E/S)                                     |

**Figure 21 – Classe d'application 6**

## 6.2 Modèle de paramètres

### 6.2.1 Définition de paramètres

#### 6.2.1.1 Généralités

Un paramètre représente une mémoire d'informations qui est constituée des éléments définis dans le Tableau 16:



**Tableau 16 – Définition des paramètres**

| Élément                                                     | Signification                                                                                                                                     |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Valeur de paramètre (PWE)<br>(se reporter à 6.2.1.2)        | Comprend la ou les variables d'information                                                                                                        |
| Description des paramètres (PBE)<br>(se reporter à 6.2.1.3) | Spécifie un paramètre                                                                                                                             |
| Texte<br>(se reporter à 6.2.1.4)                            | Est utilisé pour prendre en charge la visualisation et contient une description générale de la fonction de paramètre ou de la valeur de paramètre |

Le total de tous les paramètres d'un dispositif d'entraînement décrit de manière unique son comportement ou ses caractéristiques.

Un numéro de paramètre est affecté à chaque paramètre. La plage des numéros des paramètres est spécifiée pour les décimales 1 à 65 535. Le paramètre 0 n'est pas autorisé. Les paramètres spécifiques au profil sont spécifiés ou réservés pour les décimales de 900 à 999 et de 60 000 à 65 535 (se reporter à 0). Les paramètres spécifiques au profil doivent être mis en œuvre de façon exactement conforme à la définition donnée en 0, même si une description des paramètres est mise en œuvre dans le dispositif d'entraînement.

L'accès aux paramètres (valeur de paramètre, description de paramètre ou texte) est expliqué en 6.2.3.

#### **6.2.1.2 Valeur de paramètre**

La valeur de paramètre contient une seule variable d'information (variable simple) ou plusieurs variables similaires (matrice).

Une matrice est constituée de  $n$  éléments du même type de données qui peuvent être traités individuellement avec les sous-index de 0 à  $n-1$ .

#### **6.2.1.3 Description des paramètres**

La description des paramètres contient des informations pertinentes sur le paramètre respectif. Le Tableau 17 montre la structure de la description des paramètres qui est traitée dans le présent paragraphe.

**Tableau 17 – Éléments de description des paramètres**

| Sous-index | Signification                                      | Type de données<br>(se reporter à l'Article 5) |
|------------|----------------------------------------------------|------------------------------------------------|
| 1          | Identificateur (ID)                                | V2                                             |
| 2          | Nombre d'éléments de matrice ou longueur de chaîne | Unsigned 16                                    |
| 3          | Facteur de normalisation                           | Virgule flottante                              |
| 4          | Attribut de variable                               | OctetString 2                                  |
| 5          | Réservé                                            | OctetString 4                                  |
| 6          | Nom                                                | VisibleString 16                               |
| 7          | Limite inférieure                                  | OctetString 4                                  |
| 8          | Limite supérieure                                  | OctetString 4                                  |
| 9          | Réservé                                            | OctetString 2                                  |
| 10         | Extension d'ID                                     | V2                                             |
| 11         | Paramètre de référence de DONNEES E-S de DO        | Unsigned 16                                    |
| 12         | Normalisation de DONNÉES E-S de DO                 | V2                                             |
| 0          | Description complète                               | OctetString 46                                 |

#### Identificateur (sous-index 1)

Les caractéristiques supplémentaires des paramètres sont archivées dans l'ID (voir le Tableau 18).

Valeur du bit = "0" signifie: "le paramètre ne possède pas cet attribut".

Valeur du bit = "1" signifie: "le paramètre possède cet attribut".

**Tableau 18 – Éléments de description des paramètres "Identificateur (ID)"**

| Bit   | Signification                                                                                             | Explication                                                                                                                                                                                                                       |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 à 7 | Identificateur numérique de type de données de la valeur de paramètre (voir le Tableau 1 et le Tableau 2) |                                                                                                                                                                                                                                   |
| 8     | Facteur de normalisation et attribut de variable non pertinents                                           | Ce bit est défini si pour les types de données des paramètres, des valeurs physiques peuvent ne pas être calculées, par exemple pour la chaîne de type de données.                                                                |
| 9     | Paramètre non accessible en écriture                                                                      |                                                                                                                                                                                                                                   |
| 10    | Matrice de texte supplémentaire disponible                                                                |                                                                                                                                                                                                                                   |
| 11    | Réservé                                                                                                   |                                                                                                                                                                                                                                   |
| 12    | Le paramètre a été modifié par rapport aux réglages en usine                                              | Ce bit est défini si la valeur de paramètre est différente des réglages en usine. Il est réinitialisé si la valeur de paramètre est identique aux réglages en usine.                                                              |
| 13    | La valeur de paramètre ne peut être que réinitialisée                                                     | Si ce bit est défini, la valeur de paramètre associée est augmentée exclusivement par traitement interne, alors qu'en externe, il n'est possible de régler la valeur du bit que sur "0" (par exemple, "différences temporelles"). |
| 14    | Matrice                                                                                                   |                                                                                                                                                                                                                                   |
| 15    | Réservé                                                                                                   |                                                                                                                                                                                                                                   |

### Nombre d'éléments de matrice ou longueur de chaîne (sous-index 2)

Dans le cas des paramètres de matrice, le nombre d'éléments est déterminé ici. Dans le cas des paramètres du type chaîne, la longueur de la chaîne est déterminée ici. Les paramètres de chaîne doivent utiliser les types de données OctetString ou VisibleString et correspondent à une matrice d'octets. Il n'est pas possible de former une matrice des types de données OctetString ou VisibleString.

### Facteur de normalisation (sous-index 3)

C'est le facteur qui permet de convertir la valeur (interne) en variable normalisée (externe) qui, avec l'unité, correspond à la représentation physique du paramètre. Le type de données du facteur de normalisation est Floating Point.

### Attribut de variable (sous-index 4)

Un index variable (voir le Tableau 20 et le Tableau 22) et un index de conversion (voir le Tableau 21 et le Tableau 23) sont indiqués dans l'attribut de variable (voir le Tableau 19).

**Tableau 19 – Éléments de description des paramètres "attribut de variable"**

| Octet 1        | Octet 2                                        |
|----------------|------------------------------------------------|
| index variable | index de conversion<br>(Facteur A, décalage B) |

L'index variable représente le codage fixe de la variable physique (et donc de l'unité de base) de la valeur de paramètre. L'index variable est du type de données Unsigned 8.

L'index de conversion représente le codage fixe du facteur de conversion (A) et du décalage (B) d'une valeur de paramètre. Avec l'index de conversion, l'unité peut être convertie en unité de base. L'index de conversion est du type de données Integer 8. Voir l'exemple 1 ci-dessous.

EXEMPLE 1 attribut de variable = 13/-3 (0x0DFD)

- Index variable = 13 -> variable physique "vitesse", unité de base "mètre/seconde"
- Index de conversion = -3 -> unité "millimètre/seconde" (facteur A=0,001, décalage B=0)

Autres exemples: Représentation externe (au moyen d'un facteur de normalisation, attribut de variable)

Les valeurs suivantes s'appliquent:

- Valeur physique (dans l'unité) = valeur transmise × facteur de normalisation × unité

ou

- Valeur physique (dans l'unité de base) = (valeur transmise × facteur de normalisation × A + B) × unité de base

Codage de l'index variable et de l'index de conversion (Facteur A, décalage B), voir le Tableau 20, le Tableau 21, le Tableau 22 et le Tableau 23.

EXEMPLE 2

- Type de données: Integer 16
- Valeur de transmission: 500
- Facteur de normalisation: 1,0
- Index variable: 21 -> variable physique "Tension électrique", unité de base "Volt"

- Index de conversion: -3                      -> unité "Millivolt" (Facteur A=0,001, décalage B=0)
  - > Valeur physique (dans l'unité)                      =  $500 \times 1,0 \text{ mV} = 500 \text{ mV}$
  - > Valeur physique (dans l'unité de base)                      =  $(500 \times 1,0 \times 0,001 + 0) \text{ V} = 0,5 \text{ V}$

#### EXEMPLE 3

- Type de données: Unsigned16
- Valeur de transmission: 1 234
- Facteur de normalisation: 0,01
- Index variable: 13                      -> variable physique "Vitesse", unité de base "mètre/seconde"
- Index de conversion: 73                      -> unité "Kilomètre/Heure" (Facteur A=1 000/3 600, Décalage B=0)
  - > Valeur physique (dans l'unité)                      =  $1\,234 \times 0,01 \text{ km/h} = 12,34 \text{ km/h}$
  - > Valeur physique (dans l'unité de base) =  $(1\,234 \times 0,01 \times 1\,000/3\,600 + 0) \text{ m/s} = 3,428 \text{ m/s}$

#### EXEMPLE 4

- Type de données N2 -> 100 % correspond à  $2^{14}$ .
- Valeur de transmission: 8 043
- Facteur de normalisation: 0,006 1 ( $100/2^{14}$ )
- Index variable: 24                      -> variable physique "Rapport", unité de base "Pourcentage"
- Index de conversion: 0 -> unité = unité de base "Pourcentage" (Facteur A=1, Décalage B=0)
  - > Valeur physique                      =  $8\,043 \times 0,006\,1 \% = 49,1 \%$

NOTE Dans le cas des types de données N2, N4 ou X2, X4 ou de façon facultative Integer16, Integer32, Floating Point (variables normalisées), l'unité % peut être convertie en une autre unité physique en affectant un paramètre de référence physique (voir ci-dessous, paramètre de référence des données E-S de DO de l'élément de description).

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**Tableau 20 – Index variable et index de conversion pour les unités SI**

| Variable physique   | Index variable | Unité                                                                             | Abréviation                                                      | Index de conversion             |
|---------------------|----------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------|
|                     | 0              | Sans dimensions                                                                   |                                                                  | 0                               |
| Longueur            | 1              | Mètre<br>Millimètre<br>Kilomètre<br>Micromètre                                    | m<br>mm<br>km<br>µm                                              | 0<br>-3<br>3<br>-6              |
| Surface             | 2              | Mètre carré<br>Millimètre carré<br>Kilomètre carré                                | m <sup>2</sup><br>mm <sup>2</sup><br>km <sup>2</sup>             | 0<br>-6<br>6                    |
| Volume              | 3              | Mètre cube<br>Litre                                                               | m <sup>3</sup><br>l                                              | 0<br>-3                         |
| Temps               | 4              | Seconde<br>Minute<br>Heure<br>Jour<br>Milliseconde<br>Microseconde                | s<br>min<br>h<br>d<br>ms<br>µs                                   | 0<br>70<br>74<br>77<br>-3<br>-6 |
| Force               | 5              | Newton<br>Kilonewton<br>Méganewton                                                | N<br>kN<br>MN                                                    | 0<br>3<br>6                     |
| Pression            | 6              | Pascal<br>Kilopascal<br>Millibar<br>Bar                                           | Pa<br>kPa<br>mbar<br>bar                                         | 0<br>3<br>2<br>5                |
| Masse               | 7              | Kilogramme<br>Gramme<br>Milligramme<br>Tonne                                      | kg<br>g<br>mg<br>t                                               | 0<br>-3<br>-6<br>3              |
| Énergie, travail    | 8              | Joule<br>Kilojoule<br>Mégajoule<br>Watt heure<br>Kilowatt-heure<br>Mégawatt heure | J<br>kJ<br>MJ<br>Wh<br>kWh<br>MWh                                | 0<br>3<br>6<br>74<br>75<br>76   |
| Puissance efficace  | 9              | Watt<br>Kilowatt<br>Mégawatt<br>Milliwatt                                         | W<br>kW<br>MW<br>mW                                              | 0<br>3<br>6<br>-3               |
| Puissance apparente | 10             | Voltampère<br>Kilovoltampère<br>Mégavoltampère<br>Millivoltampère                 | VA<br>kVA<br>MVA<br>mVA                                          | 0<br>3<br>6<br>-3               |
| Vitesse             | 11             | 1/seconde<br>1/minute<br>1/heure                                                  | s <sup>-1</sup><br>r/min (min <sup>-1</sup> )<br>h <sup>-1</sup> | 0<br>67<br>72                   |
| Angle               | 12             | Radian<br>Seconde<br>Minute<br>Degrés (sexagésimaux)<br>Degrés décimaux (Grades)  | rad<br>"<br>'<br>°<br>g                                          | 0<br>79<br>78<br>80<br>81       |

| Variable physique                           | Index variable | Unité                             | Abréviation         | Index de conversion |
|---------------------------------------------|----------------|-----------------------------------|---------------------|---------------------|
| Vitesse                                     | 13             | Mètre/seconde                     | m/s                 | 0                   |
|                                             |                | Millimètre/seconde                | mm/s                | -3                  |
|                                             |                | Millimètre/minute                 | mm/min              | 66                  |
|                                             |                | Mètre/minute                      | m/min               | 67                  |
|                                             |                | Kilomètre/minute                  | km/min              | 68                  |
|                                             |                | Millimètre/heure                  | mm/h                | 71                  |
|                                             |                | Mètre/heure                       | m/h                 | 72                  |
|                                             |                | Kilomètre/heure                   | km/h                | 73                  |
| Débit volumique                             | 14             | Mètre cube/seconde                | m <sup>3</sup> /s   | 0                   |
|                                             |                | Mètre cube/minute                 | m <sup>3</sup> /min | 67                  |
|                                             |                | Mètre cube/heure                  | m <sup>3</sup> /h   | 72                  |
|                                             |                | Litre/seconde                     | l/s                 | -3                  |
|                                             |                | Litre/minute                      | l/min               | 66                  |
|                                             |                | Litre/heure                       | l/h                 | 71                  |
| Débit massique                              | 15             | Kilogramme/seconde                | kg/s                | 0                   |
|                                             |                | Gramme/seconde                    | g/s                 | -3                  |
|                                             |                | Tonne/seconde                     | t/s                 | 3                   |
|                                             |                | Gramme/minute                     | g/min               | 66                  |
|                                             |                | Kilogramme/minute                 | kg/min              | 67                  |
|                                             |                | Tonne/minute                      | t/min               | 68                  |
|                                             |                | Gramme/heure                      | g/h                 | 71                  |
|                                             |                | Kilogramme/heure                  | kg/h                | 72                  |
|                                             |                | Tonne/heure                       | t/h                 | 73                  |
| Couple                                      | 16             | Newton mètre                      | Nm                  | 0                   |
|                                             |                | Kilonewton mètre                  | kNm                 | 3                   |
|                                             |                | Méganewton mètre                  | MNm                 | 6                   |
| Température                                 | 17             | Kelvin                            | K                   | 0                   |
|                                             |                | Degrés Celsius                    | °C                  | 100                 |
|                                             |                | Degrés Fahrenheit                 | °F                  | 101                 |
| Différence de température                   | 18             | Kelvin                            | K                   | 0                   |
| Entropie                                    | 19             | Joule / (Kelvin x Kilogramme)     | J/(K x kg)          | 0                   |
|                                             |                | Kilojoule / (Kelvin x Kilogramme) | kJ/(K x kg)         | 3                   |
|                                             |                | Mégajoule / (Kelvin x Kilogramme) | MJ/(K x kg)         | 6                   |
| Enthalpie                                   | 20             | Joule/Kilogramme                  | J/kg                | 0                   |
|                                             |                | Kilojoule/Kilogramme              | kJ/kg               | 3                   |
|                                             |                | Mégajoule/Kilogramme              | MJ/kg               | 6                   |
| Tension électrique<br>valeur efficace vraie | 21             | Volt                              | V                   | 0                   |
|                                             |                | Kilovolt                          | kV                  | 3                   |
|                                             |                | Millivolt                         | mV                  | -3                  |
|                                             |                | Microvolt                         | µV                  | -6                  |
| Courant électrique                          | 22             | Ampère                            | A                   | 0                   |
|                                             |                | Milliampère                       | mA                  | -3                  |
|                                             |                | Kiloampère                        | kA                  | 3                   |
|                                             |                | Microampère                       | µA                  | -6                  |
| Résistance électrique                       | 23             | Ohm                               | Ω                   | 0                   |
|                                             |                | Milliohm                          | mΩ                  | -3                  |
|                                             |                | Kiloohm                           | kΩ                  | 3                   |
|                                             |                | Mégaohm                           | MΩ                  | 6                   |
| Rapport                                     | 24             | Pourcentage                       | %                   | 0                   |
| Humidité relative                           | 25             | Pourcentage                       | %                   | 0                   |
| Humidité absolue                            | 26             | Gramme/Kilogramme                 | g/kg                | -3                  |
| Changement relatif                          | 27             | Pourcentage                       | %                   | 0                   |

| Variable physique                                   | Index variable                    | Unité                                                                                              | Abréviation                     | Index de conversion        |
|-----------------------------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------|----------------------------|
| Fréquence                                           | 28                                | Hertz<br>Kilohertz<br>Mégahertz<br>Gigahertz                                                       | Hz<br>kHz<br>Mhz<br>GHz         | 0<br>3<br>6<br>9           |
| Couple par unité                                    | 29                                | Newton mètre/Ampère                                                                                | Nm/A                            | 0                          |
| Puissance (US)                                      | 30                                | Cheval-vapeur                                                                                      | hp                              | 0                          |
| Accélération                                        | 31                                | Mètre/(seconde <sup>2</sup> )                                                                      | m/s <sup>2</sup>                | 0                          |
| À coups                                             | 32                                | Mètre/(seconde <sup>3</sup> )                                                                      | m/s <sup>3</sup>                | 0                          |
| Débit en bauds                                      | 33                                | Bit/seconde                                                                                        | bit/s                           | 0                          |
| Vitesse angulaire                                   | 34                                | Radian/seconde<br>Radian/minute<br>Radian/heure                                                    | rad/s<br>rad/min<br>rad/h       | 0<br>67<br>72              |
| Pas de vis sans fin                                 | 35                                | Millimètre/révolution<br>Mètre/révolution                                                          | mm/rév<br>m/rév                 | -3<br>0                    |
| Inertie                                             | 36                                | Kilogramme (mètre) <sup>2</sup>                                                                    | kgm <sup>2</sup>                | 0                          |
| Capacité                                            | 37                                | Farad<br>Millifarad<br>Microfarad<br>Nanofarad<br>Picofarad                                        | f<br>mF<br>μF<br>nF<br>pF       | 0<br>-3<br>-6<br>-9<br>-12 |
| Inductance                                          | 38                                | Henry<br>Millihenry                                                                                | H<br>mH                         | 0<br>-3                    |
| <b>Constante de force, amplification</b>            |                                   |                                                                                                    |                                 |                            |
| "Kt" linéaire                                       | 39                                | Newton/Ampère                                                                                      | N/A                             | 0                          |
| "Kt" rotatif                                        | Voir: 29<br>Couple par unité      |                                                                                                    |                                 |                            |
| Gain de commande de vitesse "Kp" (rotatif)          | 40                                | Newton mètre/(1/minute)                                                                            | Nm/(1/min)                      | 70                         |
| Gain de commande de vitesse "Kp" (linéaire)         | 41                                | Newton/(mètre/seconde)                                                                             | N/(m/s)                         | 0                          |
| "adaptation de la vitesse Kp" (uniquement rotative) | 42                                | (1/minute)/(Volt x Ampère x seconde)                                                               | (1/min)/VAs                     | 67                         |
| Gain d'asservissement de position "Kv"              | 43                                | Mètre/millimètre/minute<br>1/seconde                                                               | m/mm/min<br>(=1 000/min)<br>1/s | 68<br>0                    |
| Gain de contrôle de flux "Kf"                       | 44                                | Ampère/Volt seconde                                                                                | A/Vs                            | 0                          |
| Gain de contrôle de courant "Ki"                    | voir: 23<br>Résistance électrique |                                                                                                    |                                 |                            |
| Conductance électrique                              | 50                                | Siemens<br>Millisiemens<br>Kilosiemens                                                             | 1S=1/Ω<br>1mS=1/kΩ<br>1kS=1/mΩ  | 0<br>-3<br>3               |
| Flux magnétique                                     | 51                                | Volt seconde                                                                                       | 1Vs                             | 0                          |
| Tension électrique valeur crête à crête             | 52                                | Volt crête à crête<br>Kilovolt crête à crête<br>Millivolt crête à crête<br>Microvolt crête à crête | Vpp<br>kVpp<br>mVpp<br>μVpp     | 0<br>3<br>-3<br>-6         |
| Tension électrique valeur effective                 | 53                                | Volt effectif<br>Kilovolt effectif<br>Millivolt effectif<br>Microvolt effectif                     | Veff<br>kVeff<br>mVeff<br>μVeff | 0<br>3<br>-3<br>-6         |

| Variable physique                               | Index variable | Unité                               | Abréviation | Index de conversion |
|-------------------------------------------------|----------------|-------------------------------------|-------------|---------------------|
| Tension électrique<br>valeur en courant continu | 54             | Volt valeur en courant continu      | Vdc         | 0                   |
|                                                 |                | Kilovolt valeur en courant continu  | kVdc        | 3                   |
|                                                 |                | Millivolt valeur en courant continu | mVdc        | -3                  |
|                                                 |                | Microvolt valeur en courant continu | μVdc        | -6                  |
| Défini par l'utilisateur                        | 254            | Sans dimensions                     |             | 0                   |

**Tableau 21 – Valeurs de conversion pour l'index de conversion (unités SI)**

| Index de conversion | A (facteur de conversion)   | 1/A (facteur de conversion inverse) | B (décalage) |
|---------------------|-----------------------------|-------------------------------------|--------------|
| 0                   | 1,0 E+0                     | 1,0 E+0                             | 0            |
| 1                   | 10 = 1,0 E+1                | 1,0 E-1                             | 0            |
| 2                   | 100 = 1,0 E+2               | 1,0 E-2                             | 0            |
| 3                   | 1 000 = 1,0 E+3             | 1,0 E-3                             | 0            |
| etc.                |                             |                                     |              |
|                     |                             |                                     |              |
| -1                  | 0,1 = 1,0 E-1               | 1,0 E+1                             | 0            |
| -2                  | 0,01 = 1,0 E-2              | 1,0 E+2                             | 0            |
| -3                  | 0,001 = 1,0 E-3             | 1,0 E+3                             | 0            |
| etc.                |                             |                                     |              |
|                     |                             |                                     |              |
| 66                  | 1,0 E-3/60 = 1,667 E-5      | 6,000 E+4                           | 0            |
| 67                  | 1/60 = 1,667 E-2            | 6,000 E+1                           | 0            |
| 68                  | 1,0 E+3/60 = 1,667 E+1      | 6,000 E-2                           | 0            |
| 69                  |                             |                                     | 0            |
| 70                  | 60                          | 1,667 E-2                           | 0            |
| 71                  | 1,0 E-3/3 600 = 2,778 E-7   | 3,6 E+6                             | 0            |
| 72                  | 1/3 600 = 2,778 E-4         | 3,6 E+3                             | 0            |
| 73                  | 1,0 E+3/3 600 = 2,778 E-1   | 3,6                                 | 0            |
| 74                  | 3 600                       | 1/3 600 = 2,778 E-4                 | 0            |
| 75                  | 3 600 x 1,0 E+3 = 3,600 E+6 | 2,778 E-7                           | 0            |
| 76                  | 3 600 x 1,0 E+6 = 3,600 E+9 | 2,778 E-10                          | 0            |
| 77                  | 86 400                      | 1/86 400 = 1,157 E-5                | 0            |
| 78                  | $\pi/10\,800 = 2,909\,E-4$  | 3,438 E+3                           | 0            |
| 79                  | $\pi/648\,000 = 4,848\,E-6$ | 2,063 E+5                           | 0            |
| 80                  | $\pi/180 = 1,745\,E-2$      | 5,730 E+1                           | 0            |
| 81                  | $\pi/200 = 1,571\,E-2$      | 6,366 E+1                           | 0            |
|                     |                             |                                     |              |
| 100                 | 1                           | 1                                   | +273,15      |
| 101                 | 5/9 = 0,555 6               | 1,8                                 | +459,67      |



**Tableau 22 – Index variable et index de conversion pour les unités US**

| Variable physique    | Index variable | Unité                                                                                                                                                                   | Abréviation                                                         | Index de conversion                |
|----------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------|
| Longueur US          | 100            | Millième de pouce<br>Pouce (= 0,025 4 m)<br>Pied (= 0,304 8 m)<br>Yard (= 0,914 4 m)<br>Mille (= 1 609,3 m)<br>1 ft = 12 po<br>1 yd = 3 ft = 36 po<br>1 mile = 1 760 yd | mil<br>po<br>ft<br>yd<br>mile                                       | -3<br>0<br>-70<br>-71<br>-72       |
| Surface US           | 101            | Pouce carré<br>Pied carré<br>Yard carré                                                                                                                                 | in <sup>2</sup><br>ft <sup>2</sup><br>yd <sup>2</sup>               | 0<br>-73<br>-74                    |
| Volume US 1          | 102            | Pouce cube<br>Pied cube<br>Yard cube                                                                                                                                    | in <sup>3</sup><br>ft <sup>3</sup><br>yd <sup>3</sup>               | 0<br>-76<br>-77                    |
| Volume US 2          | 103            | Gallon<br>(= 3,785 4 E-9 m <sup>3</sup> )                                                                                                                               | gal                                                                 | 0                                  |
| Vitesse US           | 104            | Pouce/seconde<br>Pouce/minute<br>Pied/seconde<br>Pied/minute<br>Mille/heure                                                                                             | en/s, IPS<br>en/min, IPM<br>ft/s, FPS<br>ft/min, FPM<br>mile/h, MPH | 0<br>67<br>-70<br>-80<br>-81       |
| Accélération US      | 105            | Pouce/(secondes <sup>2</sup> )<br>Pied/(secondes <sup>2</sup> )                                                                                                         | en/s <sup>2</sup><br>ft/s <sup>2</sup>                              | 0<br>-70                           |
| À coups US           | 106            | Pouce/(secondes <sup>3</sup> )<br>Pied/(secondes <sup>3</sup> )                                                                                                         | en/s <sup>3</sup><br>ft/s <sup>3</sup>                              | 0<br>-70                           |
| Débit volumique US 1 | 107            | Pouce cube/seconde<br>Pouce cube/minute<br>Pouce cube/heure                                                                                                             | en <sup>3</sup> /s<br>en <sup>3</sup> /min<br>en <sup>3</sup> /h    | 0<br>67<br>72                      |
| Débit volumique US 2 | 108            | Gallon/seconde<br>Gallon/minute<br>Gallon/heure                                                                                                                         | gal/s, GPS<br>gal/min, GPM<br>gal/h, GPH                            | 0<br>67<br>72                      |
| Masse US             | 109            | Once<br>Livre (= 0,453 6 kg)<br>1 lb = 16 oz                                                                                                                            | oz<br>lb                                                            | -90<br>0                           |
| Débit massique US    | 110            | Once/seconde<br>Once/minute<br>Once/heure<br>Livre/seconde<br>Livre/minute<br>Livre/heure                                                                               | oz/s<br>oz/min<br>oz/h<br>lb/s<br>lb/min<br>lb/h                    | -90<br>-91<br>-92<br>0<br>67<br>72 |
| Inertie US           | 111            | Once pouce carré<br>Livre pouce carré<br>Livre pied carré                                                                                                               | oz po <sup>2</sup><br>lb po <sup>2</sup><br>lb ft <sup>2</sup>      | -90<br>0<br>-73                    |
| Force US             | 112            | Livre-force<br>(= 4,448 22 N)                                                                                                                                           | lb f                                                                | 0                                  |
| Couple US            | 113            | Once pouce<br>Livre-force pouce<br>Livre force pied                                                                                                                     | oz po<br>lb f po, INLB<br>lb f ft, FTLB                             | -90<br>0<br>-70                    |
| Pression US          | 114            | Livre par pouce carré<br>(= 6 894,8 Pa)                                                                                                                                 | psi (lb/po <sup>2</sup> )                                           | 0                                  |
| "Kt" linéaire US     | 115            | Livre-force/ampère                                                                                                                                                      | lb f/A                                                              | 0                                  |

| Variable physique      | Index variable | Unité                                                                    | Abréviation                       | Index de conversion |
|------------------------|----------------|--------------------------------------------------------------------------|-----------------------------------|---------------------|
| "Kt" rotatif US        | 116            | Once pouce/ampère<br>Livre force pouce/ampère<br>Livre-force pied/ampère | oz po/A<br>lb f po/A<br>lb f ft/A | -90<br>0<br>-70     |
| "Kp" US                | 117            | Livre-force pouce seconde                                                | lb f po s                         | 0                   |
| "Kv" US                | pareil que SI  | Pouce/minute/millième de pouce                                           | po/min/mil<br>(=1 000/min)        | 68                  |
| Pas de vis sans fin US | 118            | Pouce/révolution                                                         | po/rev                            | 0                   |

**Tableau 23 – Valeurs de conversion  
pour l'index de conversion (unités US)**

| Index de conversion | A<br>(facteur de conversion)   | B<br>(décalage) |
|---------------------|--------------------------------|-----------------|
| -70                 | 12                             | 0               |
| -71                 | 36                             | 0               |
| -72                 | 63 360                         | 0               |
| -73                 | 144                            | 0               |
| -74                 | 1 296                          | 0               |
| -75                 | --                             | --              |
| -76                 | 1 728                          | 0               |
| -77                 | 46 656                         | 0               |
|                     |                                |                 |
| -80                 | $12/60 = 0,2$                  | 0               |
| -81                 | $63\,360/3\,600 = 176$         | 0               |
|                     |                                |                 |
| -90                 | $1/16 = 6,250\text{ E-}2$      | 0               |
| -91                 | $1/960 = 1,042\text{ E-}3$     | 0               |
| -92                 | $1/57\,600 = 1,736\text{ E-}5$ | 0               |

#### Nom (sous-index 6)

"Nom" décrit le nom symbolique du paramètre. Le nom est celui du type de données VisibleString avec une longueur de 16 octets.

#### Limite inférieure/supérieure (sous-index 7 et 8)

"Limite inférieure/supérieure" définit la plage des valeurs valide de la valeur de paramètre.

Le dispositif d'entraînement rejette une tentative d'affecter une valeur hors de la plage de valeur du paramètre. Les limites inférieure et supérieure sont du même type de données que la valeur de paramètre, mais la longueur des éléments de description est toujours 4 octets (format de fichier: justifié à droite, gros-boutiste). En ce qui concerne les paramètres dont les types de données n'autorisent pas de plage des valeurs (par exemple, VisibleString), le contenu de ces éléments de description n'a pas d'importance.

#### Extension ID (sous-index 10)

L'extension ID est réservée.

## Paramètre de référence des données E-S/normalisation des données E-S (sous-index 11 et 12)

Les valeurs de paramètre peuvent aussi être transmises en tant que données E-S (se référer à 6.3.4.4). Si des variables normalisées (types de données N2, N4 ou X2, X4 ou de façon facultative Integer16, Integer32, Floating Point) sont transmises, il est nécessaire, afin de calculer la valeur physique, de disposer de la valeur de référence physique (valeur de référence des données E-S) et le bit (se référer à la normalisation de données E-S) auquel fait référence la valeur de référence physique. Pour un exemple de calcul, se référer à 6.3.4.5.

Pour les paramètres du type de données X2, X4, les éléments de description "paramètre de référence de données E-S" et "normalisation de données E-S" doivent être disponibles.

Pour les paramètres du type de données N2, N4, les éléments de description "paramètre de référence de données E-S" doivent être disponibles et l'élément de description "normalisation de données E-S" est facultatif, comme cela est défini par le type de données.

Si les paramètres du type de données Integer8, Integer16, Integer32, Unsigned8, Unsigned16, Unsigned32 ou Floating Point sont transmis en tant que données E-S normalisées (avec l'unité "%"), les éléments de description "paramètre de référence de données E-S" et "normalisation de données E-S" doivent être disponibles (voir le Tableau 24). Si ces éléments de description sont transmis en tant que données non normalisées, ils ne doivent pas être disponibles.

Dans le cas de tous les autres types de données, ces éléments de description ne sont pas pertinents.

**Tableau 24 – Éléments de description de paramètre  
"Valeur de référence de données E-S/normalisation de données E-S"**

| Élément de description                                                                                                                                                                                                                                                | Contenu                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Paramètre de référence de données E-S                                                                                                                                                                                                                                 | 0 Aucune valeur de référence disponible <sup>b</sup>                               |
|                                                                                                                                                                                                                                                                       | 1 à 65 535 Numéro de paramètre de la valeur de référence <sup>c</sup>              |
| Normalisation de données E-S                                                                                                                                                                                                                                          | Bit 0 à 5 Bit de normalisation 0 à 31 <sup>a</sup> (la plage 32 à 63 est réservée) |
|                                                                                                                                                                                                                                                                       | Bit 6 à 14 réservé                                                                 |
|                                                                                                                                                                                                                                                                       | Bit 15 Normalisation valide                                                        |
| <sup>a</sup> Pour les paramètres dont les types de données sont N2, N4, le codage du bit de normalisation est fixe (14 et 30). Pour les paramètres normalisés dont le type de données est Floating Point, le codage du bit de normalisation n'est pas pertinent (=0). |                                                                                    |
| <sup>b</sup> La combinaison "aucune valeur de référence n'existe"/"normalisation valide" est autorisée.                                                                                                                                                               |                                                                                    |
| <sup>c</sup> Les paramètres utilisés pour les valeurs de référence ne sont pas à normaliser.                                                                                                                                                                          |                                                                                    |

## Description complète (sous-index 0)

La "description complète" comprend un champ total de 46 octets (qui correspond à l'ensemble de la structure de description de paramètre). La longueur est la constante de chaque paramètre (indépendamment du type de données, etc.). Si toute la description de paramètre est lue avec un seul accès, les éléments de description paramètre de référence de données E-S et normalisation de données E-S doivent être inclus.

### 6.2.1.4 Texte

Le texte d'une matrice de texte peut être affecté à un paramètre comme explication ou description supplémentaire. La longueur d'une ligne de texte indexée est de 16 octets (voir le Tableau 25).

**Tableau 25 – Matrice de texte pour la description de paramètre**

| Matrice de texte de sous-index | Texte                          |
|--------------------------------|--------------------------------|
| 0                              | Texte 0 (16 octets)            |
| 1                              | Texte 1 (16 octets)            |
| 2 – n                          | Texte 2 – n (16 octets chaque) |

L'existence d'une matrice de texte est indiquée dans la description de paramètre (ID: matrice de texte supplémentaire disponible). Le texte est archivé dans le type d'objet "matrice" du type de données "VisibleString 16" affecté au paramètre. Les matrices de texte peuvent être affectées aux paramètres dont le type d'objet est "matrice" (avec tout type de données) ou aux paramètres du type d'objet "simple variable" (avec type de données "Unsigned8/16/32", "Booléenne" ou "V2"). Les textes individuels d'une matrice de texte sont affectés aux éléments de matrice pour les paramètres du type "matrice" et affectés aux valeurs pour les paramètres du type "simple variable".

#### **Paramètre de matrice – matrice de texte**

Matrice de texte de sous-index == Paramètre de matrice de sous-index

#### **Unsigned8/16/32 – matrice de texte**

Matrice de texte de sous-index == valeur de paramètre (voir le Tableau 26)

$0 \leq \text{Valeur de paramètre} \leq 65\ 535$

#### **Booléen – matrice de texte**

Nombre de textes = 2

**Tableau 26 – Matrice de texte pour le type de données Booléen**

| Matrice de texte de sous-index | Valeur de paramètre |
|--------------------------------|---------------------|
| 0                              | faux ("false")      |
| 1                              | vrai ("true")       |

#### **V2 – matrice de texte**

Nombre de textes = 32

Pour chaque bit de la séquence de bits, deux textes sont affectés, un pour la valeur de bit "0" et un pour la valeur de bit "1" (voir le Tableau 27).

Matrice de texte de sous-index == Position binaire  $\times 2$  + Valeur de bit

$0 \text{ (LSB)} \leq \text{Position binaire} \leq 15 \text{ (MSB)}, 0 \leq \text{Valeur de Bit} \leq 1;$

**Tableau 27 – Matrice de texte pour le type de données V2 (séquence de bits)**

| Matrice de texte de sous-index | Valeur de paramètre |
|--------------------------------|---------------------|
| 0                              | ----- 0             |
| 1                              | ----- 1             |
| 2                              | ----- 0 -           |
| 3                              | ----- 1 -           |
| 4                              | ----- 0 --          |
| :                              | :                   |
| 30                             | 0 -----             |
| 31                             | 1 -----             |

### 6.2.2 Paramètres globaux et locaux

Comme défini en 6.1.3 et en 6.3.4.4, une unité d'entraînement est constituée du dispositif d'entraînement lui-même et d'un ou plusieurs objets d'entraînement (DO). Les axes d'entraînement sont liés aux DO de type axe.

Pour les unités d'entraînement multiaxe et modulaires, chaque DO a un emplacement dédié au numéro de paramètre.

Deux types de paramètres associés à différentes plages de valeurs sont définis dans le profil:

#### Paramètre global

Les paramètres globaux sont liés au dispositif complet (par exemple, paramètres liés à l'interface de communication). Si différents DO d'une unité d'entraînement sont traités, un paramètre global indique toujours la même valeur.

#### Paramètres spécifiques à l'axe/DO

Ces paramètres sont liés à l'objet d'entraînement. Les paramètres spécifiques à l'axe/DO peuvent avoir différentes valeurs dans chaque DO axe (par exemple le paramètre 967 "mot de commande 1").

La subdivision des paramètres en paramètres globaux et spécifiques à l'axe/DO est donnée en 6.4.

La Figure 22 donne un exemple avec le paramètre global 918 "adresse de nœud" et le paramètre spécifique à l'axe 944 "compteur de messages de défaut" pour une unité d'entraînement multiaxe ou modulaire. Une unité d'entraînement à un seul axe est similaire à l'unité d'entraînement multiaxe, mais seul le DO1 est présent.

| Multi-Axis / Modular Drive Unit |       |                  |       |                  |       |                  |       |
|---------------------------------|-------|------------------|-------|------------------|-------|------------------|-------|
| DO 1 (e.g. Axis)                |       | DO 2 (e.g. Axis) |       | DO 3 (e.g. Axis) |       | DO n (e.g. Axis) |       |
| PNU                             | Value | PNU              | Value | PNU              | Value | PNU              | Value |
| 1                               | ...   | 1                | ...   | 1                | ...   | 1                | ...   |
| 2                               | ...   | 2                | ...   | 2                | ...   | 2                | ...   |
| 91<br>8                         | 3     | 91<br>8          | 3     | 91<br>8          | 3     | 91<br>8          | 3     |
| 94<br>4                         | 12    | 94<br>4          | 3     | 94<br>4          | 7     | 94<br>4          | 4     |
|                                 |       | ...              | ...   | ...              | ...   | ...              | ...   |
|                                 |       | ...              | ...   | ...              | ...   | ...              | ...   |

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| Anglais                         | Français                                  |
|---------------------------------|-------------------------------------------|
| Multi-Axis / Modular Drive Unit | Unité d'entraînement multiaxe / modulaire |
| DO 1 (e.g. Axis)                | DO 1 (par exemple axe)                    |
| Value                           | Valeur                                    |

**Figure 22 – Exemple de présentation générale de paramètres globaux et locaux d'une unité d'entraînement multiaxe/modulaire**

La plage de valeurs des numéros ID de DO va de 0 à 254. Avec l'ID de DO 0, le dispositif d'entraînement peut être adressé (représentatif du dispositif, pas d'axe) et les paramètres globaux peuvent être lus. L'affectation des numéros d'axe d'entraînement aux DO est spécifique au dispositif et peut être lue du paramètre P978 "liste d'ID de module" (se référer à 6.3.4.4).

L'adressage est donné en 6.2.3.

### 6.2.3 Accès aux paramètres du mode de base

#### 6.2.3.1 Généralités

Le présent paragraphe définit l'accès aux paramètres via le "mode de base". Une langue de demande est définie pour l'accès. Les demandes et les réponses sont transmises de façon acyclique en utilisant le mécanisme d'"échange de données acycliques" du système de communication.

L'accès aux paramètres du mode de base existe pour des raisons de compatibilité dues à l'ancien profil PROFIdrive et chaque entraînement doit être capable de prendre en charge l'accès aux paramètres du mode de base (obligatoire).

#### 6.2.3.2 Caractéristiques générales

L'accès aux paramètres du mode de base présente les caractéristiques suivantes.

- Adresse de 16 bits pour chaque numéro de paramètre et chaque sous-index.
- Transmission des matrices complètes ou partielles ou description complète du paramètre.

- Transmission de différents paramètres par un seul accès (demandes multiparamètre). Il convient que le dispositif transmette le nombre maximal d'accès aux paramètres dans une demande de paramètre dans le paramètre facultatif P974.
- Traitement systématique d'un seul paramètre à la fois (pas d'exécution simultanée).
- Une demande de paramètre/réponse de paramètre doit s'ajuster dans un bloc de données (240 octets par défaut). Les demandes/réponses ne sont pas réparties sur plusieurs blocs de données. La longueur maximale des blocs de données peut être différente de 240 octets selon les caractéristiques du dispositif ou la configuration du bus. Avec PROFIBUS, la taille maximale de bloc est limitée à 240 octets, avec Profinet, la taille maximale de bloc est limitée à une longueur de données  $2^{32} - 65$  octets. Le dispositif doit transmettre la longueur maximale du bloc de demande/réponse dans le paramètre P974 si la taille est différente de la taille par défaut de 240 octets.
- Aucun message spontané n'est transmis.
- Pour un accès simultané optimisé aux différents paramètres (par exemple, le contenu de l'écran d'interface de l'opérateur), des demandes "multiparamètre" sont définies.
- Il n'y a pas de demande de paramètre cyclique.
- Après exécution, les paramètres spécifiques au profil doivent être au moins lisibles dans chaque état.

#### 6.2.3.3 Modes d'adressage du DO

L'accès aux paramètres du mode de base est défini par deux modes différents d'adresse DO selon la définition suivante:

- Accès aux paramètres du mode de base – Local: Dans ce mode d'adresse, seuls les paramètres locaux du DO sont accessibles; le CO, auquel est attaché le point d'accès aux paramètres, est lié au DO. L'accès à tous les paramètres globaux est également possible. L'ID de DO de l'en-tête de demande de paramètre n'a pas d'importance.
- Accès aux paramètres du mode de base – Global: Dans ce mode d'adresse sont accessibles tous les paramètres de l'unité d'entraînement, à laquelle est lié le CO, auquel est attaché le point d'accès aux paramètres. L'ID de DO de la demande de paramètre est utilisé pour accéder aux paramètres locaux dans l'unité d'entraînement. Pour accéder aux paramètres globaux, l'ID de DO 0 peut aussi être utilisé. Ce mode d'adresse est utilisé pour des raisons de compatibilité (PROFIBUS) et il convient que le nouveau contrôleur ES PROFINET et les processus d'application du superviseur ne l'utilisent pas.

#### 6.2.3.4 Demandes de paramètre et réponses de paramètre

Une demande de paramètre est constituée de trois segments:

##### En-tête de demande

ID de la demande et numéro des paramètres accessibles. Dispositifs d'entraînement multiaxe et modulaires, adressage d'un DO.

##### Adresse de paramètre

Adressage d'un paramètre. Si plusieurs paramètres sont accessibles, il y a donc plusieurs adresses de paramètre. L'adresse de paramètre n'apparaît que dans la demande, pas dans la réponse.

##### Valeur de paramètre

Pour chaque paramètre adressé, il y a un segment pour les valeurs de paramètre. En fonction de l'ID de la demande, les valeurs de paramètre apparaissent soit dans la demande, soit dans la réponse.

Mots et doubles mots:

Le contenu du message suivant est affiché en mots (un mot ou 2 octets par ligne). L'octet de poids fort des mots ou des doubles mots est transmis en premier (gros-boutiste). (voir la Figure 23).

|       |        |        |
|-------|--------|--------|
| Word: | Byte 1 | Byte 2 |
|-------|--------|--------|

|              |        |        |
|--------------|--------|--------|
| Double word: | Byte 1 | Byte 2 |
|              | Byte 3 | Byte 4 |

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|--------------|-------------|
| Word:        | Mot:        |
| Double word: | Double mot: |
| Byte 1       | Octet 1     |

**Figure 23 – Ordre des octets pour les mots et les doubles mots**

Selon l'accès aux paramètres du mode de base, la structure de la demande de paramètre et de la réponse de paramètre est donnée respectivement dans le Tableau 28 ou dans le Tableau 29.

**Tableau 28 – Demande de paramètre du mode de base**

| Définition du bloc                                                                    | Octet n                   | Octet n+1                | n                                    |
|---------------------------------------------------------------------------------------|---------------------------|--------------------------|--------------------------------------|
| En-tête de demande                                                                    | Référence de la demande   | ID de la demande         | 0                                    |
|                                                                                       | Numéro d'axe/ID de DO     | Nombre de paramètres = i | 2                                    |
| 1ère adresse de paramètre                                                             | Attribut                  | Nombre d'éléments        | 4                                    |
|                                                                                       | Numéro de paramètre (PNU) |                          |                                      |
|                                                                                       | Sous-index                |                          |                                      |
| ième adresse de paramètre                                                             | ...                       |                          | 4 + 6 × (i-1)                        |
| 1ère(s) valeur(s) des paramètres<br>(uniquement pour demande<br>"Modifier paramètre") | Format                    | Nombre de valeurs        | 4 + 6 × i                            |
|                                                                                       | Valeurs                   |                          |                                      |
|                                                                                       | ...                       |                          |                                      |
|                                                                                       |                           |                          |                                      |
| ièmes valeurs de paramètre                                                            | ...                       |                          |                                      |
|                                                                                       |                           |                          | 4 + 6 × i + ... + (Format_n × Qty_n) |



**Tableau 29 – Réponse de paramètre du mode de base**

| Définition du bloc                                                                       | Octet n                                  | Octet n+1                | n                            |
|------------------------------------------------------------------------------------------|------------------------------------------|--------------------------|------------------------------|
| En-tête de réponse                                                                       | Référence de la demande écrite en miroir | ID de la réponse         | 0                            |
|                                                                                          | Numéro d'axe/ID de DO écrit en miroir    | Nombre de paramètres = i | 2                            |
| 1 <sup>ère</sup> (s) valeur(s) des paramètres<br>(uniquement après demande<br>"Demande") | Format                                   | Nombre de valeurs        | 4                            |
|                                                                                          | Valeurs ou valeurs d'erreur              |                          |                              |
|                                                                                          | ...                                      |                          |                              |
|                                                                                          |                                          |                          |                              |
| i <sup>èmes</sup> valeurs de paramètre                                                   | ...                                      |                          |                              |
|                                                                                          |                                          |                          | 4 + ... + (Format_n × Qty_n) |

Signification des champs:

#### En-tête de demande

- Référence de la demande

Identification unique de la paire demande/réponse pour le maître. Le maître modifie la référence de la demande avec chaque nouvelle demande (par exemple, modulo 255). L'esclave écrit en miroir la référence de la demande dans la réponse sans vérification.

- ID de la demande

Deux ID sont définis:

- Demander paramètre
- Modifier paramètre

Une modification de paramètre peut être archivée dans la mémoire RAM soit volatile soit non volatile, en fonction du dispositif. Un paramètre modifié archivé dans la RAM volatile peut être archivé d'abord dans la mémoire ROM avec le paramètre P971. La différenciation Valeur/Description/Texte est ajoutée à l'adresse comme attribut. La différenciation Mot/Double Mot est ajoutée aux valeurs de paramètre comme format. Pour la différenciation Paramètre simple/de matrice, se référer au "Nombre d'éléments" dans l'adresse de paramètre.

- ID de la réponse

Écriture miroir de l'ID de demande avec information supplémentaire indiquant si la demande a été exécutée positivement ou négativement.

- Demande de paramètre positive
- Demande de paramètre négative (il n'était pas possible d'exécuter la demande, entièrement ou partiellement)
- Modification de paramètre positive
- Modification de paramètre négative (il n'était pas possible d'exécuter la demande, entièrement ou partiellement)

Si la réponse est négative, les numéros des erreurs sont renseignés par réponse partielle, à la place des valeurs.

- Numéro d'axe/ID de DO

Pour l'accès aux paramètres du mode de base – Local: non pertinent; Dans la réponse du paramètre, l'ID de DO de la demande est écrit en miroir.

Pour l'accès aux paramètres du mode de base – Global: informations d'adressage de DO utilisées pour les dispositifs d'entraînement multiaxe ou modulaires. Cela permet l'accès à plusieurs axes/DO, avec pour chacun un espace pour le numéro de paramètre dédié dans le dispositif d'entraînement via le même PAP. Voir également 6.2.3.3.

- **Nombre de paramètres**

Dans le cas de demandes multiparamètre, spécification du nombre de domaines suivants Adresse de paramètre et/ou Valeur de paramètre. Pour les demandes simples, nombre de paramètres = 1.

Plage des valeurs par défaut 1 à 39. La plage des valeurs peut être réduite ou étendue; cela doit être indiqué par P974.

Pour une demande multiparamètre, l'unité d'entraînement PROFIdrive doit placer, dans le message de réponse, les domaines de valeur de paramètre dans le même ordre que dans le message de demande multiparamètre correspondant.

### **Adresse de paramètre**

- **Attribut**

Type d'objet accessible. Plage de valeurs:

- Valeur
- Description
- Texte

- **Nombre d'éléments**

Nombre d'éléments de matrice accessibles ou longueur de chaîne accessible.

Plage des valeurs par défaut 0, 1 à 234. La plage de valeurs peut être réduite ou étendue; cela doit être indiqué par P974.

Nombre d'éléments de cas spécial = 0: Si des valeurs sont accessibles: recommandé pour des paramètres non indexés (voir également le Tableau 30 pour de plus amples informations).

- **Numéro de paramètre (PNU)**

Adresse le paramètre accessible. Plage de valeurs: 1 à 65 535.

- **Sous-index**

Adresse le premier élément de matrice du paramètre ou le début d'une chaîne d'accès ou la matrice de texte, ou l'élément de description accessible. Plage de valeurs: 0 à 65 534.

### **Valeur de paramètre**

- **Format**

Le format et le numéro spécifient l'emplacement dans le message auquel sont affectées les valeurs ultérieures.

Plage de valeurs:

- Zéro (sans valeur comme réponse partielle positive à une demande de modification)
- Type de données
- Erreur (comme réponse partielle négative)
- Au lieu d'un type de données, les options suivantes sont possibles:
- Octet (pour la description et les textes)
- Mot
- Double mot

- **Nombre de valeurs**

Nombre des valeurs suivantes ou nombre des éléments suivants de type de données (nombre d'octets dans le cas de OctetString). Dans le cas d'une demande d'écriture de

OctetString, la longueur correcte doit être fournie, sinon le dispositif d'entraînement doit répondre par l'erreur 0x18, "le nombre de valeurs n'est pas cohérent" (voir le Tableau 32).

- Valeurs

Les valeurs du paramètre

Si les valeurs sont constituées d'un nombre impair d'octets, un octet zéro est ajouté afin de garantir la structure des mots des messages.

Dans le cas d'une réponse partielle positive, la valeur de paramètre contient les informations suivantes:

- Format = (Type de données ou Octet, Mot, Double Mot)
- Nombre de valeurs
- les valeurs

Dans le cas d'une réponse partielle négative, la valeur de paramètre contient les informations suivantes:

- Format = erreur
- Nombre de valeurs = 1
- Valeur = valeur d'erreur = numéro d'erreur

Dans le cas d'une réponse négative, la valeur de paramètre peut contenir les informations suivantes:

- Format = erreur
- Nombre de valeurs = 2
- Valeur 1 = valeur d'erreur 1: numéro d'erreur
- Valeur 2 = valeur d'erreur 2: sous-index du premier élément de matrice dans lequel a lieu l'erreur
- (Objectif: après un accès en écriture erroné à une matrice, toutes les valeurs ne doivent pas être répétées)

Dans le cas d'une réponse partielle positive sans valeur, la valeur de paramètre contient les informations suivantes:

- Format = zéro
- Nombre de valeurs = 0
- (aucune valeur)

Les combinaisons constituées d'un attribut, d'un nombre d'éléments et d'un sous-index ne sont pas toutes autorisées (se référer au Tableau 30).

Un paramètre non indexé dans le profil peut être réalisé avec les index dans l'unité d'entraînement si la réponse à un accès aux paramètres est spécifique au profil.

**Tableau 30 – Combinaisons autorisées constituées d'un attribut, d'un nombre d'éléments et d'un sous-index**

| Attribut                                                                                                                                                                 | Nombre d'éléments  | Sous-index | Données connexes                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Valeur (paramètre simple)                                                                                                                                                | 0                  | 0          | La valeur (recommandée)                                                                                                               |
|                                                                                                                                                                          | 1                  | 0          | La valeur (pour compatibilité, ne pas utiliser pour la demande)                                                                       |
| Valeur (paramètre de matrice)                                                                                                                                            | 0                  | 0          | Une valeur, sous sous-index 0                                                                                                         |
|                                                                                                                                                                          | 1                  | 0 – n      | Une valeur, sous sous-index                                                                                                           |
|                                                                                                                                                                          | 2 – n <sup>a</sup> | 0 – n      | Plusieurs valeurs, commençant par le sous-index                                                                                       |
| Valeur (paramètre de chaîne)                                                                                                                                             | 0                  | 0          | La chaîne entière (si la réponse dépasse la taille de bloc, la chaîne est coupée à l'extrémité pour correspondre à la taille de bloc) |
|                                                                                                                                                                          | 1                  | 0 – n      | Un caractère, sous sous-index                                                                                                         |
|                                                                                                                                                                          | 2 – n <sup>a</sup> | 0 – n      | Plusieurs caractères, commençant par le sous-index                                                                                    |
| Description                                                                                                                                                              | 0 (non pertinent)  | 0          | La description entière                                                                                                                |
|                                                                                                                                                                          | 1                  | 1 – 12     | Un élément de description                                                                                                             |
| Texte (de la matrice de texte)                                                                                                                                           | 1                  | 0 – n      | Un texte (16 octets), sous sous-index                                                                                                 |
|                                                                                                                                                                          | 2 – n              | 0 – n      | Plusieurs textes, commençant par le sous-index                                                                                        |
| <sup>a</sup> Si le nombre d'éléments disponibles dans le dispositif ne correspond pas au nombre d'éléments demandés ou doit être modifié, une erreur doit être affichée. |                    |            |                                                                                                                                       |

### 6.2.3.5 Codage

Le codage est donné dans le Tableau 31.

**Tableau 31 – Codage des champs dans la demande de paramètre/réponse de paramètre de l'accès aux paramètres du mode de base**

| Champ                   | Type de données | Valeurs                                                                                                              |                                                                                                                                                                                                                                         | Commentaire                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Référence de la demande | Unsigned8       | 0x00<br>0x01 – 0xFF                                                                                                  | réservé                                                                                                                                                                                                                                 | L'esclave doit écrire en miroir la référence de demande sans vérification. Il convient que le maître n'utilise pas la valeur 0.                                                                                                                                                                                                                                                                                                                                                         |
| ID de la demande        | Unsigned8       | 0x00<br>0x01<br>0x02<br><br>0x03 – 0x3F<br>0x40 – 0x7F<br>0x80 – 0xFF                                                | réservé (illégal)<br>Demander paramètre<br>Modifier paramètre<br><br>réservé<br>spécifique au constructeur<br>non applicable (illégal)                                                                                                  | ID de demande = 0 et ID de demande hors de la plage de valeurs de 0x80 à 0xFF est toujours un ID de demande illégal et doit faire l'objet d'une réponse avec "service non pris en charge" (ID de réponse = 0x21)                                                                                                                                                                                                                                                                        |
| ID de la réponse        | Unsigned8       | 0x00<br>0x01<br>0x02<br><br>0x03 – 0x3F<br>0x40 – 0x7F<br><br>0x80<br>0x81<br>0x82<br><br>0x83 – 0xBF<br>0xC0 – 0xFF | réservé<br>Demander paramètre(+)<br>Modifier paramètre(+)<br><br>réservé<br>spécifique au constructeur<br><br>service non pris en charge<br>Demander paramètre(-)<br>Modifier paramètre(-)<br><br>réservé<br>spécifique au constructeur |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Axe/ID de DO            | Unsigned8       | 0x00<br>0x01 – 0xFE<br>0xFF                                                                                          | représentatif du dispositif<br>Numéro d'ID de DO 1 – 254<br>réservé                                                                                                                                                                     | Zéro n'est pas un DO mais l'accès au représentant de l'unité d'entraînement.                                                                                                                                                                                                                                                                                                                                                                                                            |
| Nombre de paramètres    | Unsigned8       | 0x00<br>0x01 – 0xFF                                                                                                  | réservé<br>Quantité 1 à 255                                                                                                                                                                                                             | Pour les dispositifs PROFIBUS, le nombre maximal de paramètres pour un accès multiparamètre est limité à 39.<br>Pour les dispositifs PROFINET, le nombre maximal de paramètres est 255.<br>Il peut y avoir des limites supplémentaires par le système de communication (longueur maximale de registre de données) ou le gestionnaire de paramètre de dispositif. En l'absence de paramètre 974 mis en œuvre, le nombre maximal par défaut de paramètres est 39. Voir également 6.3.9.4. |
| Attribut                | Unsigned8       | 0x00<br>0x10<br>0x20<br>0x30<br><br>0x40 – 0x70<br>0x80 – 0xF0                                                       | réservé<br>Valeur<br>Description<br>Texte<br><br>réservé<br>spécifique au constructeur                                                                                                                                                  | Les quatre bits de poids faible sont réservés pour une augmentation (ultérieure) du "Nombre d'éléments" à 12 bits.                                                                                                                                                                                                                                                                                                                                                                      |

| Champ               | Type de données | Valeurs                                                                                                                 |                                                                                                                                  | Commentaire                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nombre d'éléments   | Unsigned8       | 0x00<br>0x01 – 0xEA<br>0xEB – 0xFF                                                                                      | Fonction spéciale<br>Quantité 1 à 234<br>réservé                                                                                 | Limitation du fait de la compatibilité avec les anciennes versions de profil (taille de bloc de données maximale PROFIBUS de 240 octets).<br>Il peut y avoir des limites supplémentaires par le système de communication (longueur maximale de registre de données) ou le gestionnaire de paramètres de dispositif. En l'absence de paramètre 974 mis en œuvre, le nombre maximal par défaut de paramètres est 234. Voir également 6.3.9.4.                                                                          |
| Numéro de paramètre | Unsigned16      | 0x0000<br>0x0001 – 0xFFFF                                                                                               | réservé<br>Nombre 1 à 65 535                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Sous-index          | Unsigned16      | 0x0000 – 0xFFFF                                                                                                         | Nombre 0 à 65 534                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Format              | Unsigned8       | 0x00<br>0x01 – 0x39<br>0x39 – 0x3F<br>0x40<br>0x41<br>0x42<br>0x43<br>0x44<br>0x45 – 0x70<br>0x71 – 0x7C<br>0x7D – 0xFF | réservé<br>Types de données<br>réservé<br>Zéro<br>Octet<br>Mot<br>Double mot<br>Erreur<br>réservé<br>Types de données<br>réservé | Chaque dispositif doit au moins prendre en charge les types de données de base Octet, Mot et Double Mot (obligatoire).<br>Il est préférable que les demandes d'écriture du Contrôleur utilisent les types de données normalisés et spécifiques au profil "corrects" (se référer à l'Article 5). Il est aussi possible d'y substituer Octet, Mot ou Double Mot. Le Contrôleur doit être capable d'interpréter toutes les valeurs/tous les types de données. Pour de plus amples informations, voir également 6.2.3.6. |
| Nombre de valeurs   | Unsigned8       | 0x00 – 0xEA<br>0xEB – 0xFF                                                                                              | Quantité 0 à 234<br>réservé                                                                                                      | Limitation du fait de la compatibilité avec les anciennes versions de profil (taille de bloc de données maximale PROFIBUS de 240 octets).<br>Il peut y avoir des limites supplémentaires par le système de communication (longueur maximale de registre de données) ou le gestionnaire de paramètres de dispositif. En l'absence de paramètre 974 mis en œuvre, le nombre maximal par défaut de paramètres est 234. Voir également 6.3.9.4.                                                                          |
| Numéro d'erreur     | Unsigned16      | 0x0000 – 0x00FF                                                                                                         | Numéros d'erreur (voir le Tableau 32)                                                                                            | L'octet de poids fort est réservé.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

Le dispositif doit afficher une erreur, si les valeurs réservées sont accessibles (pas de référence de demande).

**Tableau 32 – Numéros des erreurs dans les réponses  
de paramètre de mode de base**

| <b>Numéro<br/>d'erreur<br/>= Erreur<br/>valeur1</b> | <b>Signification</b>                                                   | <b>Utilisation</b>                                                                                                                                                                                                                    | <b>Informations<br/>supplémentaires<br/>= Erreur valeur 2</b> |
|-----------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| 0x00                                                | Numéro de paramètre non autorisé                                       | Accès à un paramètre indisponible <sup>a</sup>                                                                                                                                                                                        | 0                                                             |
| 0x01                                                | Impossible de modifier la valeur de paramètre                          | Modifier l'accès à une valeur de paramètre qui ne peut être modifiée                                                                                                                                                                  | Sous-index                                                    |
| 0x02                                                | Limite inférieure ou supérieure dépassée                               | Modifier l'accès avec une valeur hors des limites de valeur                                                                                                                                                                           | Sous-index                                                    |
| 0x03                                                | Sous-index erroné                                                      | Accès à un sous-index indisponible du paramètre de matrice ou de chaîne. Ne doit pas être utilisé pour des paramètres simples <sup>a</sup>                                                                                            | Sous-index                                                    |
| 0x04                                                | Pas de matrice                                                         | Accès avec un sous-index à un paramètre non indexé <sup>a</sup>                                                                                                                                                                       | 0                                                             |
| 0x05                                                | Type de données incorrect                                              | Modifier l'accès avec une valeur qui ne correspond pas au type de données du paramètre                                                                                                                                                | 0                                                             |
| 0x06                                                | Réglage non autorisé (peut uniquement être réinitialisé)               | Modifier l'accès avec une valeur différente de 0 lorsque ce n'est pas autorisé                                                                                                                                                        | Sous-index                                                    |
| 0x07                                                | Impossible de modifier l'élément de description                        | Modifier l'accès à un élément de description qui ne peut être modifié                                                                                                                                                                 | Sous-index                                                    |
| 0x08                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x09                                                | Aucune donnée de description disponible                                | Accès à une description indisponible <sup>a</sup> (la valeur de paramètre est disponible)                                                                                                                                             | 0                                                             |
| 0x0A                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x0B                                                | Aucune priorité de fonctionnement                                      | Modifier l'accès sans les droits de modification des paramètres                                                                                                                                                                       | 0                                                             |
| 0x0C                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x0D                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x0E                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x0F                                                | Aucune matrice de texte disponible                                     | Accès à une matrice de texte qui n'est pas disponible <sup>a</sup> (la valeur de paramètre est disponible)                                                                                                                            | 0                                                             |
| 0x10                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x11                                                | La demande ne peut être exécutée en raison de l'état de fonctionnement | L'accès est temporairement impossible pour des raisons qui ne sont pas détaillées                                                                                                                                                     | 0                                                             |
| 0x12                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x13                                                | réservé                                                                | Raisons de compatibilité                                                                                                                                                                                                              | -                                                             |
| 0x14                                                | Valeur non autorisée                                                   | Modifier l'accès avec une valeur qui se trouve dans les limites de la valeur mais qui n'est pas autorisée pour d'autres raisons à long terme (paramètre avec des valeurs simples définies)                                            | Sous-index                                                    |
| 0x15                                                | Réponse trop longue                                                    | La longueur de la réponse en question dépasse la longueur maximale transmissible du bloc de transport de réponse. Dans le cas d'une demande multiparamètre, le bloc de réponse a été raccourci en omettant les demandes de paramètre. | 0                                                             |

| Numéro d'erreur<br>= Erreur valeur1                                                                                                                                                                                                                                                                  | Signification                                          | Utilisation                                                                                                                                                                                                                    | Informations supplémentaires<br>= Erreur valeur 2 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| 0x16                                                                                                                                                                                                                                                                                                 | Adresse de paramètre non autorisée                     | Valeur illégale (réservée) ou valeur qui n'est pas prise en charge pour l'attribut, nombre d'éléments illégal ou non pris en charge, numéro de paramètre illégal ou sous-index illégal ou une combinaison <sup>a</sup> de cela | 0                                                 |
| 0x17                                                                                                                                                                                                                                                                                                 | Format illégal                                         | Demande d'écriture: Format illégal ou format des données de paramètres qui n'est pas pris en charge                                                                                                                            | 0                                                 |
| 0x18                                                                                                                                                                                                                                                                                                 | Le nombre de valeurs n'est pas cohérent                | Demande d'écriture: Le nombre de valeurs des données de paramètres ne correspond pas au nombre d'éléments dans l'adresse de paramètre                                                                                          | 0                                                 |
| 0x19                                                                                                                                                                                                                                                                                                 | Axe/DO inexistant                                      | Accès à un Axe/DO inexistant                                                                                                                                                                                                   | 0                                                 |
| 0x1A – 0x1F                                                                                                                                                                                                                                                                                          | réservé                                                | -                                                                                                                                                                                                                              | -                                                 |
| 0x20                                                                                                                                                                                                                                                                                                 | Impossible de modifier l'élément de texte de paramètre | Modifier l'accès à un élément de texte de paramètre qui ne peut être modifié                                                                                                                                                   | Sous-index                                        |
| 0x21                                                                                                                                                                                                                                                                                                 | Service non pris en charge                             | ID de demande illégal ou inconnu (ID de réponse = 0x80)                                                                                                                                                                        | -                                                 |
| 0x22                                                                                                                                                                                                                                                                                                 | Trop grand nombre de demandes de paramètres            | Demande multiparamètre: le bloc de réponse ne contient pas toutes les réponses de paramètre du fait du dépassement du nombre maximal de demandes de paramètre prises en charge par demande multiparamètre.                     | -                                                 |
| 0x23                                                                                                                                                                                                                                                                                                 | Accès multiparamètre non pris en charge                | Le gestionnaire de paramètres de dispositif ne prend pas en charge les demandes multiparamètre. La demande est rejetée.                                                                                                        | -                                                 |
| 0x24 – 0x64                                                                                                                                                                                                                                                                                          | réservé                                                | -                                                                                                                                                                                                                              | -                                                 |
| 0x65 – 0xFF                                                                                                                                                                                                                                                                                          | Spécifique au constructeur                             | -                                                                                                                                                                                                                              | -                                                 |
| <sup>a</sup> Dans le cas d'erreurs multiples dans l'adresse de paramètre, son évaluation doit s'effectuer dans l'ordre suivant: attribut, nombre d'éléments, numéro de paramètre et sous-index. La notification d'erreur dans Erreur valeur1 doit être conforme à la première erreur dans cet ordre. |                                                        |                                                                                                                                                                                                                                |                                                   |

### 6.2.3.6 Prise en charge des types de données dans l'accès aux paramètres du mode de base

Généralement, pour les nouveaux développements, il convient que tous les Contrôleurs et dispositifs PROFIdrive prennent en charge les types de données normalisés et spécifiques au profil selon la définition donnée à l'Article 5.

Pour des raisons de compatibilité, chaque unité d'entraînement PROFIdrive doit également prendre en charge les demandes d'écriture du paramètre de mode de base avec les types de données de base Octet, Mot et Double Mot selon la définition donnée dans le Tableau 31 (obligatoire).

L'unité d'entraînement PROFIdrive doit se comporter de la manière suivante:

- Dans le cas d'une demande de lecture de paramètre, elle doit signaler le type de données correspondant dans la réponse de lecture (par exemple, Integer16).
- Dans le cas d'une demande d'écriture de paramètre, elle doit vérifier le type de données et signaler une erreur si les types de données de paramètre ne correspondent pas. Par exemple, si la demande est faite avec le type de données de base Mot et que la représentation interne du dispositif d'entraînement de paramètre est réalisée avec le type



de données normalisé Integer16, les types de données correspondent et l'unité d'entraînement doit accepter la demande.

Si l'unité d'entraînement PROFIdrive ne prend pas en charge des types de données autres que les types de données de base Octet, Mot et Double Mot, elle doit se comporter de la manière suivante.

- Elle rejette la demande d'écriture de paramètre avec une réponse d'erreur si les types de données ne correspondent pas.

Pour des raisons de compatibilité, chaque contrôleur PROFIdrive doit également pouvoir interpréter les réponses de paramètre du mode de base contenant les types de données de base Octet, Mot et Double Mot (obligatoire).

Le contrôleur PROFIdrive doit se comporter de la manière suivante:

- Dans le cas d'une demande d'écriture de paramètre, il convient qu'il signale le type de données correspondant dans la demande d'écriture (par exemple, Integer16).
- Si le dispositif est ancien et répond à la demande de lecture de paramètre par une réponse utilisant les types de données de base Octet, Mot et Double Mot, il convient que le contrôleur accepte la réponse et puisse traiter la valeur.

Les numéros d'erreur 0x00 – 0x13 sont extraits du profil PROFIdrive, Version 2. Les valeurs qui ne peuvent être affectées sont réservées pour une utilisation ultérieure.

#### **6.2.3.7 Traitement des demandes multiparamètre**

La prise en charge de la fonction d'accès multiparamètre pour l'accès aux paramètres du mode de base est une fonction facultative. La capacité d'accès multiparamètre permet de réduire de manière significative le temps de transfert pour les cas d'application de démarrage ou de chargement des bases de données de paramètre.

Si une demande multiparamètre contient plus de demandes de paramètres que ne peut en prendre en charge le gestionnaire de paramètres de dispositif, le gestionnaire de paramètres doit traiter le plus grand nombre de demandes de paramètres que possible. Le bloc de réponse contient les résultats de toutes les demandes de paramètre traitées et il convient qu'il se termine par un bloc d'erreur comportant à la fin le code d'erreur 0x22. Pour des raisons de compatibilité, il est également possible d'omettre le bloc d'erreur avec le code d'erreur 0x22.

Si le traitement d'une demande multiparamètre indique que la taille de la réponse dépasse la taille maximale de bloc du bloc de réponse, le gestionnaire de paramètres doit traiter autant de demandes de paramètre que peut contenir le bloc de réponse. Le bloc de réponse contient les résultats de toutes les demandes de paramètre traitées et il convient qu'il se termine par un bloc d'erreur comportant le code d'erreur 0x15. Pour des raisons de compatibilité, il est également possible d'omettre le bloc d'erreur avec le code d'erreur 0x15.

Si une erreur avec un numéro d'erreur 0x05, 0x16, 0x17 ou 0x18 se produit lors du traitement d'une demande de modification de valeur multiparamètre, toutes les autres demandes de paramètre dans la demande multiparamètre doivent être abandonnées.

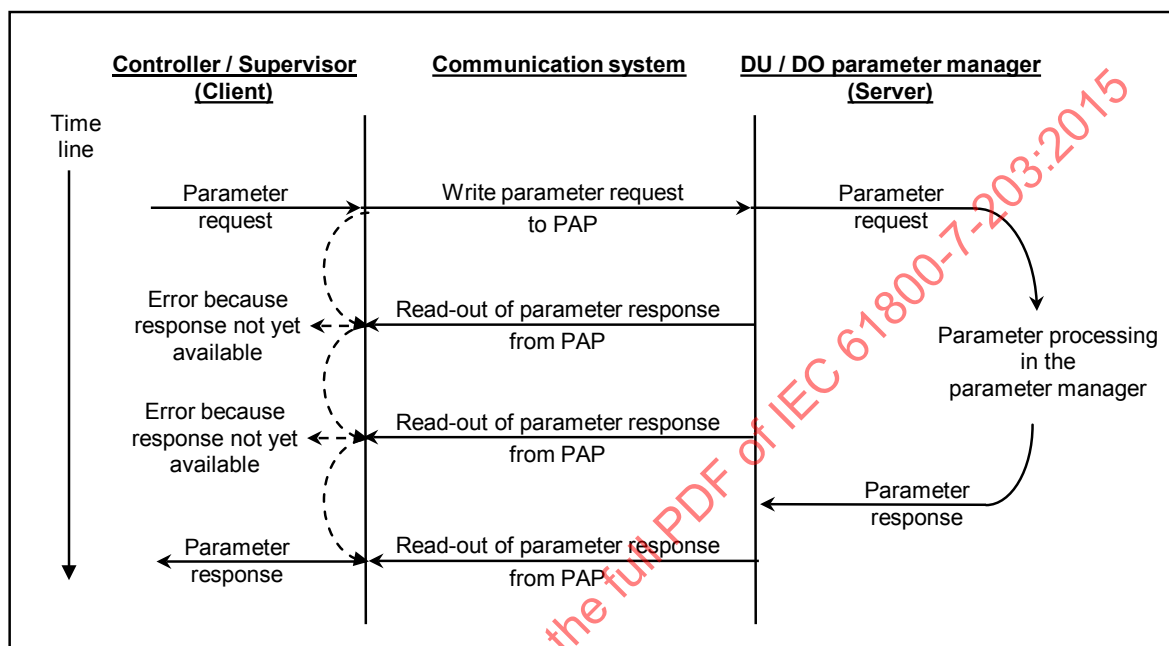
#### **6.2.3.8 Flux de données pour l'accès aux paramètres du mode de base**

Le transfert de la demande d'accès aux paramètres du mode de base vers le gestionnaire de paramètres DO/DU est effectué en écrivant la structure de données de la demande dans le registre des données du point d'accès aux paramètres (PAP). Lorsque l'opération d'écriture est terminée, le diagramme d'états du gestionnaire de paramètres est déclenché selon la Figure 24 et le Tableau 33.

Le transfert de la réponse d'accès aux paramètres du mode de base à partir du gestionnaire de paramètres DO/DU vers le client est effectué en lisant la structure de données de la

réponse à partir du registre des données du point d'accès aux paramètres (PAP). La réponse à l'accès de lecture dépend de l'état interne du gestionnaire de paramètres selon la Figure 24 et le Tableau 33.

Noter que le flux de données selon la Figure 24 et le diagramme d'états associé défini dans le Tableau 33 sont valides pour une connexion exactement. Si plusieurs connexions ont été établies, le nombre approprié de diagrammes d'états doit être disponible et un diagramme d'états distinct est affecté à chaque connexion.



IEC

| Anglais                                       | Français                                                   |
|-----------------------------------------------|------------------------------------------------------------|
| Controller / Supervisor (Client)              | Contrôleur / superviseur (Client)                          |
| Communication system                          | Système de communication                                   |
| DU / DO parameter manager (Server)            | Gestionnaire de paramètres (serveur)                       |
| Time line                                     | Chronologie                                                |
| Parameter request                             | Demande de paramètre                                       |
| Write parameter request to PAP                | Écrire demande de paramètre au PAP                         |
| Error because response not yet available      | Erreur due à la réponse qui n'est pas encore disponible    |
| Read-out of parameter response from PAP       | Lire réponse de paramètre du PAP                           |
| Parameter response                            | Réponse de paramètre                                       |
| Parameter processing in the parameter manager | Traitement de paramètre dans le gestionnaire de paramètres |

**Figure 24 – Flux de données pour l'accès aux paramètres du mode de base**

**Tableau 33 – Diagramme d'états général pour le traitement du gestionnaire de paramètres**

| Évènement<br>(Communication)                                                                                                                                                 |                | État (gestionnaire de paramètres)          |                                           |                                       |                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------|-------------------------------------------|---------------------------------------|--------------------------------------------------------------|
|                                                                                                                                                                              |                | Connexion interrompue                      | Au repos                                  | Demande en cours de traitement        | Réponse disponible                                           |
| Connexion en cours                                                                                                                                                           | Action         |                                            | Traitement de la réinitialisation         |                                       |                                                              |
|                                                                                                                                                                              | État ultérieur | Au repos                                   | Au repos                                  |                                       |                                                              |
| Déconnexion en cours                                                                                                                                                         | Action         | (ignorer)                                  | Traitement de la réinitialisation         |                                       |                                                              |
|                                                                                                                                                                              | État ultérieur | -                                          | Connexion interrompue                     |                                       |                                                              |
| Écrire demande                                                                                                                                                               | Action         | (erreur de protocole)<br>Écrire réponse(-) | Démarrer traitement<br>Écrire réponse (+) | Écrire réponse(-)<br>"conflit d'état" | Rejeter réponse<br>Démarrer traitement<br>Écrire réponse (+) |
|                                                                                                                                                                              | État ultérieur | -                                          | Demande en cours de traitement            | -                                     | Demande en cours de traitement                               |
| Lire demande                                                                                                                                                                 | Action         | (erreur de protocole) Lire réponse(-)      | Lire réponse(-)<br>"conflit d'état"       |                                       | Lire réponse(+)                                              |
|                                                                                                                                                                              | État ultérieur | -                                          | -                                         |                                       | Au repos                                                     |
| Traitement terminé                                                                                                                                                           | Action         | Rejeter                                    | Rejeter                                   |                                       | (erreur interne)<br>Rejeter                                  |
|                                                                                                                                                                              | État ultérieur | -                                          | -                                         | Réponse disponible                    | -                                                            |
| Les colonnes de ce tableau spécifient l'état. Les lignes expliquent un événement. Chaque ligne est divisée en deux champs. L'un décrit l'action et l'autre l'état ultérieur. |                |                                            |                                           |                                       |                                                              |

### 6.2.3.9 Séquences de message pour accès aux paramètres

#### 6.2.3.9.1 Généralités

Les séquences de message sont données du Tableau 34 au Tableau 69..

#### 6.2.3.9.2 Séquence 1: Valeur de paramètre de demande, simple

**Tableau 34 – Séquence 1: Demande de paramètre**

| Définition du bloc   | Octet n                        | Octet n+1                               | n  |
|----------------------|--------------------------------|-----------------------------------------|----|
| En-tête de demande   | Référence de la demande        | ID de la demande = Paramètre de demande | 0  |
|                      | ID de DO = 0                   | Nombre de paramètres = 1                | 2  |
| Adresse de paramètre | Attribut = Valeur              | Nombre d'éléments = 0                   | 4  |
|                      | Numéro de paramètre            |                                         |    |
|                      | Sous-index = 0 (non pertinent) |                                         |    |
|                      |                                |                                         | 10 |

**Tableau 35 – Séquence 1: Réponse de paramètre positive  
avec les données du type de données Mot**

| Définition du bloc  | Octet n                                  | Octet n+1                                   | n |
|---------------------|------------------------------------------|---------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                    | 2 |
| Valeur de paramètre | Format = Word                            | Nombre de valeurs = 1                       | 4 |
|                     | Valeur                                   |                                             | 6 |
|                     |                                          |                                             | 8 |

**Tableau 36 – Séquence 1: Réponse de paramètre positive  
avec les données du type de données Double Mot**

| Définition du bloc  | Octet n                                  | Octet n+1                                   | n  |
|---------------------|------------------------------------------|---------------------------------------------|----|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0  |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                    | 2  |
| Valeur de paramètre | Format = Double mot                      | Nombre de valeurs = 1                       | 4  |
|                     | Valeur                                   |                                             | 6  |
|                     |                                          |                                             | 10 |

**Tableau 37 – Séquence 1: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                      | n |
|---------------------|------------------------------------------|------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de la demande (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                       | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                          | 4 |
|                     | Valeur d'erreur                          |                                                | 6 |
|                     |                                          |                                                | 8 |

**6.2.3.9.3 Séquence 2: Valeur de paramètre de modification, simple****Tableau 38 – Séquence 2: Demande de paramètre**

| Définition du bloc   | Octet n                        | Octet n+1                                    | n  |
|----------------------|--------------------------------|----------------------------------------------|----|
| En-tête de demande   | Référence de la demande        | ID de la demande = Paramètre de modification | 0  |
|                      | ID de DO = 0                   | Nombre de paramètres = 1                     | 2  |
| Adresse de paramètre | Attribut = Valeur              | Nombre d'éléments = 0                        | 4  |
|                      | Numéro de paramètre            |                                              |    |
|                      | Sous-index = 0 (non pertinent) |                                              |    |
| Valeur de paramètre  | Format = Word                  | Nombre de valeurs = 1                        | 10 |
|                      | Valeur                         |                                              | 12 |
|                      |                                |                                              | 14 |

**Tableau 39 – Séquence 2: Réponse de paramètre, positive**

| Définition du bloc | Octet n                                  | Octet n+1                                        | n |
|--------------------|------------------------------------------|--------------------------------------------------|---|
| En-tête de réponse | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de modification (+) | 0 |
|                    | ID de DO écrit en miroir                 | Nombre de paramètres = 1                         | 2 |
|                    |                                          |                                                  | 4 |

**Tableau 40 – Séquence 2: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                        | n |
|---------------------|------------------------------------------|--------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de modification (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                         | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                            | 4 |
|                     | Valeur d'erreur                          |                                                  | 6 |
|                     |                                          |                                                  | 8 |

**6.2.3.9.4 Séquence 3: Valeur de paramètre de demande, plusieurs éléments de matrice****Tableau 41 – Séquence 3: Demande de paramètre**

| Définition du bloc   | Octet n                 | Octet n+1                               | n  |
|----------------------|-------------------------|-----------------------------------------|----|
| En-tête de demande   | Référence de la demande | ID de la demande = Paramètre de demande | 0  |
|                      | ID de DO = 0            | Nombre de paramètres = 1                | 2  |
| Adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 5                   | 4  |
|                      | Numéro de paramètre     |                                         |    |
|                      | Sous-index = 0          |                                         |    |
|                      |                         |                                         | 10 |

**Tableau 42 – Séquence 3: Réponse de paramètre, positive**

| Définition du bloc  | Octet n                                  | Octet n+1                                   | n  |
|---------------------|------------------------------------------|---------------------------------------------|----|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0  |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                    | 2  |
| Valeur de paramètre | Format = Word                            | Nombre de valeurs = 5                       | 4  |
|                     | Valeur 1                                 |                                             | 6  |
|                     | Valeur 2                                 |                                             |    |
|                     | Valeur 3                                 |                                             |    |
|                     | Valeur 4                                 |                                             |    |
|                     | Valeur 5                                 |                                             |    |
|                     |                                          |                                             | 16 |

**Tableau 43 – Séquence 3: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                      | n |
|---------------------|------------------------------------------|------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de la demande (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                       | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                          | 4 |
|                     | Valeur d'erreur                          |                                                | 6 |
|                     |                                          |                                                | 8 |

#### 6.2.3.9.5 Séquence 4: Valeur de paramètre de modification, plusieurs éléments de matrice

**Tableau 44 – Séquence 4: Demande de paramètre**

| Définition du bloc   | Octet n                 | Octet n+1                                    | n  |
|----------------------|-------------------------|----------------------------------------------|----|
| En-tête de demande   | Référence de la demande | ID de la demande = Paramètre de modification | 0  |
|                      | ID de DO = 0            | Nombre de paramètres = 1                     | 2  |
| Adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 5                        | 4  |
|                      | Numéro de paramètre     |                                              |    |
|                      | Sous-index = 125        |                                              |    |
| Valeur de paramètre  | Format = Word           | Nombre de valeurs = 5                        | 10 |
|                      | Valeur 1                |                                              | 12 |
|                      | Valeur 2                |                                              |    |
|                      | Valeur 3                |                                              |    |
|                      | Valeur 4                |                                              |    |
|                      | Valeur 5                |                                              |    |
|                      |                         |                                              | 22 |

**Tableau 45 – Séquence 4: Réponse de paramètre, positive**

| Définition du bloc | Octet n                                  | Octet n+1                                        | n |
|--------------------|------------------------------------------|--------------------------------------------------|---|
| En-tête de réponse | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de modification (+) | 0 |
|                    | ID de DO écrit en miroir                 | Nombre de paramètres = 1                         | 2 |
|                    |                                          |                                                  | 4 |

**Tableau 46 – Séquence 4: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                        | n |
|---------------------|------------------------------------------|--------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de modification (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                         | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                            | 4 |
|                     | Valeur d'erreur                          |                                                  | 6 |
|                     |                                          |                                                  | 8 |

#### 6.2.3.9.6 Séquence 5: Valeur de paramètre de modification, plusieurs éléments de matrice, Format Octet

**Tableau 47 – Séquence 5: Demande de paramètre**

| Définition du bloc   | Octet n                 | Octet n+1                                    | n  |
|----------------------|-------------------------|----------------------------------------------|----|
| En-tête de demande   | Référence de la demande | ID de la demande = Paramètre de modification | 0  |
|                      | ID de DO = 0            | Nombre de paramètres = 1                     | 2  |
| Adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 7                        | 4  |
|                      | Numéro de paramètre     |                                              |    |
|                      | Sous-index = 110        |                                              |    |
| Valeur de paramètre  | Format = Octet          | Nombre de valeurs = 7                        | 10 |
|                      | Valeur 1                | Valeur 2                                     | 12 |
|                      | Valeur 3                | Valeur 4                                     |    |
|                      | Valeur 5                | Valeur 6                                     |    |
|                      | Valeur 7                | Octet fictif                                 | 18 |

**Tableau 48 – Séquence 5: Réponse de paramètre, positive**

| Définition du bloc | Octet n                                  | Octet n+1                                        | n |
|--------------------|------------------------------------------|--------------------------------------------------|---|
| En-tête de réponse | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de modification (+) | 0 |
|                    | ID de DO écrit en miroir                 | Nombre de paramètres = 1                         | 2 |
|                    |                                          |                                                  | 4 |

**Tableau 49 – Séquence 5: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                        | n |
|---------------------|------------------------------------------|--------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de modification (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                         | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                            | 4 |
|                     | Valeur d'erreur                          |                                                  | 6 |
|                     |                                          |                                                  | 8 |

#### 6.2.3.9.7 Séquence 6: Valeur de paramètre de demande, multiparamètre

**Tableau 50 – Séquence 6: Demande de paramètre**

| Définition du bloc        | Octet n                 | Octet n+1                               | n  |
|---------------------------|-------------------------|-----------------------------------------|----|
| En-tête de demande        | Référence de la demande | ID de la demande = Paramètre de demande | 0  |
|                           | ID de DO = 0            | Nombre de paramètres = 3                | 2  |
| 1ère adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 1                   | 4  |
|                           | Numéro de paramètre     |                                         |    |
|                           | Sous-index = 7          |                                         |    |
| 2ème adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 100                 | 10 |
|                           | Numéro de paramètre     |                                         |    |
|                           | Sous-index = 0          |                                         |    |
| 3ème adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 2                   | 16 |
|                           | Numéro de paramètre     |                                         |    |
|                           | Sous-index = 13         |                                         |    |
|                           |                         |                                         | 22 |



**Tableau 51 – Séquence 6: Réponse de paramètre (+):  
tous les accès partiels OK**

| Définition du bloc             | Octet n                                  | Octet n+1                                   | n   |
|--------------------------------|------------------------------------------|---------------------------------------------|-----|
| En-tête de réponse             | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0   |
|                                | ID de DO écrit en miroir                 | Nombre de paramètres = 3                    | 2   |
| 1ère(s) valeur(s) de paramètre | Format = Mot                             | Nombre de valeurs = 1                       | 4   |
|                                | Valeur                                   |                                             | 6   |
| 2ème(s) valeur(s) de paramètre | Format = Mot                             | Nombre de valeurs = 100                     | 8   |
|                                | Valeur 1                                 |                                             | 10  |
|                                | Valeur 2                                 |                                             |     |
|                                | ...                                      |                                             |     |
|                                | Valeur 100                               |                                             |     |
| 3ème(s) valeur(s) de paramètre | Format = Double mot                      | Nombre de valeurs = 2                       | 210 |
|                                | Valeur 1                                 |                                             | 212 |
|                                |                                          |                                             |     |
|                                | Valeur 2                                 |                                             |     |
|                                |                                          |                                             |     |
|                                |                                          |                                             | 220 |

**Tableau 52 – Séquence 6: Réponse de paramètre (-): premier et troisième accès partiels OK, deuxième accès partiel erroné**

| Définition du bloc             | Octet n                                  | Octet n+1                                      | n  |
|--------------------------------|------------------------------------------|------------------------------------------------|----|
| En-tête de réponse             | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de la demande (-) | 0  |
|                                | ID de DO écrit en miroir                 | Nombre de paramètres = 3                       | 2  |
| 1ère(s) valeur(s) de paramètre | Format = Mot                             | Nombre de valeurs = 1                          | 4  |
|                                | Valeur                                   |                                                | 6  |
| 2ème(s) valeur(s) de paramètre | Format = Erreur                          | Nombre de valeurs = 1                          | 8  |
|                                | Valeur d'erreur                          |                                                | 10 |
| 3ème(s) valeur(s) de paramètre | Format = Double mot                      | Nombre de valeurs = 2                          | 12 |
|                                | Valeur 1                                 |                                                | 14 |
|                                |                                          |                                                |    |
|                                | Valeur 2                                 |                                                |    |
|                                |                                          |                                                | 22 |

### 6.2.3.9.8 Séquence 7: Valeur de paramètre de modification, multiparamètre

**Tableau 53 – Séquence 7: Demande de paramètre**

| Définition du bloc             | Octet n                 | Octet n+1                                       | n   |
|--------------------------------|-------------------------|-------------------------------------------------|-----|
| En-tête de demande             | Référence de la demande | ID de la demande =<br>Paramètre de modification | 0   |
|                                | ID de DO = 0            | Nombre de paramètres = 3                        | 2   |
| 1ère adresse de paramètre      | Attribut = Valeur       | Nombre d'éléments = 1                           | 4   |
|                                | Numéro de paramètre     |                                                 |     |
|                                | Sous-index = 7          |                                                 |     |
| 2ème adresse de paramètre      | Attribut = Valeur       | Nombre d'éléments = 100                         | 10  |
|                                | Numéro de paramètre     |                                                 |     |
|                                | Sous-index = 0          |                                                 |     |
| 3ème adresse de paramètre      | Attribut = Valeur       | Nombre d'éléments = 2                           | 16  |
|                                | Numéro de paramètre     |                                                 |     |
|                                | Sous-index = 13         |                                                 |     |
| 1ère(s) valeur(s) de paramètre | Format = Mot            | Nombre de valeurs = 1                           | 22  |
|                                | Valeur                  |                                                 | 24  |
| 2ème(s) valeur(s) de paramètre | Format = Mot            | Nombre de valeurs = 100                         | 26  |
|                                | Valeur 1                |                                                 | 28  |
|                                | Valeur 2                |                                                 |     |
|                                | ...                     |                                                 |     |
|                                | Valeur 100              |                                                 |     |
| 3ème(s) valeur(s) de paramètre | Format = Double mot     | Nombre de valeurs = 2                           | 228 |
|                                | Valeur 1                |                                                 | 230 |
|                                | Valeur 2                |                                                 |     |
|                                |                         |                                                 |     |
|                                |                         |                                                 | 238 |

**Tableau 54 – Séquence 7: Réponse de paramètre (+):  
tous les accès partiels OK**

| Définition du bloc | Octet n                                     | Octet n+1                                           | n |
|--------------------|---------------------------------------------|-----------------------------------------------------|---|
| En-tête de réponse | Référence de la demande<br>écrite en miroir | ID de la réponse =<br>Paramètre de modification (+) | 0 |
|                    | ID de DO écrit en miroir                    | Nombre de paramètres = 3                            | 2 |
|                    |                                             |                                                     | 4 |

**Tableau 55 – Séquence 7: Réponse de paramètre (-):  
premier et troisième accès partiels OK, deuxième accès partiel erroné**

| Définition du bloc             | Octet n                                  | Octet n+1                                        | n  |
|--------------------------------|------------------------------------------|--------------------------------------------------|----|
| En-tête de réponse             | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de modification (-) | 0  |
|                                | ID de DO écrit en miroir                 | Nombre de paramètres = 3                         | 2  |
| 1ère(s) valeur(s) de paramètre | Format = Zéro                            | Nombre de valeurs = 0                            | 4  |
| 2ème(s) valeur(s) de paramètre | Format = Erreur                          | Nombre de valeurs = 2                            | 6  |
|                                | Valeur d'erreur                          |                                                  | 8  |
|                                | Sous-index erroné                        |                                                  | 10 |
| 3ème(s) valeur(s) de paramètre | Format = Zéro                            | Nombre de valeurs = 0                            | 12 |
|                                |                                          |                                                  | 14 |

#### 6.2.3.9.9 Séquence 8: Description de demande, simple

**Tableau 56 – Séquence 8: Demande de paramètre**

| Définition du bloc   | Octet n                 | Octet n+1                               | n  |
|----------------------|-------------------------|-----------------------------------------|----|
| En-tête de demande   | Référence de la demande | ID de la demande = Paramètre de demande | 0  |
|                      | ID de DO = 0            | Nombre de paramètres = 1                | 2  |
| Adresse de paramètre | Attribut = Description  | Nombre d'éléments = 1                   | 4  |
|                      | Numéro de paramètre     |                                         |    |
|                      | Sous-index = n          |                                         |    |
|                      |                         |                                         | 10 |

**Tableau 57 – Séquence 8: Réponse de paramètre positive  
avec les données du type de données Mot (par exemple ID)**

| Définition du bloc  | Octet n                                  | Octet n+1                                   | n |
|---------------------|------------------------------------------|---------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                    | 2 |
| Valeur de paramètre | Format = Mot                             | Nombre de valeurs = 1                       | 4 |
|                     | Valeur                                   |                                             | 6 |
|                     |                                          |                                             | 8 |

**Tableau 58 – Séquence 8: Réponse de paramètre positive avec texte**

| Définition du bloc  | Octet n                                  | Octet n+1                                   | n   |
|---------------------|------------------------------------------|---------------------------------------------|-----|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0   |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                    | 2   |
| Valeur de paramètre | Format = Octet                           | Nombre de valeurs = 16                      | 4   |
|                     | Octet 1                                  | Octet 2                                     | 6   |
|                     | ...                                      | ...                                         | ... |
|                     | Octet 15                                 | Octet 16                                    | ... |
|                     |                                          |                                             | 22  |

**Tableau 59 – Séquence 8: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                      | n |
|---------------------|------------------------------------------|------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de la demande (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                       | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                          | 4 |
|                     | Valeur d'erreur                          |                                                | 6 |
|                     |                                          |                                                | 8 |

#### 6.2.3.9.10 Séquence 9: Description de demande, complète

**Tableau 60 – Séquence 9: Demande de paramètre**

| Définition du bloc   | Octet n                 | Octet n+1                               | n  |
|----------------------|-------------------------|-----------------------------------------|----|
| En-tête de demande   | Référence de la demande | ID de la demande = Paramètre de demande | 0  |
|                      | ID de DO = 0            | Nombre de paramètres = 1                | 2  |
| Adresse de paramètre | Attribut = Description  | Nombre d'éléments = 0 (non pertinent)   | 4  |
|                      | Numéro de paramètre     |                                         |    |
|                      | Sous-index = 0 (!)      |                                         |    |
|                      |                         |                                         | 10 |

**Tableau 61 – Séquence 9: Réponse de paramètre, positive**

| Définition du bloc  | Octet n                                  | Octet n+1                                   | n               |
|---------------------|------------------------------------------|---------------------------------------------|-----------------|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0               |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                    | 2               |
| Valeur de paramètre | Format = Octet                           | Nombre de valeurs = (Octets)                | 4               |
|                     | ID                                       |                                             | 6               |
|                     | (etc.)                                   |                                             |                 |
|                     | ...                                      | ...                                         |                 |
|                     |                                          |                                             |                 |
|                     | ...                                      | ...                                         |                 |
|                     |                                          |                                             | 6 + Description |

**Tableau 62 – Séquence 9: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                      | n |
|---------------------|------------------------------------------|------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de la demande (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                       | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                          | 4 |
|                     | Valeur d'erreur                          |                                                | 6 |
|                     |                                          |                                                | 8 |

**6.2.3.9.11 Séquence 10: Texte de demande, simple****Tableau 63 – Séquence 10: Demande de paramètre**

| Définition du bloc   | Octet n                 | Octet n+1                               | n  |
|----------------------|-------------------------|-----------------------------------------|----|
| En-tête de demande   | Référence de la demande | ID de la demande = Paramètre de demande | 0  |
|                      | ID de DO = 0            | Nombre de paramètres = 1                | 2  |
| Adresse de paramètre | Attribut = Texte        | Nombre d'éléments = 1                   | 4  |
|                      | Numéro de paramètre     |                                         |    |
|                      | Sous-index = n          |                                         |    |
|                      |                         |                                         | 10 |

**Tableau 64 – Séquence 10: Réponse de paramètre, positive**

| Définition du bloc  | Octet n                                  | Octet n+1                                   | n   |
|---------------------|------------------------------------------|---------------------------------------------|-----|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0   |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                    | 2   |
| Valeur de paramètre | Format = Octet                           | Nombre de valeurs = 16                      | 4   |
|                     | Octet 1                                  | Octet 2                                     | 6   |
|                     | ...                                      | ...                                         | ... |
|                     | Octet 15                                 | Octet 16                                    | ... |
|                     |                                          |                                             | 22  |

**Tableau 65 – Séquence 10: Réponse de paramètre, négative**

| Définition du bloc  | Octet n                                  | Octet n+1                                        | n |
|---------------------|------------------------------------------|--------------------------------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = Description de la demande (-) | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1                         | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1                            | 4 |
|                     | Valeur d'erreur                          |                                                  | 6 |
|                     |                                          |                                                  | 8 |

#### 6.2.3.9.12 Séquence 11: Paramètre de demande, multiparamètre, différents attributs

**Tableau 66 – Séquence 11: Demande de valeurs, description et texte dans une demande**

| Définition du bloc        | Octet n                 | Octet n+1                               | n  |
|---------------------------|-------------------------|-----------------------------------------|----|
| En-tête de demande        | Référence de la demande | ID de la demande = Paramètre de demande | 0  |
|                           | ID de DO = 0            | Nombre de paramètres = 3                | 2  |
| 1ère adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 3                   | 4  |
|                           | Numéro de paramètre     |                                         |    |
|                           | Sous-index = 0          |                                         |    |
| 2ème adresse de paramètre | Attribut = Description  | Nombre d'éléments = 0                   | 10 |
|                           | Numéro de paramètre     |                                         |    |
|                           | Sous-index = 0          |                                         |    |
| 3ème adresse de paramètre | Attribut = Texte        | Nombre d'éléments = 3                   | 16 |
|                           | Numéro de paramètre     |                                         |    |
|                           | Sous-index = 0          |                                         |    |
|                           |                         |                                         | 22 |

**Tableau 67 – Séquence 11: Réponse de paramètre (+):  
tous les accès partiels OK**

| Définition du bloc                                   | Octet n                                  | Octet n+1                                   | n                |
|------------------------------------------------------|------------------------------------------|---------------------------------------------|------------------|
| En-tête de réponse                                   | Référence de la demande écrite en miroir | ID de la réponse = Paramètre de demande (+) | 0                |
|                                                      | ID de DO écrit en miroir                 | Nombre de paramètres = 3                    | 2                |
| 1ères valeurs de paramètre<br>(trois valeurs)        | Format = Mot                             | Nombre de valeurs = 3                       | 4                |
|                                                      | Valeur 1                                 |                                             |                  |
|                                                      | Valeur 2                                 |                                             |                  |
|                                                      | Valeur 3                                 |                                             |                  |
| 2èmes valeurs de paramètre<br>(description complète) | Format = Octet                           | Nombre de valeurs = (Octets)                | 12               |
|                                                      | ID                                       |                                             |                  |
|                                                      | (etc.)                                   |                                             |                  |
|                                                      | ...                                      | ...                                         |                  |
|                                                      |                                          |                                             |                  |
| 3èmes valeurs de paramètre<br>(trois textes)         | Format = Octet                           | Nombre de valeurs = 48                      | 12 + Description |
|                                                      | Octet 1                                  | Octet 2                                     |                  |
|                                                      | ...                                      | ...                                         |                  |
|                                                      | Octet 47                                 | Octet 48                                    |                  |
|                                                      |                                          |                                             | 62 + Description |

#### 6.2.3.9.13 Séquence 12: Paramètre de demande, multiparamètre, en-tête de demande erroné

**Tableau 68 – Séquence 12: Demande de valeurs,  
entête avec ID de demande illégal**

| Définition du bloc        | Octet n                 | Octet n+1                | n  |
|---------------------------|-------------------------|--------------------------|----|
| En-tête de demande        | Référence de la demande | ID de la demande = 0     | 0  |
|                           | ID de DO = 0            | Nombre de paramètres = 3 | 2  |
| 1ère adresse de paramètre | Attribut = Valeur       | Nombre d'éléments = 3    | 4  |
|                           | Numéro de paramètre     |                          |    |
|                           | Sous-index = 0          |                          |    |
| 2ème adresse de paramètre | Attribut = Description  | Nombre d'éléments = 0    | 10 |
|                           | Numéro de paramètre     |                          |    |
|                           | Sous-index = 0          |                          |    |
| 3ème adresse de paramètre | Attribut = Texte        | Nombre d'éléments = 3    | 16 |
|                           | Numéro de paramètre     |                          |    |
|                           | Sous-index = 0          |                          |    |
|                           |                         |                          | 22 |

**Tableau 69 – Séquence 12: Réponse de paramètre (-):  
service non pris en charge**

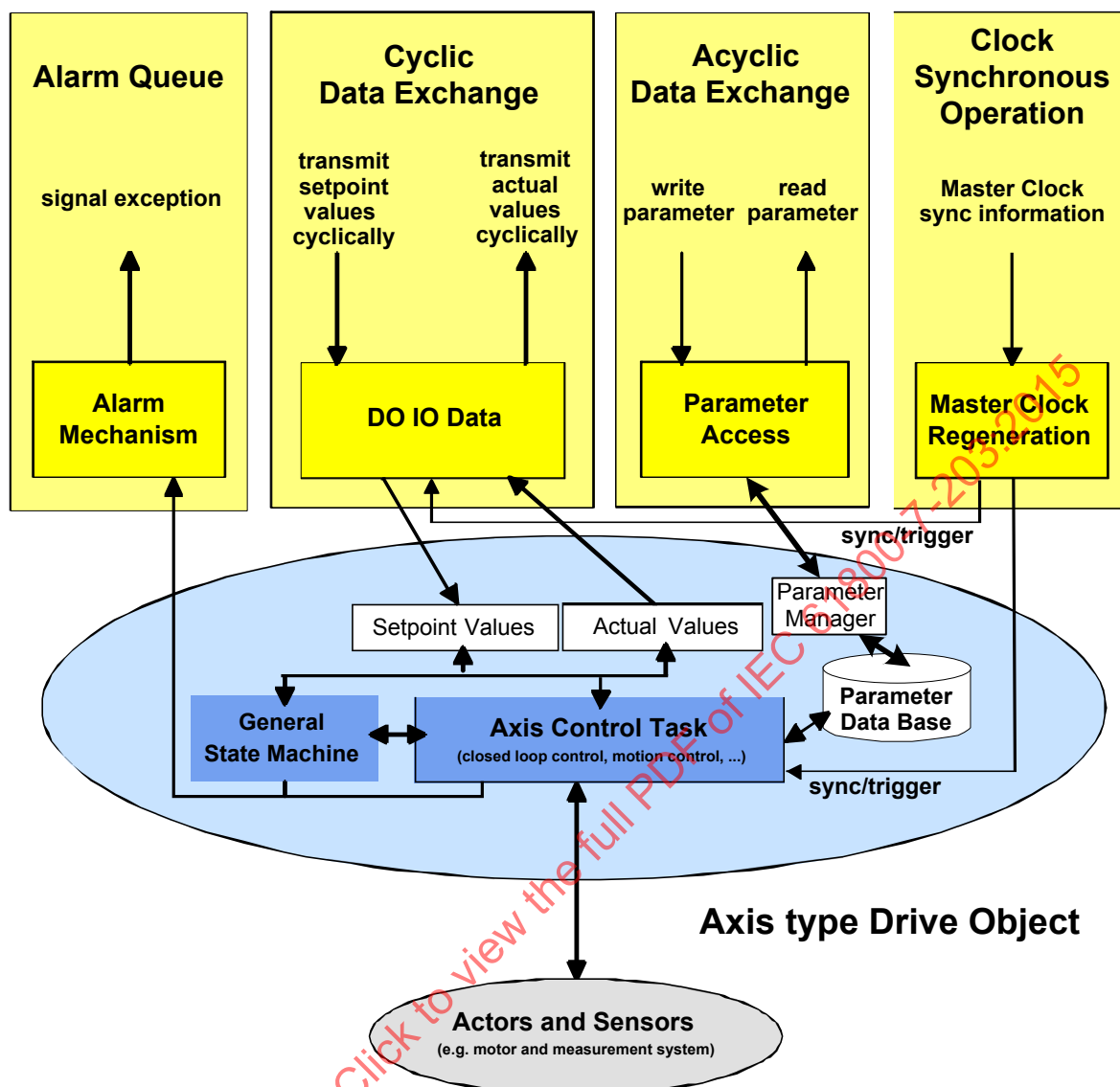
| Définition du bloc  | Octet n                                  | Octet n+1                | n |
|---------------------|------------------------------------------|--------------------------|---|
| En-tête de réponse  | Référence de la demande écrite en miroir | ID de la réponse = 0x80  | 0 |
|                     | ID de DO écrit en miroir                 | Nombre de paramètres = 1 | 2 |
| Valeur de paramètre | Format = Erreur                          | Nombre de valeurs = 1    | 4 |
|                     | Valeur d'erreur = 0x21                   |                          | 6 |
|                     |                                          |                          | 8 |

### 6.3 Processus d'application de commande d'entraînement

#### 6.3.1 Architecture générale d'objet d'entraînement de type axe

La Figure 25 montre les éléments fonctionnels de l'objet d'entraînement de type axe (DO). L'élément central d'un DO de type axe est la tâche de commande d'axe en charge de la commande de l'axe correspondant. Les propriétés du DO et la tâche de commande d'axe sont représentées et contrôlées par les paramètres. Les paramètres sont gérés dans la base de données de paramètres. Pour accéder aux paramètres du DO, le service d'échange de données acycliques est utilisé en interaction avec le gestionnaire de paramètres. Le gestionnaire de paramètres reçoit les demandes de paramètre, donne accès à la base de données de paramètres et répond à la demande de paramètre avec une réponse de paramètre correspondante. Pour le transport périodique de valeurs de point de consigne vers l'axe et de valeurs instantanées à partir du DO axe, le service d'échange de données cycliques est utilisé. Le DO de type axe comprend le diagramme d'états général, qui contrôle et représente les états de la tâche de commande d'axe. Les situations d'exception de la tâche de commande d'axe et du diagramme d'états général peuvent être signalées par le mécanisme d'alarme au dispositif de commande. Pour le fonctionnement synchrone de l'horloge de plusieurs DO (axe), le service de fonctionnement synchrone de l'horloge doit être utilisé pour déclencher les tâches de commande pertinentes.





IEC

| Anglais                             | Français                                                       |
|-------------------------------------|----------------------------------------------------------------|
| Alarm Queue                         | File d'attente alarme                                          |
| Signal exception                    | Exception de signal                                            |
| Alarm mechanism                     | Mécanisme d'alarme                                             |
| Cyclic data exchange                | Échange de données cycliques                                   |
| Transmit setpoint values cyclically | Transmettre des valeurs de point de consigne de façon cyclique |
| Transmit actual values cyclically   | Transmettre des valeurs instantanées de façon cyclique         |
| DO IO Data                          | Données E-S de DO                                              |
| Acyclic data exchange               | Échange de données acycliques                                  |
| Write parameter                     | Écriture de paramètre                                          |
| Read parameter                      | Lecture de paramètre                                           |
| Parameter access                    | Accès aux paramètres                                           |
| Clock synchronous operation         | Fonctionnement synchrone de l'horloge                          |
| Master clock sync information       | Informations sur la synchronisation de l'horloge maîtresse     |

| Anglais                                                         | Français                                                                           |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------|
| Master clock regeneration                                       | Régénération de l'horloge maîtresse                                                |
| Sync/trigger                                                    | Synchroniser/déclencher                                                            |
| Setpoint values                                                 | Valeurs de point de consigne                                                       |
| Actual values                                                   | Valeurs instantanées                                                               |
| Parameter manager                                               | Gestionnaire de paramètres                                                         |
| General State Machine                                           | Diagramme d'états général                                                          |
| Axis Control Task<br>(closed loop control, motion control, ...) | Tâche de commande d'axe<br>(commande en boucle fermée, commande de mouvement, ...) |
| Parameter Data Base                                             | Base de données de paramètres                                                      |
| Axis type Drive Object                                          | Objet d'entraînement de type axe                                                   |
| Actors and sensors<br>(e.g. motor and measurement system)       | Actionneurs et capteurs<br>(par exemple moteur et système de mesure)               |

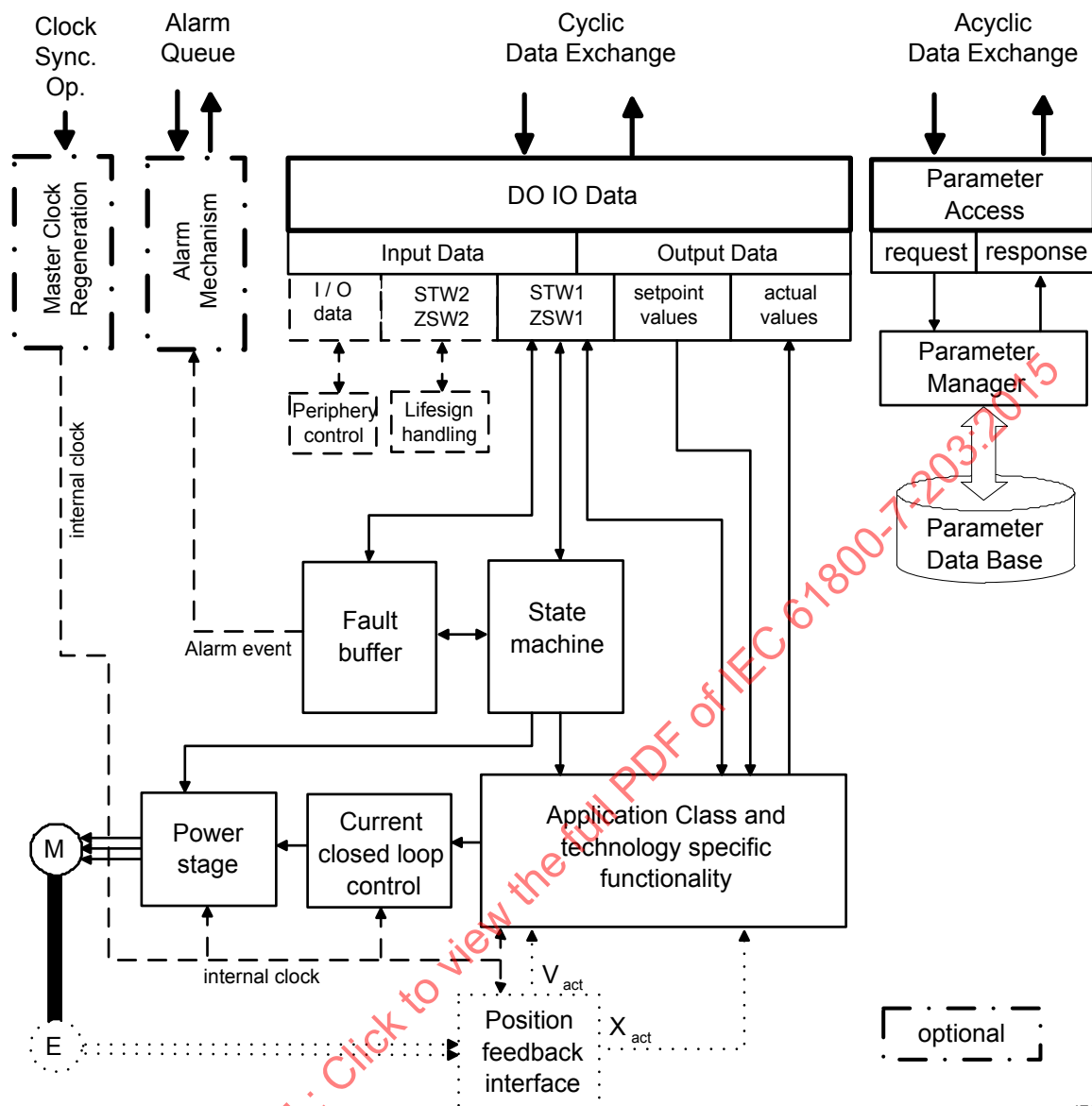
**Figure 25 – Éléments fonctionnels généraux du DO de type axe PROFIdrive**

Le DO de type axe doit comprendre les fonctionnalités obligatoires suivantes:

- les paramètres,
- la tâche de commande d'axe,
- le diagramme d'états général,
- les données E-S de DO (valeurs de point de consigne et valeurs instantanées).

Le DO de type axe peut comprendre les fonctionnalités facultatives suivantes:

- la prise en charge du mécanisme d'alarme,
- le fonctionnement synchrone de l'horloge de la tâche de commande d'axe.



IEC

| Anglais                   | Français                              |
|---------------------------|---------------------------------------|
| Clock Sync. Op.           | Fonctionnement synchrone de l'horloge |
| Alarm Queue               | File d'attente alarme                 |
| Cyclic Data Exchange      | Échange de données cycliques          |
| Acyclic Data Exchange     | Échange de données acycliques         |
| Master Clock Regeneration | Régénération de l'horloge maîtresse   |
| Alarm Mechanism           | Mécanisme d'alarme                    |
| DO IO Data                | Données E-S de DO                     |
| Input Data                | Données d'entrée                      |
| I/O Data                  | Données E/S                           |
| Output Data               | Données de sortie                     |
| Setpoint values           | Valeurs de point de consigne          |
| Actual values             | Valeurs instantanées                  |
| Parameter access          | Accès aux paramètres                  |
| Request                   | Demande                               |

| Anglais                                                 | Français                                                           |
|---------------------------------------------------------|--------------------------------------------------------------------|
| Response                                                | Réponse                                                            |
| Parameter manager                                       | Gestionnaire de paramètres                                         |
| Parameter Data Base                                     | Base de données de paramètres                                      |
| Periphery control                                       | Commande périphérique                                              |
| Lifesign handling                                       | Traitement du signe de vie                                         |
| Internal clock                                          | Horloge interne                                                    |
| Alarm event                                             | Événement d'alarme                                                 |
| Fault buffer                                            | Mémoire tampon des défauts                                         |
| State machine                                           | Diagramme d'états                                                  |
| Power stage                                             | Étage de puissance                                                 |
| Current closed loop control                             | Commande en boucle fermée actuelle                                 |
| Application class and technology specific functionality | Classe d'application et fonctionnalité spécifique à la technologie |
| Position feedback interface                             | Interface de retour en position                                    |
| Optional                                                | Facultatif                                                         |

**Figure 26 – Schéma fonctionnel du DO de type Axe PROFIdrive**

La Figure 26 montre l'architecture fonctionnelle plus détaillée du DO de type axe. La tâche de commande d'axe est divisée dans les éléments suivants:

- mémoire tampon des défauts,
- interface de retour en position,
- étage de puissance,
- commande en boucle fermée actuelle,
- traitement du signe de vie,
- commande périphérique.
- classe d'application et fonctionnalité spécifique à la technologie.

Selon le niveau de l'interface d'entraînement, l'axe PROFIdrive peut fonctionner en différents modes de commande. Ces modes généraux de contrôle sont liés à une ou plusieurs classes d'application PROFIdrive. Pour plus de détails sur les modes de commande, se référer à 6.3.3.

## **6.3.2 Mots de commande et d'état**

### **6.3.2.1 Généralités**

Pour améliorer l'échange de dispositifs de différents constructeurs dans une application de commande, il est fortement recommandé d'utiliser les bits spécifiques au dispositif uniquement pour le contrôle des fonctions spécifiques au constructeur. Les bits spécifiques au dispositif ne doivent pas être nécessaires pour le fonctionnement d'un dispositif dans le mode de commande de vitesse et dans le mode de positionnement (valeur par défaut des bits spécifiques au dispositif = 0).

#### **6.3.2.2 Mot de commande 1 (STW1)**

La structure du mot de commande 1 est présentée dans le Tableau 70.

**Tableau 70 – Présentation générale de l'affectation  
des bits du mot de commande 1**

| Bit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Signification                                                              |                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Mode de commande de vitesse                                                | Mode de positionnement                                                                                             |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ON/OFF (MARCHÉ/ARRÊT).                                                     |                                                                                                                    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Pas d'arrêt progressif/Arrêt progressif (pas de OFF2/OFF 2)                |                                                                                                                    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Pas d'arrêt rapide/Arrêt rapide (pas de OFF3/OFF 3)                        |                                                                                                                    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Activer le fonctionnement/Désactiver le fonctionnement                     |                                                                                                                    |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Autoriser le générateur de rampe/<br>Réinitialiser le générateur de rampe/ | Ne pas rejeter la tâche traversante<br>Rejeter la tâche traversante                                                |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Libérer le générateur de rampe/<br>Figer le générateur de rampe            | Pas d'arrêt intermédiaire /<br>Arrêt intermédiaire                                                                 |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Autoriser le point de consigne/Désactiver le point de consigne             | Activer la tâche traversante<br>(0 -> 1)                                                                           |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Acquittement de défaut (0 -> 1)                                            |                                                                                                                    |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A-coups 1 ON <sup>a</sup> /A-coups 1 OFF <sup>a</sup>                      |                                                                                                                    |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A-coups 2 ON <sup>a</sup> /A-coups 2 OFF <sup>a</sup>                      |                                                                                                                    |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Commande par PLC/Pas de commande par PLC                                   |                                                                                                                    |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Spécifique au dispositif                                                   | Lancer la procédure de retour à la position de référence/Arrêter la procédure de retour à la position de référence |
| 12 à 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Spécifique au dispositif                                                   |                                                                                                                    |
| La signification de la valeur de bit = 1 est à gauche de la barre oblique; celle de la valeur de bit = 0 à sa droite.                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                            |                                                                                                                    |
| NOTE A l'aide du mode en boucle fermée contrôlé en vitesse dans la classe d'application 4 avec ou sans DSC (positionnement avec interpolation centrale et asservissement de positionnement), les bits 4 et 6 STW1 ("Autoriser générateur de rampe/Réinitialiser générateur de rampe" et "Autoriser/Désactiver le point de consigne") maintiennent leur efficacité; le bit 5 STW1 ("Libérer/Figer le générateur de rampe") peut être avec ou sans effet. Si le bit 5 STW1 est sans effet, ceci est indiqué par le paramètre PNU930 = 3. |                                                                            |                                                                                                                    |
| <sup>a</sup> Facultatif.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                            |                                                                                                                    |

Le Tableau 71 énumère les bits de commande communs, le Tableau 72 et le Tableau 73 énumèrent les bits de commande pour lesquels la commande de vitesse (AC 4) et les modes de positionnement (AC 3) sont différents.

**Tableau 71 – Affectation détaillée des bits du mot de commande commun 1 (STW1) pour la commande de vitesse/le positionnement**

| Bit     | Valeur | Signification                            | Commentaires                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------|--------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0       | 1      | ON                                       | État "mis sous tension"; tension au convertisseur, c'est-à-dire le contact principal est fermé (le cas échéant).                                                                                                                                                                                                                                                                                                                                                                                              |
|         | 0      | OFF<br>(OFF 1)                           | Mise hors tension (le dispositif d'entraînement retourne à l'état "prêt pour mise sous tension"); le dispositif d'entraînement est diminué le long de la rampe (RFG) ou le long de la limite de courant ou le long de la limite de tension de la liaison en courant continu; si l'arrêt est détecté, la tension est isolée; le contact principal est ouvert (le cas échéant). Pendant la décélération, le bit 1 de ZSW1 est toujours actif.<br><br>Une commande OFF peut être interrompue.                    |
| 1       | 1      | Pas d'arrêt progressif<br>(pas de OFF 2) | Toutes les commandes "Arrêt progressif (OFF2)" sont supprimées.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|         | 0      | Arrêt progressif<br>(OFF 2)              | La tension est isolée.<br>Le contact principal est ensuite ouvert (le cas échéant) et le dispositif d'entraînement passe en état "Mise sous tension annulée"; le moteur passe progressivement à l'arrêt.                                                                                                                                                                                                                                                                                                      |
| 2       | 1      | Pas d'arrêt rapide<br>(pas de OFF 3)     | Toutes les commandes "Arrêt rapide (OFF3)" sont supprimées.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|         | 0      | Arrêt rapide<br>(OFF 3)                  | Arrêt rapide; si c'est exigé, retirer l'activation de fonctionnement, le dispositif d'entraînement est ralenti le plus rapidement possible, par exemple le long de la limite de courant ou à la limite de tension de la liaison en courant continu, pour $n/f = 0$ ; si les impulsions redressées sont désactivées, la tension est isolée (le contact est ouvert) et le dispositif d'entraînement passe en état "Mise sous tension annulée".<br><br>Une commande d'arrêt rapide ne peut pas être interrompue. |
| 3       | 1      | Activer le fonctionnement                | Activer l'électronique et les impulsions<br>Le dispositif d'entraînement s'exécute ensuite jusqu'au point de consigne.                                                                                                                                                                                                                                                                                                                                                                                        |
|         | 0      | Désactiver le fonctionnement             | Le dispositif d'entraînement s'arrête progressivement (générateur de fonction de rampe à 0 ou localisation) et passe en état "Mis sous tension" (se reporter au mot de commande 1, bit 0).                                                                                                                                                                                                                                                                                                                    |
| 7       | 1      | Acquittement de défaut<br>(0 -> 1)       | Le signal de groupe est acquitté positivement; la réaction du dispositif d'entraînement à un défaut dépend du type de défaut. Si la réaction au défaut a isolé la tension, le dispositif d'entraînement passe ensuite en état "Mise sous tension annulée".                                                                                                                                                                                                                                                    |
|         | 0      | Pas de signification                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 10      | 1      | Commande par PLC                         | Commande via interface, données E-S de DO valides (se reporter à 6.3.11).                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|         | 0      | Pas de commande par PLC                  | Données E-S de DO non valides; attendre signe de vie. Dans le cas d'une perte du bit de priorité de commande, la réaction est spécifique au dispositif.<br><br>Réactions possibles:<br>1) commande de vitesse: les "anciennes" données de processus sont conservées,<br>2) positionnement: les données E-S de DO sont définies sur 0.                                                                                                                                                                         |
| 12 à 15 |        | spécifique au dispositif                 | Définition non spécifiée.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Tableau 72 – Affectation détaillée des bits du mot de commande spécial 1 (STW1) pour le mode de commande de vitesse**

| Bit                      | Valeur | Signification                     | Commentaires                                                                                                                                                                                                                                                   |
|--------------------------|--------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                        | 1      | Autoriser générateur de rampe     |                                                                                                                                                                                                                                                                |
|                          | 0      | Réinitialiser générateur de rampe | La sortie du RFG est définie sur 0. Le contact principal reste fermé, le convertisseur n'est pas isolé de la ligne, le dispositif d'entraînement ralentit le long de la limite de courant ou le long de la limite de tension de la liaison en courant continu. |
| 5                        | 1      | Libérer le générateur de rampe    |                                                                                                                                                                                                                                                                |
|                          | 0      | Figurer le générateur de rampe    | Figurer le point de consigne réel saisi par le générateur de fonction de rampe. Si la classe d'application 4 est utilisée, le bit 5 peut être sans effet. La non-pertinence du bit STW1 5 est indiquée par le paramètre PNU930 = 3.                            |
| 6                        | 1      | Autoriser le point de consigne    | La valeur sélectionnée à l'entrée du RFG est mise sous tension.                                                                                                                                                                                                |
|                          | 0      | Désactiver le point de consigne   | La valeur sélectionnée à l'entrée du RFG est définie sur 0.                                                                                                                                                                                                    |
| 8                        | 1      | ON <sup>a</sup> A coups 1         | Condition préalable: Le fonctionnement est activé, le dispositif d'entraînement est à l'arrêt et bit STW1 4, 5, 6 = 0. Le dispositif d'entraînement s'exécute le long de la rampe du RFG jusqu'au point de consigne par à-coups 1.                             |
|                          | 0      | OFF <sup>a</sup> A coups 1        | Le dispositif d'entraînement freine le long de la rampe du RFG, si "à-coups 1" était auparavant ON et passe en "Fonctionnement activé" lorsque le dispositif d'entraînement s'arrête.                                                                          |
| 9                        | 1      | ON <sup>a</sup> A coups 2         | Condition préalable: Le fonctionnement est activé, le dispositif d'entraînement est à l'arrêt et bit STW1 4, 5, 6 = 0. Le dispositif d'entraînement s'exécute le long de la rampe du RFG jusqu'au point de consigne par à-coups 2.                             |
|                          | 0      | OFF <sup>a</sup> A coups 2        | Le dispositif d'entraînement freine le long de la rampe du RFG, si "à-coups 2" était auparavant ON et passe en "Fonctionnement activé" lorsque le dispositif d'entraînement s'arrête.                                                                          |
| 11                       |        | spécifique au dispositif          | Signification non spécifiée.                                                                                                                                                                                                                                   |
| <sup>a</sup> Facultatif. |        |                                   |                                                                                                                                                                                                                                                                |

**Tableau 73 – Affectation détaillée des bits du mot de commande spécial 1 (STW1) pour le mode de positionnement**

| Bit                      | Valeur | Signification                                             | Commentaires                                                                                                                                                                                                                                                                                      |
|--------------------------|--------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                        | 1      | Ne pas rejeter la tâche traversante                       | Une Tâche traversante est activée à l'aide du front positif du signal au bit 6.                                                                                                                                                                                                                   |
|                          | 0      | Rejeter la tâche traversante                              | Le dispositif d'entraînement freine à partir d'une Tâche traversante active avec une accélération maximale $n=0$ et reste stationnaire avec le couple de maintien. La Tâche traversante réelle est rejetée.                                                                                       |
| 5                        | 1      | Pas d'arrêt intermédiaire                                 | Cela doit être défini de façon continue lors de l'exécution d'une Tâche traversante.                                                                                                                                                                                                              |
|                          | 0      | Arrêt intermédiaire                                       | Le dispositif d'entraînement freine à partir d'une Tâche traversante active pour atteindre $n=0$ le long d'une rampe et reste stationnaire avec le couple de maintien. La Tâche traversante n'est pas rejetée. La Tâche traversante est continue lorsque le bit 5 du mot de commande 1 passe à 1. |
| 6                        |        | Activer la tâche traversante (0 -> 1).                    | Le front positif du signal active une Tâche traversante ou un nouveau point de consigne MDI.                                                                                                                                                                                                      |
| 8                        | 1      | ON <sup>a</sup> A coups 1                                 | Condition préalable: Le fonctionnement est activé et aucune procédure de positionnement n'est active. Le dispositif d'entraînement est en mode à vitesse variable avec le point de consigne par à-coups 1.                                                                                        |
|                          | 0      | OFF <sup>a</sup> A coups 1                                |                                                                                                                                                                                                                                                                                                   |
| 9                        | 1      | ON <sup>a</sup> A coups 2                                 | Comme le bit 8 avec le point de consigne par à-coups 2.                                                                                                                                                                                                                                           |
|                          | 0      | OFF <sup>a</sup> A coups 2                                |                                                                                                                                                                                                                                                                                                   |
| 11                       | 1      | Lancer la procédure de retour à la position de référence  | La procédure de retour à la position de référence est lancée avec une modification de 0 à 1. Le bit 11 dans le mot d'état est défini sur 0 avec le lancement de la procédure de retour à la position de référence. Condition préalable: Le fonctionnement est activé.                             |
|                          | 0      | Arrêter la procédure de retour à la position de référence | La procédure de retour à la position de référence en cours est abandonnée, le dispositif d'entraînement s'arrête le long d'une rampe.                                                                                                                                                             |
| <sup>a</sup> Facultatif. |        |                                                           |                                                                                                                                                                                                                                                                                                   |

### 6.3.2.3 Mot de commande 2 (STW2)

La structure du mot de commande 2 est présentée dans le Tableau 74.

**Tableau 74 – Présentation générale de l'affectation des bits du mot de commande 2**

| Bit                                                                                                                                                                                                                                                            | Signification                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| 0 à 11                                                                                                                                                                                                                                                         | Spécifique au dispositif                |
| 12 à 15                                                                                                                                                                                                                                                        | Signe de vie du contrôleur <sup>a</sup> |
| <sup>a</sup> Si une application synchrone de l'horloge n'est pas mise en œuvre, c'est-à-dire les bits 12 à 15 du mot de commande 2 ne sont pas exigés pour transférer le signe de vie du contrôleur, le mot de commande 2 complet peut être librement utilisé. |                                         |

### 6.3.2.4 Mot de commande 2 du codeur (STW2\_ENC)

Le mot de commande 2 du codeur est tout particulièrement dédié aux messages des DO de codeur et associe la fonctionnalité de commande de STW1 au signe de vie du contrôleur de STW2. La structure du mot de commande 2 du codeur est présentée dans le Tableau 75..



**Tableau 75 – Présentation générale de l'affectation des bits du mot de commande 2 du codeur**

| Bit                                                                                                                   | Signification                            |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| 0 à 6                                                                                                                 | Spécifique au dispositif                 |
| 7                                                                                                                     | Acquittement de défaut (0 -> 1)          |
| 8 à 9                                                                                                                 | Spécifique au dispositif                 |
| 10                                                                                                                    | Commande par PLC/Pas de commande par PLC |
| 11                                                                                                                    | Spécifique au dispositif                 |
| 12 à 15                                                                                                               | Signe de vie du contrôleur               |
| La signification de la valeur de bit = 1 est à gauche de la barre oblique; celle de la valeur de bit = 0 à sa droite. |                                          |

### 6.3.2.5 Mot d'état 1 (ZSW1)

La structure du mot d'état 1 est présentée dans le Tableau 76.

**Tableau 76 – Présentation générale de l'affectation des bits du mot d'état 1**

| Bit     | Signification                                                                                             |                                                                                               |
|---------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
|         | Mode de commande de vitesse                                                                               | Mode de positionnement                                                                        |
| 0       | Prêt à être mis sous tension/Non prêt à être mis sous tension                                             |                                                                                               |
| 1       | Prêt à fonctionner/Non prêt à fonctionner                                                                 |                                                                                               |
| 2       | Fonctionnement autorisé (le dispositif d'entraînement suit le point de consigne)/Fonctionnement désactivé |                                                                                               |
| 3       | Défaut présent / Pas de défaut                                                                            |                                                                                               |
| 4       | Arrêt progressif non activé/Arrêt progressif activé (pas de OFF2/OFF2)                                    |                                                                                               |
| 5       | Arrêt rapide non activé/Arrêt rapide activé (pas de OFF3/OFF3)                                            |                                                                                               |
| 6       | Mise sous tension annulée/Mise sous tension non annulée                                                   |                                                                                               |
| 7       | Avertissement présent/Pas d'avertissement                                                                 |                                                                                               |
| 8       | Erreur de vitesse dans la plage de tolérance /<br>Erreur de vitesse hors de la plage de tolérance         | Erreur suivante dans la plage de tolérance /<br>Erreur suivante hors de la plage de tolérance |
| 9       | Commande sollicitée/Aucune commande sollicitée                                                            |                                                                                               |
| 10      | f ou n atteint ou dépassé /<br>f ou n non atteint                                                         | Position cible atteinte /<br>Pas en position cible                                            |
| 11      | Spécifique au dispositif                                                                                  | Position d'origine définie/Position d'origine pas encore définie                              |
| 12      | Spécifique au dispositif                                                                                  | Acquittement de tâche traversante<br>(0 -> 1)                                                 |
| 13      | Spécifique au dispositif                                                                                  | Dispositif d'entraînement arrêté/dispositif d'entraînement en mouvement                       |
| 14 à 15 | Spécifique au dispositif                                                                                  |                                                                                               |

La signification de la valeur de bit = 1 est à gauche de la barre oblique; la valeur de bit = 0 à sa droite.

Les bits d'état communs sont donnés dans le Tableau 77 et les bits d'état qui sont différents pour la commande de vitesse (AC 4) et le positionnement (AC 3) dans le Tableau 78 et le Tableau 79.

**Tableau 77 – Affectation détaillée des bits du mot d'état commun 1 (ZSW1) pour le mode de commande de vitesse/de positionnement**

| Bit     | Valeur | Signification                              | Commentaires                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------|--------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0       | 1      | Prêt à être mis sous tension               | L'alimentation est mise sous tension, l'électronique initialisée, le compteur principal, s'il est disponible, a été désactivé, les impulsions sont annulées.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|         | 0      | Non prêt à être mis sous tension           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1       | 1      | Prêt à fonctionner                         | Se reporter au mot de commande 1, bit 0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|         | 0      | Non prêt à fonctionner                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2       | 1      | Fonctionnement autorisé                    | Le dispositif d'entraînement suit le point de consigne. Cela signifie que l'électronique et les impulsions sont activées (se reporter au mot de commande 1, bit 3), la commande en boucle fermée est active et contrôle le moteur et la sortie du canal de point de consigne est l'entrée pour la commande en boucle fermée.                                                                                                                                                                                                                                                                   |
|         | 0      | Fonctionnement désactivé                   | Soit les impulsions sont désactivées, soit le dispositif d'entraînement ne suit pas la valeur de sortie du canal de point de consigne.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3       | 1      | Défaut présent                             | Les défauts non acquittés ou les défauts actuellement non acquittables (messages de défaut) sont présents (dans la mémoire tampon des défauts). La réaction au défaut est spécifique au défaut et au dispositif. L'acquiescement d'un défaut ne peut avoir lieu que si une cause de défaut a disparu ou a été annulée auparavant. Si le défaut a isolé la tension, le dispositif d'entraînement passe en état "Mise sous tension annulée", sinon le dispositif d'entraînement se remet à fonctionner. La mémoire tampon des défauts contient les numéros de défauts spécifiques au dispositif. |
|         | 0      | Absence de défaut                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 4       | 1      | Arrêt progressif non activé (pas de OFF 2) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|         | 0      | Arrêt progressif activé (OFF 2)            | La commande "arrêt progressif (OFF 2)" est présente.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 5       | 1      | Arrêt rapide non activé (pas de OFF 3)     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|         | 0      | Arrêt rapide activé (OFF 3)                | La commande "arrêt rapide (OFF 3)" est présente.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 6       | 1      | Mise sous tension annulée                  | Le dispositif d'entraînement retourne à l'état "Mis sous tension" uniquement si "Pas d'arrêt progressif ET pas d'arrêt rapide" est suivi de "ON". Cela signifie que le bit "Mise sous tension annulée" n'est redéfini sur zéro que si la commande OFF est définie après "Pas d'arrêt progressif ET pas d'arrêt rapide".                                                                                                                                                                                                                                                                        |
|         | 0      | Mise sous tension non annulée              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 7       | 1      | Avertissement présent                      | Informations sur l'avertissement présentes dans le paramètre service/maintenance; aucun acquiescement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|         | 0      | Aucun avertissement                        | Il n'y a pas d'avertissement ou l'avertissement a à nouveau disparu.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 9       | 1      | Commande sollicitée                        | Le système d'automatisation est sollicité pour assurer le contrôle (se reporter à 6.3.11).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|         | 0      | Pas de commande sollicitée                 | Le contrôle effectué par le système d'automatisation n'est pas possible; le contrôle n'est possible qu'au dispositif ou par une autre interface.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 14 à 15 | -      | spécifique au dispositif                   | Signification non spécifiée.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**Tableau 78 – Affectation détaillée des bits du mot d'état spécial 1 (ZSW1) pour le mode de commande de vitesse**

| Bit     | Valeur | Signification                                   | Commentaires                                                                                                                                                                                                                            |
|---------|--------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8       | 1      | Erreur de vitesse dans la plage de tolérance    | La valeur réelle se trouve dans une plage de tolérance; les violations dynamiques sont autorisées pour $t < t_{\max}$ , par exemple<br>$n = n_{\text{set}} \pm$ ,<br>$f = f_{\text{set}} \pm$ , etc.,<br>$t_{\max}$ peut être paramétré |
|         | 0      | Erreur de vitesse hors de la plage de tolérance |                                                                                                                                                                                                                                         |
| 10      | 1      | f ou n atteint ou dépassé                       | Valeur instantanée $\geq$ valeur de comparaison (point de consigne) qui peut être définie via le numéro de paramètre.                                                                                                                   |
|         | 0      | f ou n non atteint                              |                                                                                                                                                                                                                                         |
| 11 à 13 | -      | spécifique au dispositif                        | Signification non spécifiée.                                                                                                                                                                                                            |

**Tableau 79 – Affectation détaillée des bits du mot d'état spécial 1 (ZSW1) pour le mode de positionnement**

| Bit | Valeur | Signification                                 | Commentaires                                                                                                                                                                                           |
|-----|--------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8   | 1      | Erreur suivante dans la plage de tolérance    | La comparaison dynamique de la position du point de consigne avec la valeur de position réelle est située avec la fenêtre d'erreur suivante définie.                                                   |
|     | 0      | Erreur suivante hors de la plage de tolérance |                                                                                                                                                                                                        |
| 10  | 1      | Position cible atteinte                       | La valeur instantanée de position est située à l'extrémité d'une Tâche traversante dans la fenêtre de positionnement.                                                                                  |
|     | 0      | Pas en position cible                         |                                                                                                                                                                                                        |
| 11  | 1      | Position d'origine définie                    | La procédure de retour à la position de référence a été exécutée et la position d'origine est valide.                                                                                                  |
|     | 0      | Position d'origine pas encore définie         | Pas de position d'origine valide disponible.                                                                                                                                                           |
| 12  | Front  | Acquittement de tâche traversante (0 -> 1)    | À l'aide du front positif, acquittement d'une nouvelle Tâche traversante ou d'un point de consigne MDI accepté. Si de diagramme d'états général de DO n'est pas à l'état S4, le bit 12 est mis à zéro. |
| 13  | 1      | Dispositif d'entraînement arrêté              | Indique qu'une Tâche traversante a été effectuée ou immobilisée pour l'arrêt intermédiaire et l'arrêt.                                                                                                 |
|     | 0      | Dispositif d'entraînement en mouvement        | La Tâche traversante est exécutée $n \neq 0$ .                                                                                                                                                         |

### 6.3.2.6 Mot d'état 2 (ZSW2)

La structure du mot d'état 2 est présentée dans le Tableau 80.

**Tableau 80 – Présentation générale de l'affectation des bits du mot d'état 2**

| Bit                                                                                                                                                                                                                                                         | Signification                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 0 à 11                                                                                                                                                                                                                                                      | Spécifique au dispositif        |
| 12 à 15                                                                                                                                                                                                                                                     | Signe de vie du DO <sup>a</sup> |
| <sup>a</sup> Si une application synchrone du cycle de l'horloge n'est pas mise en œuvre, c'est-à-dire les bits 12 à 15 du mot d'état 2 ne sont pas exigés pour transférer le signe de vie du DO, alors le mot d'état 2 complet peut être librement utilisé. |                                 |

### 6.3.2.7 Mot d'état 2 du codeur (ZSW2\_ENC)

Le mot d'état 2 du codeur est tout particulièrement dédié aux messages des DO de codeur et associe la fonctionnalité d'état de ZSW1 au signe de vie du DO de ZSW2. La structure du mot d'état 2 du codeur est présentée dans le Tableau 81..

**Tableau 81 – Présentation générale de l'affectation des bits du mot d'état 2 du codeur**

| Bit                                                                                                                   | Signification                              |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| 0 à 2                                                                                                                 | Spécifique au dispositif                   |
| 3                                                                                                                     | Présence de défaut/pas de défaut           |
| 4 à 8                                                                                                                 | Spécifique au dispositif                   |
| 9                                                                                                                     | Commande demandée/Pas de commande demandée |
| 10 à 11                                                                                                               | Spécifique au dispositif                   |
| 12 à 15                                                                                                               | Signe de vie du DO                         |
| La signification de la valeur de bit = 1 est à gauche de la barre oblique; celle de la valeur de bit = 0 à sa droite. |                                            |

### 6.3.2.8 Bit d'état "Impulsions activées/désactivées"

Le contrôleur peut obtenir les informations, si le DO a désactivé les impulsions, hors du bit d'état "Impulsions activées".

Ce bit est facultatif. Le constructeur peut utiliser un bit spécifique au dispositif du mot d'état 1 ou 2 ou, éventuellement, un bit dans un mot d'état spécifique au constructeur.

Dans les nouveaux développements, il est recommandé d'utiliser le bit 11 du mot d'état 2 pour "Impulsions activées".

L'évaluation du bit du mot d'état "Impulsions activées" est facultative (se reporter à 6.4).

Pour identifier l'utilisation et la position du bit "Impulsions activées", un paramètre de profil P924 "bit de mot d'état Impulsions activées" est défini avec la structure dans le Tableau 82.

**Tableau 82 – Structure du Paramètre 924 "Bit de mot d'état Impulsions activées"**

| Sous-index | Signification    | Commentaires                                                                                                                                                                                                                       |
|------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0          | numéro de signal | Mot d'état 1 (ZSW1), mot d'état 2 (ZSW2) ou mot d'état spécifique au constructeur. En l'absence de bit d'état "Impulsions activées" dans les données d'E/S de DO en cours, le numéro de signal 0 doit être indiqué dans PNU924[0]. |
| 1          | position binaire | 0 à 15                                                                                                                                                                                                                             |

Si le paramètre P924 est mis en œuvre dans le dispositif d'entraînement, le dispositif d'entraînement prend en charge l'évaluation des "Impulsions activées".

### 6.3.3 Modes de fonctionnement et diagramme d'états

#### 6.3.3.1 Généralités

Pour les applications avec l'axe d'entraînement, une différenciation peut se faire selon les six classes d'application PROFIdrive avec les niveaux associés des interfaces d'entraînement (se reporter à 6.1.5). Selon les différents niveaux d'interface, les modes de fonctionnement suivants sont définis dans ce profil:

- Mode de commande de vitesse  
En mode de commande de vitesse, les classes d'application 1 et 4 peuvent être combinées.

NOTE Le mode de fonctionnement commande de vitesse peut être réalisé avec différents types de modes de commande, par exemple, commande v/f, contrôle de fréquence, contrôle de tension et commande de vitesse en boucle fermée.

- Mode de positionnement  
La classe d'application 3 est émulée sous le mode de positionnement.
- Mode de fonctionnement pour la technologie de processus  
Le mode de fonctionnement pour l'intégration des dispositifs d'entraînement dans les applications de technologie de processus selon les recommandations VIK<sup>15</sup>-NAMUR<sup>16</sup> est généralement basé sur la classe d'application 1. Pour une description détaillée de ce mode, se reporter à 6.5.
- Modes spécifiques au constructeur  
Les classes d'application avec la technologie répartie ne peuvent être affectées à un mode de fonctionnement défini par le profil, dans la mesure où l'interface de commande en boucle ouverte de plus haut niveau avec la technologie est exclusivement spécifique à l'application. L'interface de mode de fonctionnement avec la commande de vitesse et la commande de retour en positionnement est déplacée vers l'intérieur entre le contrôleur technologique et le contrôleur d'axe.  
En plus des modes de fonctionnement définis par le profil et les diagrammes d'états associés, les modes de fonctionnement peuvent être définis de façon spécifique au constructeur, aussi les bits 0 à 3, 7 et 10 du mot de commande 1 et les bits 0 à 7 et 9 du mot d'état 1 doivent être utilisés en correspondance avec les modes de fonctionnement spécifiés dans le profil.
- Permutation de mode de fonctionnement  
Le réglage d'un mode de fonctionnement en régime établi peut être réalisé via le paramètre 930.

<sup>15</sup> VIK = association des clients industriels et producteurs industriels d'énergie (Association of the Industrial Customers and Industrial Power Producers).

<sup>16</sup> NAMUR = groupe de travail normatif pour l'instrumentation de mesure et de régulation dans l'industrie chimique (Standards Working Group for Instrumentation and Control in the Chemical Industry).

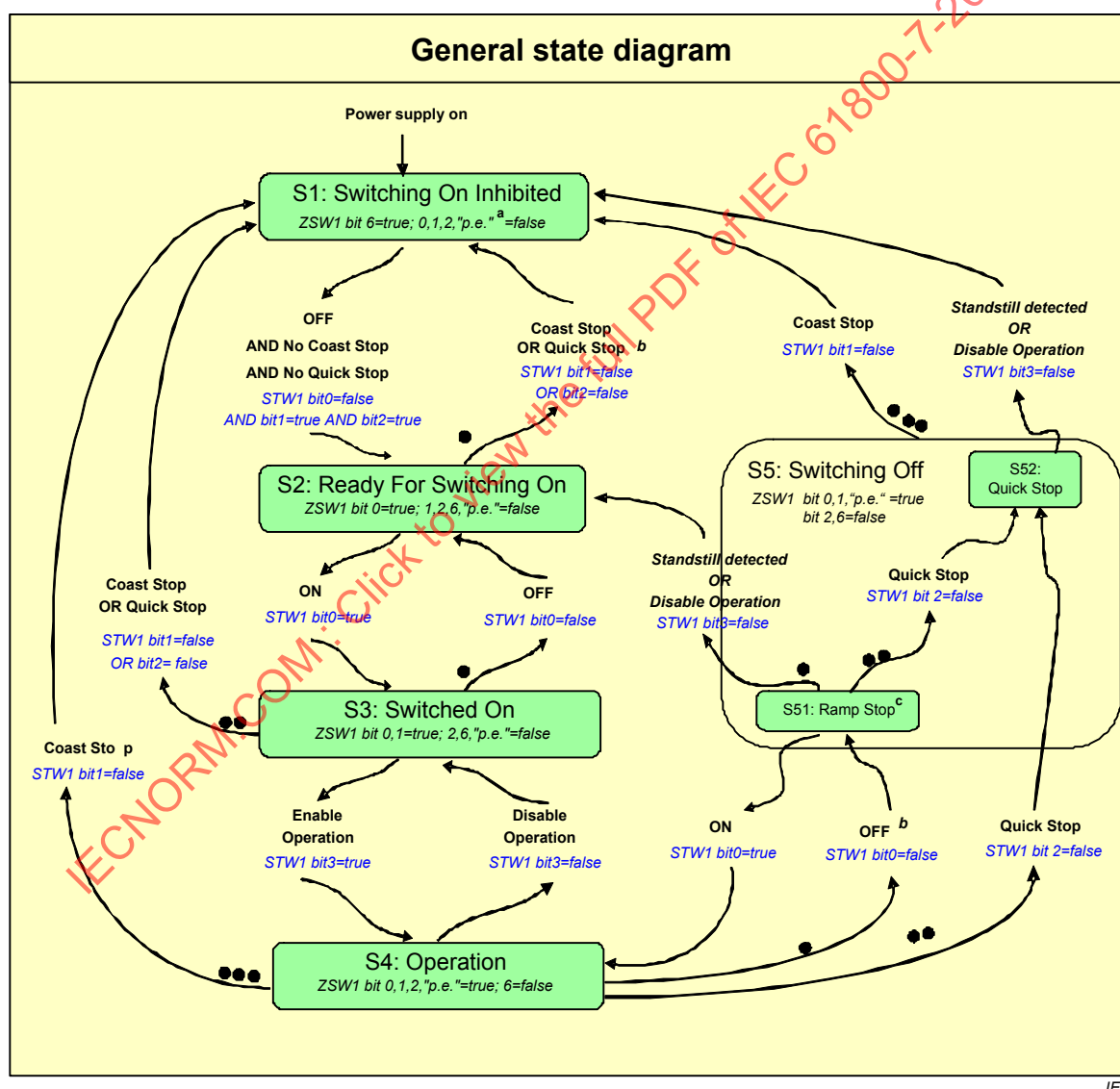
Une permutation dynamique est mise en œuvre de façon spécifique au constructeur à l'aide des bits définis de mot de commande spécifiques au dispositif.

### 6.3.3.2 Diagramme d'états général

#### Diagramme d'états

Les diagrammes d'états sont définis pour les modes de fonctionnement.

Afin de simplifier le diagramme, les états, communs à tous les modes de fonctionnement (également spécifiques au constructeur), sont combinés dans le diagramme d'états général (voir la Figure 27) avec uniquement les états supplémentaires des modes individuels donnés dans les diagrammes dédiés. Ce diagramme d'états correspond au bloc de fonction "diagramme d'états" dans le schéma fonctionnel général de l'objet d'entraînement (voir la Figure 26).



<sup>a</sup> "p.e." = "Impulsions activées" facultatives (se reporter à 6.3.2.7).

<sup>b</sup> La condition interne "défaut avec arrêt de rampe" active également la transition.

<sup>c</sup> La vitesse de décélération en mode d'arrêt de rampe passe à la vitesse maximale si bit 4 STW1 = faux en mode de commande de vitesse.

NOTE 1 Bit STW1 x,y =: Ces bits de mot de commande sont définis par la commande.

NOTE 2 Bit ZSW1 x,y = Ces bits de mot d'état indiquent l'état réel.

NOTE 3 **Arrêt détecté** est un résultat interne d'une opération d'arrêt.

| Anglais                                                                                         | Français                                                                                                  |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| General state diagram                                                                           | Diagramme d'états général                                                                                 |
| Power supply on                                                                                 | Alimentation en marche                                                                                    |
| S1: Switching On Inhibited<br>ZSW1 bit 6=true; 0,1,2 "p.e." <sup>a</sup> =false                 | S1: mise sous tension annulée<br>bit 6 ZSW1 =vrai; 0,1,2 "p.e." <sup>a</sup> =faux                        |
| OFF<br>AND No Coast Stop<br>AND No Quick Stop<br>STW1 bit0=false<br>AND bit1=true AND bit2=true | OFF<br>ET pas d'arrêt progressif<br>ET pas d'arrêt rapide<br>STW1 bit0=false<br>ET bit1=vrai ET bit2=vrai |
| Coast Stop OR Quick Stop <sup>b</sup><br>STW1 bit1=false<br>OR bit2=false                       | Arrêt progressif OU arrêt rapide <sup>b</sup><br>bit1STW1 =faux<br>OU bit2=false                          |
| Coast Stop<br>STW1 bit1=false                                                                   | Arrêt progressif<br>bit1STW1 =faux                                                                        |
| Standstill detected OR Disable Operation<br>STW1 bit3=false                                     | Arrêt détecté OU annuler fonctionnement<br>bit3STW1 =faux                                                 |
| S2: Ready For Switching On<br>ZSW1 bit 0=true; 1,2,6,"p.e."=false                               | S2: prêt pour mise sous tension<br>bit 0 ZSW1 =vrai; 1,2,6,"p.e."=faux                                    |
| S5: Switching Off<br>ZSW1 bit 0,1,"p.e."=true<br>bit 2,6=false                                  | S5: mise hors tension<br>bit 0,1 ZSW1, "p.e."=vrai<br>bit 2,6=false                                       |
| Quick Stop                                                                                      | Arrêt rapide                                                                                              |
| Coast Stop OR Quick Stop                                                                        | Arrêt progressif OU arrêt rapide                                                                          |
| ON<br>STW1 bit0=true                                                                            | ON<br>STW1 bit0=vrai                                                                                      |
| OFF<br>STW1 bit0=false                                                                          | OFF<br>bit0STW1 =faux                                                                                     |
| Quick Stop<br>STW1 bit2=false                                                                   | Arrêt rapide<br>bit2STW1 =faux                                                                            |
| Coast Stop<br>STW1 bit1=false                                                                   | Arrêt progressif<br>bit1STW1 =faux                                                                        |
| S3: Switched On<br>ZSW1 bit 0,1=true; 2,6,"p.e."=false                                          | S3: mis sous tension<br>bit 0,1 ZSW1 =vrai; 2,6,"p.e."=faux                                               |
| Ramp Stop                                                                                       | Arrêt de rampe                                                                                            |
| Enable Operation<br>STW1 bit3=true                                                              | Autoriser opération<br>bit3 STW1 =vrai                                                                    |
| Disable Operation<br>STW1 bit3= false                                                           | Annuler fonctionnement<br>bit3 STW1 =faux                                                                 |
| ON<br>STW1 bit0=true                                                                            | ON<br>bit0 STW1 =vrai                                                                                     |
| OFF <sup>b</sup><br>STW1 bit0=false                                                             | OFF <sup>b</sup><br>bit0 STW1 =faux                                                                       |
| Quick Stop<br>STW1 bit2=false                                                                   | Arrêt rapide<br>bit2 STW1 =faux                                                                           |
| S4: Operation<br>ZSW1 bit 0,1,2,"p.e."=true; 6=false                                            | S4: Fonctionnement<br>bit 0,1,2 ZSW1, "p.e."=vrai; 6=false                                                |

**Figure 27 – Diagramme d'états général  
pour tous les modes de fonctionnement**

Informations sur le diagramme d'états général.

- Les blocs verts représentent les états, les flèches représentent les transitions.
- À partir de plusieurs états, différentes transitions sont possibles. Afin d'obtenir un comportement de dispositif normalisé, les transitions sont spécifiées avec les priorités affectées dans les diagrammes d'états particuliers en 6.3.3. Les points sont utilisés pour identifier le niveau de priorité. Plus une transition a de points, plus la priorité est élevée. À une transition sans point correspond donc la priorité la plus faible.

- Dans le diagramme d'états général, les conditions internes du dispositif d'entraînement ne sont pas données. Les signaux internes peuvent influencer les transitions.

Toutes les transitions dans ce diagramme d'états général ne peuvent être initiées que par un contrôleur, si celui-ci a la priorité de commande. Les conditions suivantes doivent être satisfaites pour donner au contrôleur la priorité de commande (se reporter aussi à 6.3.11):

- l'interface PROFIBUS ou PROFINET entre ce contrôleur et le DO a la priorité de commande (P928);
- le Bit 9 ZSW1 est défini par le DO;
- le Bit 10 ZSW1 est défini par le contrôleur.

Les conditions internes du dispositif d'entraînement ou de la priorité de commande d'une autre interface peuvent provoquer des transitions qui sont indépendantes de ce contrôleur.

Les bits définis pour le mode de positionnement sont pertinents uniquement si le dispositif d'entraînement se trouve dans l'état S4 "Fonctionnement".

À noter que la priorité des Réactions d'arrêt suit l'ordre suivant: Arrêt de rampe, arrêt rapide et arrêt progressif; l'arrêt progressif correspondant à la priorité la plus haute et l'arrêt de rampe à la priorité la plus faible. L'effet et la priorité des Réactions d'arrêt sont indépendants de l'origine (diagramme d'états général, canal de point de consigne de vitesse bits 4, 6 STW1 ou Réactions d'arrêt provoquées par des défauts). Cela signifie que toute Réaction d'arrêt avec une priorité plus élevée écrase toute Réaction d'arrêt avec une priorité plus faible. Par exemple, si l'axe est mis hors tension par le bit 0 STW1 = 0 et reste dans Arrêt de rampe S5, un réglage simultané de bit 4 STW1 = 0 entraîne l'axe à un Arrêt de rampe avec une vitesse de décélération maximale.

De plus, toutes les réactions d'arrêt provoquées par des défauts (défaut avec Arrêt de rampe, défaut avec arrêt rapide, défaut avec arrêt progressif) forcent le diagramme d'états général à passer à l'état S1 (Mise sous tension annulée) ou S2 (prêt pour mise sous tension).

### **6.3.3.3 Mode de commande de vitesse**

#### **6.3.3.3.1 Généralités**

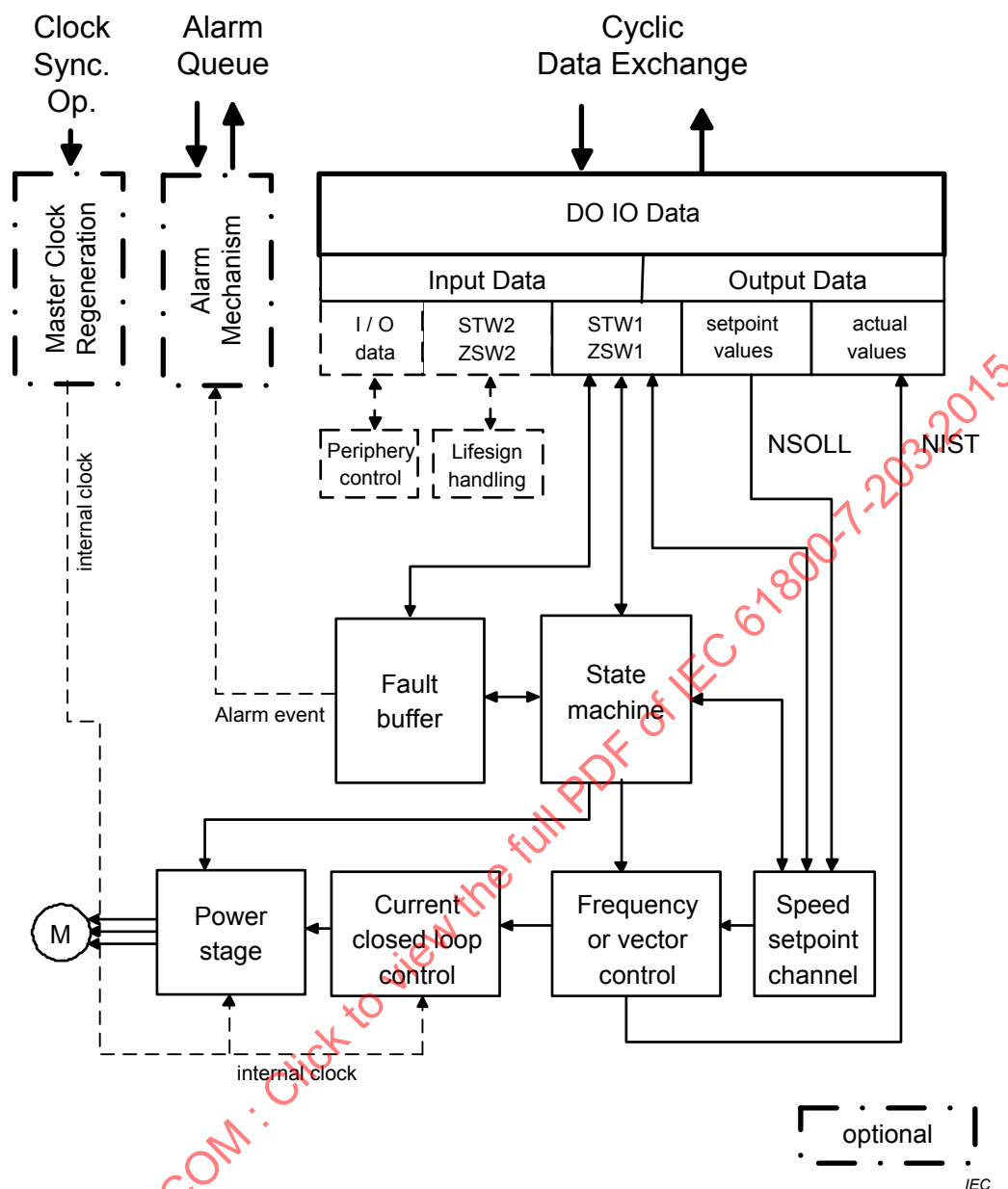
Le mode de commande de vitesse comprend les interfaces du point de consigne de vitesse utilisées dans les classes d'application 1 et 4. Généralement, les deux interfaces utilisent STW1/ZSW1 et l'entrée du point de consigne de vitesse pour contrôler le dispositif d'entraînement. Les différences entre l'interface du point de consigne de vitesse dans la classe d'application 1 et la classe d'application 4 sont les différentes valeurs de réaction (données de sortie) et les différentes fonctionnalités du canal de point de consigne de vitesse.

A noter que toutes les réactions d'arrêt hors du diagramme d'états (arrêt progressif, arrêt rapide et arrêt de rampe) ont une priorité plus élevée que les fonctions d'asservissement du canal de point de consigne de vitesse.

#### **6.3.3.3.2 Mode de commande de vitesse pour la classe d'application 1**

La commande de vitesse dans la classe d'application 1 est généralement représentée par l'absence d'interface de retour en position et le commande en boucle ouverte de la vitesse (ou couple) via l'interface PROFIdrive. La Figure 28 montre la fonctionnalité typique d'un objet d'entraînement PROFIdrive de classe d'application 1. Le fonctionnement synchrone de l'horloge est facultatif et généralement non nécessaire.





| Anglais                   | Français                              |
|---------------------------|---------------------------------------|
| Clock Sync. Op.           | Fonctionnement synchrone de l'horloge |
| Alarm Queue               | File d'attente d'alarme               |
| Cyclic Data Exchange      | Échange de données cycliques          |
| Master Clock Regeneration | Régénération de l'horloge maîtresse   |
| Alarm Mechanism           | Mécanisme d'alarme                    |
| DO IO Data                | Données E-S de DO                     |
| Input Data                | Données d'entrée                      |
| Output Data               | Données de sortie                     |
| I/O data                  | Données E/S                           |
| Setpoint values           | Valeurs de point de consigne          |
| Actual values             | Valeurs instantanées                  |
| Periphery control         | Commande périphérique                 |

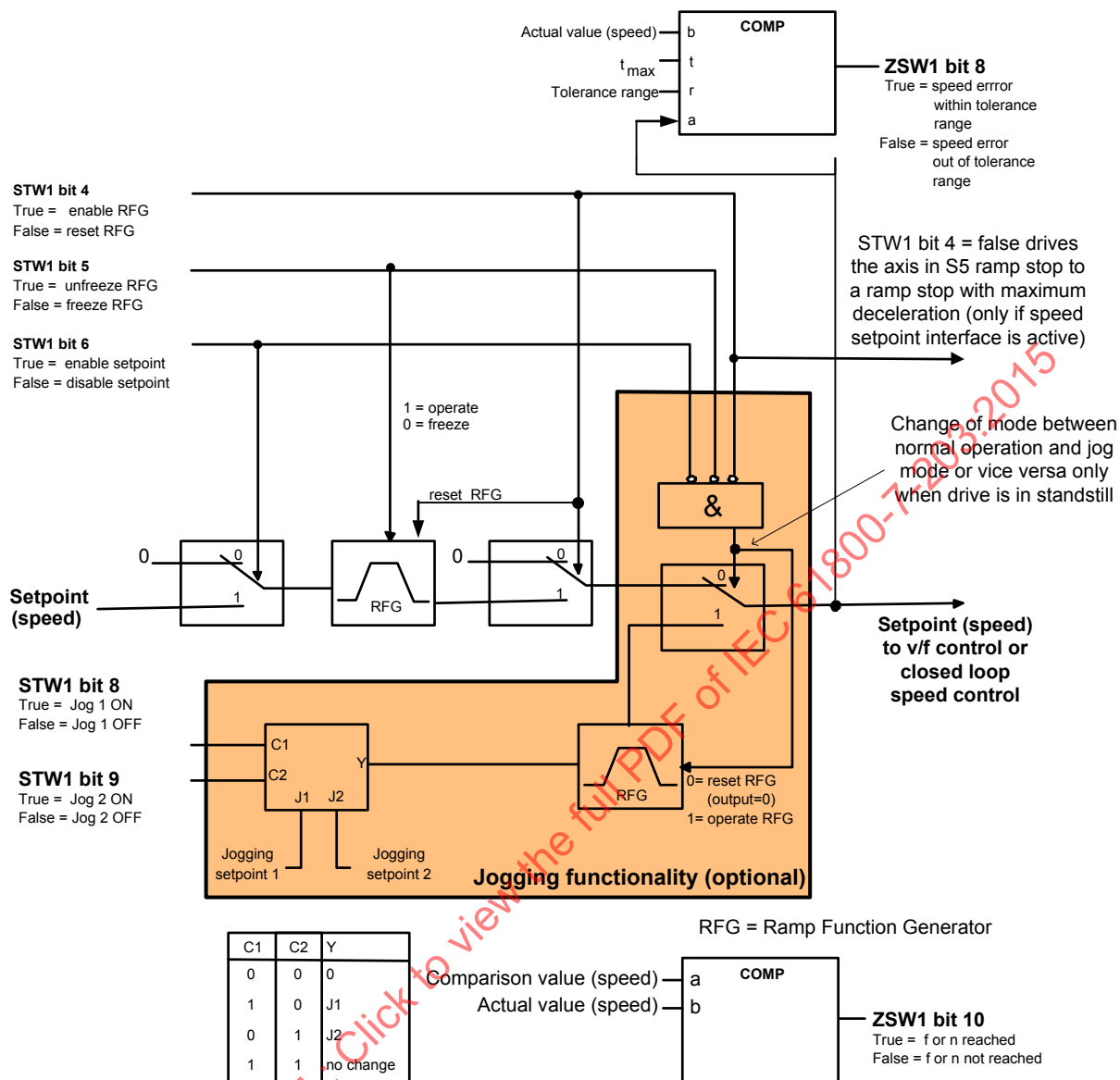
| Anglais                     | Français                              |
|-----------------------------|---------------------------------------|
| Lifesign handling           | Traitement de signe de vie            |
| Internal clock              | Horloge interne                       |
| Alarm event                 | Événement d'alarme                    |
| Fault buffer                | Mémoire tampon des défauts            |
| State machine               | Diagramme d'états                     |
| Power stage                 | Étage de puissance                    |
| Current closed loop control | Commande en boucle fermée actuelle    |
| Frequency or vector control | Contrôle de fréquence ou de vecteur   |
| Speed setpoint channel      | Canal de point de consigne de vitesse |
| Optional                    | Facultatif                            |

**Figure 28 – Fonctionnalité générale d'un DO axe PROFIdrive avec fonctionnalité de classe d'application 1**

La Figure 29 montre la fonctionnalité typique du bloc de canal de point de consigne de vitesse dans la classe d'application 1 et l'effet des bits de commande STW1 sur le canal de point de consigne de vitesse. La fonctionnalité de mode par à-coups est facultative.

Si le DO prend en charge le paramètre PNU930 (mode de fonctionnement), le dispositif d'entraînement montre la fonctionnalité du canal de point de consigne de vitesse et la prise en charge des bits 4, 5, 6 en STW1 selon la Figure 29 en répondant à une demande de lecture de paramètre sur PNU930 avec la valeur = 1 (il s'agit aussi de la valeur par défaut si le DO ne prend pas en charge PNU930).

Le générateur de fonction de rampe (RFG) est défini sur la sortie zéro si le bit 4 STW1 est défini sur zéro. Si le RFG est activé par le bit 4 STW1 = 1, la sortie RFG lance la valeur de point de consigne zéro ou la valeur de point de consigne de la sortie RFG peut être synchronisée avec la valeur instantanée de la vitesse d'axe (spécifique au fournisseur).



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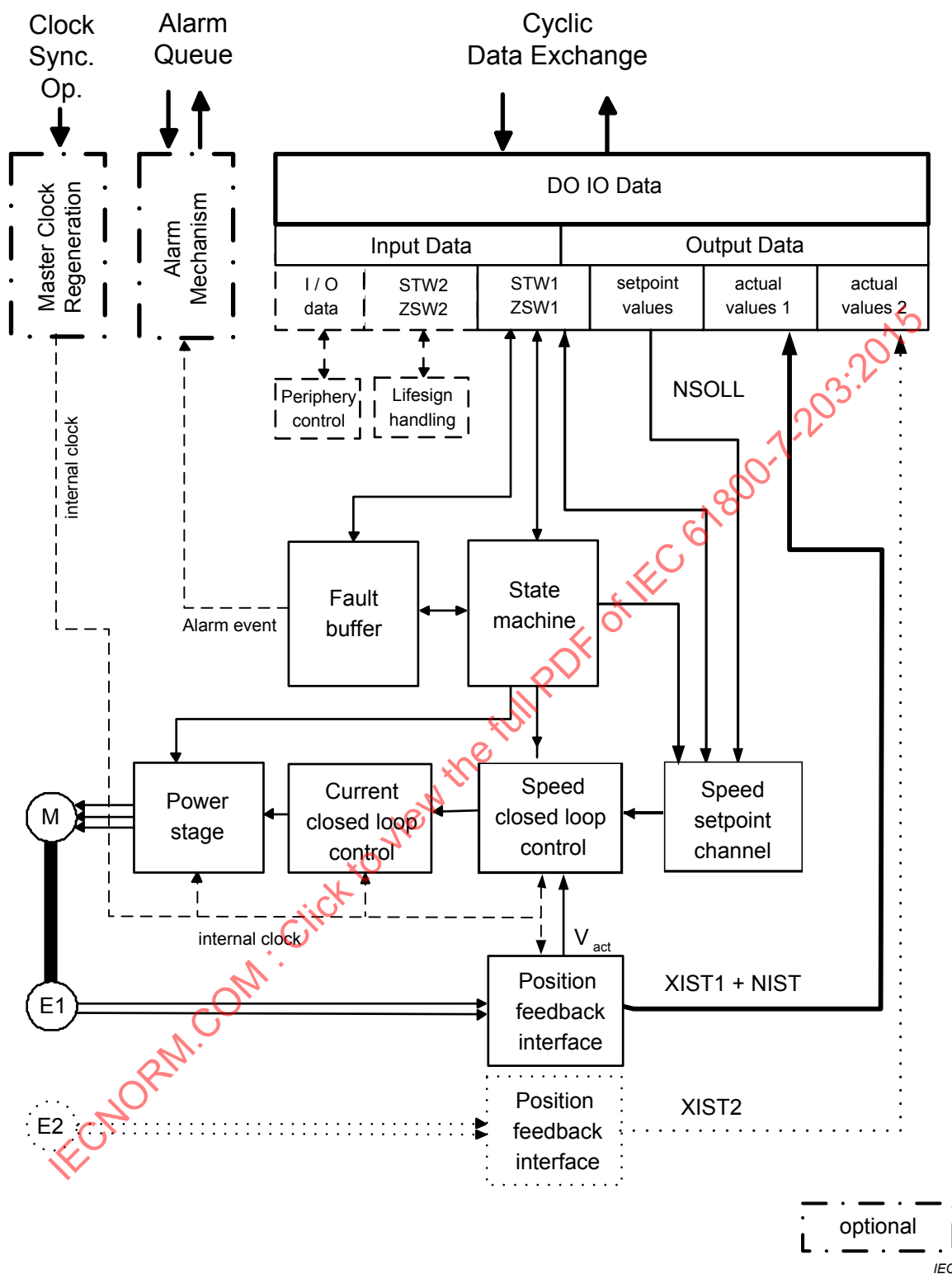
| Anglais                                    | Français                                               |
|--------------------------------------------|--------------------------------------------------------|
| Tolerance range                            | Plage de tolérance                                     |
| Actual value (speed)                       | Valeur instantanée (vitesse)                           |
| True = speed error within tolerance range  | Vrai = erreur de vitesse dans la plage de tolérance    |
| False = speed error out of tolerance range | Faux = erreur de vitesse hors de la plage de tolérance |
| True = enable RFG                          | Vrai = activer RFG                                     |
| False = reset RFG                          | Faux = réinitialiser RFG                               |
| True = unfreeze RFG                        | Vrai = libérer RFG                                     |
| False = freeze RFG                         | Faux = figer RFG                                       |
| True = enable setpoint                     | Vrai = activer point de consigne                       |
| False = disable setpoint                   | Faux = désactiver point de consigne                    |
| 1 = operate                                | 1 = fonctionner                                        |
| 0 = freeze                                 | 0 = figer                                              |
| Setpoint (speed)                           | Point de consigne (vitesse)                            |
| Reset RFG                                  | Réinitialiser RFG                                      |

| Anglais                                                                                                                                  | Français                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| True = jog 1 ON                                                                                                                          | Vrai = à coups 1 ON                                                                                                                                                              |
| False = jog 1 OFF                                                                                                                        | Faux = à coups 1 OFF                                                                                                                                                             |
| True = jog 2 ON                                                                                                                          | Vrai = à coups 2 ON                                                                                                                                                              |
| False = jog 2 OFF                                                                                                                        | Faux = à coups 2 OFF                                                                                                                                                             |
| Jogging setpoint                                                                                                                         | Point de consigne par à-coups                                                                                                                                                    |
| Jogging functionality (optional)                                                                                                         | Fonctionnalité par à-coups (facultative)                                                                                                                                         |
| STW1 bit 4 = false drives the axis in S5 ramp stop to a ramp stop with maximum deceleration (only if speed setpoint interface is active) | Bit 4 STW1 = faux entraîne l'axe de l'arrêt de rampe S5 à l'arrêt de rampe avec une décélération maximale (uniquement si l'interface de point de consigne de vitesse est active) |
| Change of mode between normal operation and jog mode or vice versa only when drive is in stand still                                     | Changement de mode entre le fonctionnement normal et le mode par à-coups, ou inversement, uniquement une fois que le dispositif d'entraînement est à l'arrêt                     |
| Setpoint (speed) To v/f control or closed loop speed control                                                                             | Point de consigne (vitesse) Vers la commande v/f ou la commande de vitesse en boucle fermée                                                                                      |
| RFG = Ramp Function Generator                                                                                                            | RFG = générateur de fonction de rampe                                                                                                                                            |
| True = f or n reached                                                                                                                    | Vrai = f ou n atteint                                                                                                                                                            |
| False = f or n not reached                                                                                                               | Faux = f ou n non atteint                                                                                                                                                        |
| Output=0                                                                                                                                 | Sortie=0                                                                                                                                                                         |
| Operate RFG                                                                                                                              | Activer RFG                                                                                                                                                                      |
| No change                                                                                                                                | Pas de modification                                                                                                                                                              |
| Comparison value (speed)                                                                                                                 | Valeur de comparaison (vitesse)                                                                                                                                                  |
| Actual value (speed)                                                                                                                     | Valeur instantanée (vitesse)                                                                                                                                                     |

**Figure 29 – Canal de point de consigne de vitesse pour utilisation dans les classes d'application 1 et 4**

#### 6.3.3.3.3 Mode de commande de vitesse pour la classe d'application 4

La commande de vitesse dans la classe d'application 4 est généralement utilisée pour le positionnement par l'utilisation d'entraînements asservis avec interpolation centrale. La commande en boucle fermée de position située sur la commande est donc fermée via l'interface PROFIdrive. Pour cette classe d'application, l'interface de retour en position et le fonctionnement synchrone de l'horloge sont nécessaires. En option, une deuxième interface de retour en position et une fonctionnalité DSC supplémentaire peuvent être appliquées. La Figure 30 montre la fonctionnalité typique d'un DO axe PROFIdrive de classe d'application 4.



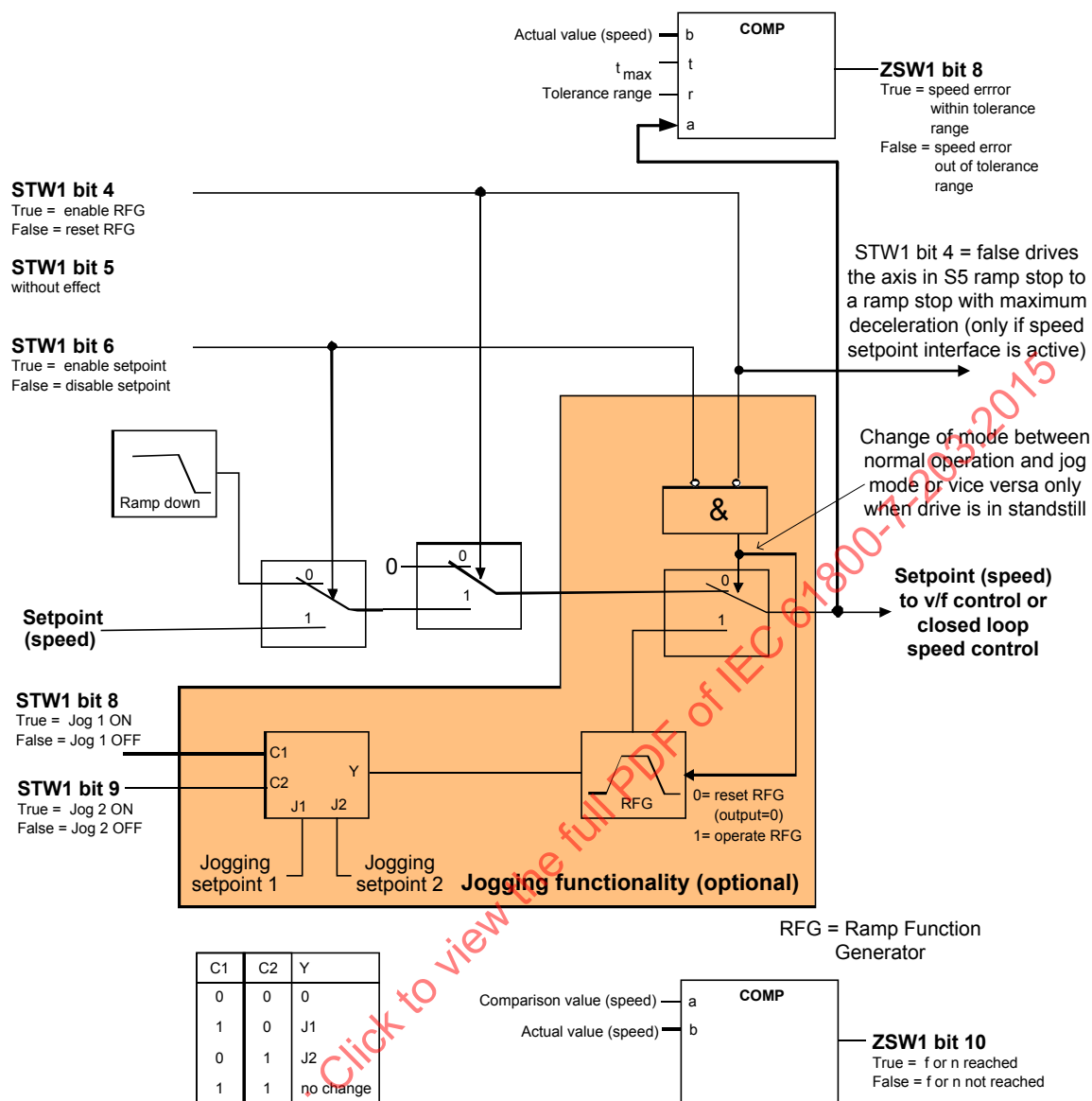
| Anglais                   | Français                              |
|---------------------------|---------------------------------------|
| Clock Sync. Op.           | Fonctionnement synchrone de l'horloge |
| Alarm Queue               | File d'attente alarme                 |
| Cyclic Data Exchange      | Échange de données cycliques          |
| Master Clock Regeneration | Régénération d'horloge maîtresse      |
| Alarm Mechanism           | Mécanisme d'alarme                    |

| Anglais                     | Français                              |
|-----------------------------|---------------------------------------|
| DO IO Data                  | Données E-S de DO                     |
| Input Data                  | Données d'entrée                      |
| Output Data                 | Données de sortie                     |
| I/O data                    | Données E/S                           |
| Setpoint values             | Valeurs de point de consigne          |
| Actual values               | Valeurs instantanées                  |
| Periphery control           | Commande périphérique                 |
| Lifesign handling           | Traitement de signe de vie            |
| Internal clock              | Horloge interne                       |
| Alarm event                 | Événement d'alarme                    |
| Fault buffer                | Mémoire tampon des défauts            |
| State machine               | Diagramme d'états                     |
| Power stage                 | Étage de puissance                    |
| Current closed loop control | Commande en boucle fermée actuelle    |
| Speed closed loop control   | Commande en boucle fermée de vitesse  |
| Speed setpoint channel      | Canal de point de consigne de vitesse |
| Optional                    | Facultatif                            |
| Position feedback interface | Interface de retour en position       |

**Figure 30 – Fonctionnalité générale d'un DO axe PROFIdrive avec fonctionnalité de classe d'application 4**

Dans la classe d'application 4, un générateur de fonction de rampe (RFG) n'est généralement pas nécessaire dans le canal de point de consigne de vitesse. Un canal de point de consigne de vitesse plus simple, sans fonctionnalité RFG (facultatif), peut donc être utilisé. La Figure 31 montre la fonctionnalité de ce bloc de canal de point de consigne de vitesse réduit utilisé dans la classe d'application 4 et l'effet des bits de commande STW1 sur le canal de point de consigne de vitesse. Avec ce canal de point de consigne de vitesse, le bit 5 STW1 n'a pas d'effet. La fonctionnalité de mode par à-coups est facultative.

Si le DO prend en charge le paramètre PNU930 (mode de fonctionnement), le DO montre la fonctionnalité du canal de point de consigne de vitesse réduit en répondant à une demande de lecture de paramètre sur PNU930 avec une valeur = 3 (si le DO prend en charge un canal de point de consigne de vitesse réduit, PNU930 est obligatoire).



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| Anglais                                    | Français                                               |
|--------------------------------------------|--------------------------------------------------------|
| Tolerance range                            | Plage de tolérance                                     |
| Actual value (speed)                       | Valeur instantanée (vitesse)                           |
| True = speed error within tolerance range  | Vrai = erreur de vitesse dans la plage de tolérance    |
| False = speed error out of tolerance range | Faux = erreur de vitesse hors de la plage de tolérance |
| True = enable RFG                          | Vrai = activer RFG                                     |
| False = reset RFG                          | Faux = réinitialiser RFG                               |
| Without effect                             | Sans effet                                             |
| True = enable setpoint                     | Vrai = activer point de consigne                       |
| False = disable setpoint                   | Faux = désactiver point de consigne                    |
| Ramp down                                  | Rampe arrêtée                                          |
| Setpoint (speed)                           | Point de consigne (vitesse)                            |
| True = jog 1 ON                            | Vrai = à coups 1 ON                                    |

| Anglais                                                                                                                                  | Français                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| False = jog 1 OFF                                                                                                                        | Faux = à coups 1 OFF                                                                                                                                                             |
| True = jog 2 ON                                                                                                                          | Vrai = à coups 2 ON                                                                                                                                                              |
| False = jog 2 OFF                                                                                                                        | Faux = à coups 2 OFF                                                                                                                                                             |
| Jogging setpoint                                                                                                                         | Point de consigne par à-coups                                                                                                                                                    |
| Jogging functionality (optional)                                                                                                         | Fonctionnalité par à-coups (facultative)                                                                                                                                         |
| 0=reset RFG<br>(output=0)<br>1=operate RFG                                                                                               | 0=réinitialiser RFG<br>(sortie=0)<br>1=fonctionnement RFG                                                                                                                        |
| STW1 bit 4 = false drives the axis in S5 ramp stop to a ramp stop with maximum deceleration (only if speed setpoint interface is active) | Bit 4 STW1 = faux entraîne l'axe de l'arrêt de rampe S5 à l'arrêt de rampe avec une décélération maximale (uniquement si l'interface de point de consigne de vitesse est active) |
| Change of mode between normal operation and jog mode or vice versa only when drive is in stand still                                     | Changement de mode entre le fonctionnement normal et le mode par à-coups, ou inversement, uniquement une fois que le dispositif d'entraînement est à l'arrêt                     |
| Setpoint (speed) To v/f control or closed loop speed control                                                                             | Point de consigne (vitesse) Vers la commande v/f ou la commande de vitesse en boucle fermée                                                                                      |
| RFG = Ramp Function Generator                                                                                                            | RFG = générateur de fonction de rampe                                                                                                                                            |
| True = f or n reached                                                                                                                    | Vrai = f ou n atteint                                                                                                                                                            |
| False = f or n not reached                                                                                                               | Faux = f ou n non atteint                                                                                                                                                        |
| Comparison value (speed)                                                                                                                 | Valeur de comparaison (vitesse)                                                                                                                                                  |
| Actual value (speed)                                                                                                                     | Valeur instantanée (vitesse)                                                                                                                                                     |
| No change                                                                                                                                | Pas de modification                                                                                                                                                              |

**Figure 31 – Canal de point de consigne de vitesse réduit pour utilisation dans la classe d'application 4 (facultatif)**

#### 6.3.3.3.4 Fonctionnalité par à-coups en mode de commande de vitesse

La fonctionnalité par à-coups est facultative. La condition préalable pour le mode par à-coups est que le dispositif d'entraînement soit déjà commuté sur l'état S4 "fonctionnement". La commutation de mode entre le fonctionnement normal et le mode par à-coups (le dispositif d'entraînement suit le point de consigne par à-coups) n'est possible que lorsque le dispositif d'entraînement est à l'arrêt. Pour passer en mode par à-coups (le dispositif d'entraînement montre l'effet sur les bits par à-coups (STW1, bits 8 et 9)), le canal de point de consigne normalisé doit être entièrement désactivé (STW1, bit 4 = 0, bit 5 = 0, bit 6 = 0; le bit 5 n'a pas d'effet dans le cas d'un "canal de point de consigne de vitesse réduit"). Quitter le mode par à-coups et recommuter en fonctionnement normal exige tout d'abord que le dispositif d'entraînement soit à l'arrêt en mode par à-coups (STW1, Bits 8, 9 = 0). Il n'est pas nécessaire que les bits 4, 5, 6 STW1 forcent le dispositif d'entraînement à quitter le mode par à-coups si le dispositif d'entraînement n'est pas déjà à l'arrêt. Si en mode par à-coups, le point de consigne de vitesse du "point de consigne par à-coups 1" est activé (bit 8 = 1 STW1) et qu'ensuite le "point de consigne par à-coups 2" (bit 9 = 1 STW1) est activé, le dispositif d'entraînement conserve alors l'ancienne valeur du point de consigne "point de consigne par à-coups 1". Si les deux bits par à-coups sont activés simultanément (du bit 8 STW1 = bit 9 = 0 au bit 8 STW1 = bit 9 = 1 avec le cycle DP suivant), la valeur du point de consigne par à-coups est zéro.

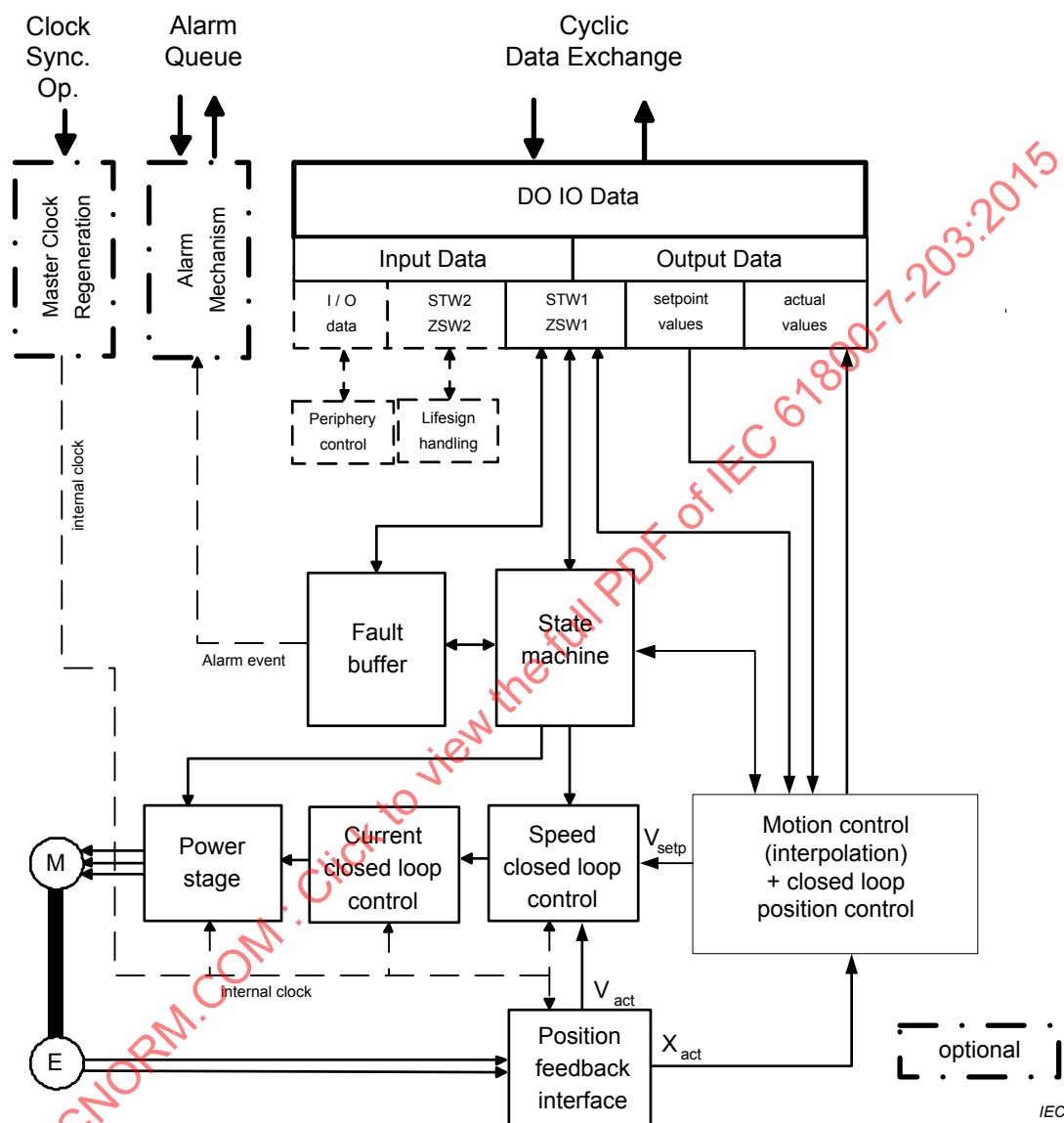
#### 6.3.3.4 Mode de positionnement

##### 6.3.3.4.1 Généralités

En "mode positionnement", qui fait référence à la classe d'application 3, le bloc de fonction du canal de point de consigne de vitesse est remplacé par le bloc de fonction "commande de mouvement" (voir la Figure 32). Le bloc de commande de mouvement comprend la fonctionnalité d'un asservissement en boucle fermée de position et un interpolateur pour un



mouvement de point à point d'axe simple ainsi que la fonctionnalité facultative de retour à la position de référence et par à-coups. En mode de positionnement, les bits dans le STW1/ZSW1, dédiés en mode de commande de vitesse au canal de point de consigne de vitesse, sont utilisés pour contrôler le fonctionnement de commande de mouvement (se reporter à 6.3.2). De plus, le diagramme d'états général/de transition conforme à la Figure 27 est étendu en mode de positionnement selon la Figure 35.



| Anglais                   | Français                              |
|---------------------------|---------------------------------------|
| Clock Sync. Op.           | Fonctionnement synchrone de l'horloge |
| Alarm Queue               | File d'attente alarme                 |
| Cyclic Data Exchange      | Échange de données cycliques          |
| Master Clock Regeneration | Régénération d'horloge maîtresse      |
| Alarm Mechanism           | Mécanisme d'alarme                    |
| DO IO Data                | Données E-S de DO                     |
| Input Data                | Données d'entrée                      |
| Output Data               | Données de sortie                     |
| I/O data                  | Données E/S                           |
| Setpoint values           | Valeurs de point de consigne          |
| Actual values             | Valeurs instantanées                  |

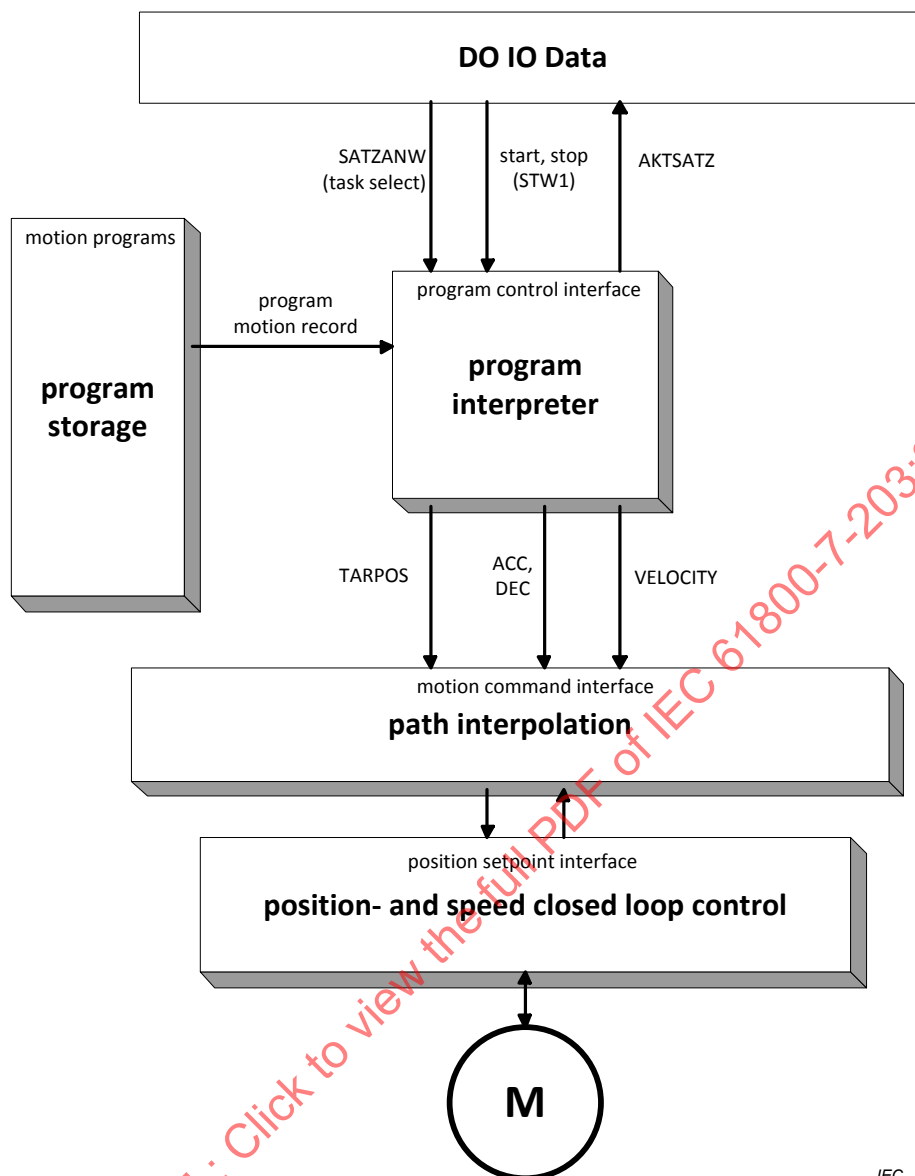
| Anglais                                                       | Français                                                                            |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Periphery control                                             | Commande périphérique                                                               |
| Lifesign handling                                             | Traitement de signe de vie                                                          |
| Internal clock                                                | Horloge interne                                                                     |
| Alarm event                                                   | Événement d'alarme                                                                  |
| Fault buffer                                                  | Mémoire tampon des défauts                                                          |
| State machine                                                 | Diagramme d'états                                                                   |
| Power stage                                                   | Étage de puissance                                                                  |
| Current closed loop control                                   | Commande en boucle fermée actuelle                                                  |
| Speed closed loop control                                     | Commande en boucle fermée de vitesse                                                |
| Motion control (interpolation) + closed loop position control | Commande de mouvement (interpolation) + asservissement de position en boucle fermée |
| Optional                                                      | Facultatif                                                                          |
| Position feedback interface                                   | Interface de retour en position                                                     |

**Figure 32 – Fonctionnalité générale d'un DO axe PROFIdrive avec fonctionnalité de classe d'application 3**

Généralement, le mode de positionnement comprend les deux sous-modes "Programme" et "saisie manuelle de données" (MDI). Un dispositif d'entraînement qui prend en charge le mode de positionnement doit prendre en charge le sous-mode Programme et peut prendre en charge le sous-mode MDI.

#### **6.3.3.4.2 Mode de positionnement avec sous-mode Programme**

Le contrôleur de mouvement pour le sous-mode Programme est constitué de la commande en boucle fermée de position, de l'interpolation de chemin, l'interpréteur de programme et l'archivage de programme (voir la Figure 33). L'interpolation de chemin génère de façon cyclique des points de consigne de position pour la commande en boucle fermée de position de l'axe. L'entrée dans l'interpolation de chemin est une commande de mouvement qui est constituée de la nouvelle position cible (TARPOS) et de la vitesse, l'accélération et la décélération pour le calcul du chemin entre la position réelle de l'axe et la nouvelle position cible. Avec le sous-mode Programme, la commande de mouvement est fournie par l'interpréteur de programme à partir d'un programme de mouvement. Un ou plusieurs programmes de mouvement sont archivés par les registres de mouvement de façon spécifique au dispositif dans l'archivage de programme. Le contrôle de l'interpréteur de programme est effectué par les bits dédiés de STW1 (voir le Tableau 73) et le signal SATZANW depuis les données E-S de DO.



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| Anglais                                 | Français                                                                            |
|-----------------------------------------|-------------------------------------------------------------------------------------|
| DO IO data                              | Données E-S de DO                                                                   |
| (task selected)                         | (tâche sélectionnée)                                                                |
| Start, stop                             | Démarrage, arrêt                                                                    |
| Motion programs                         | Programmes de mouvement                                                             |
| Program storage                         | Archivage de programme                                                              |
| Program motion record                   | Registre de mouvement de programme                                                  |
| Program control interface               | Interface de commande de programme                                                  |
| Program interpreter                     | Interpréteur de programme                                                           |
| Motion command interface                | Interface de commande de mouvement                                                  |
| Path interpolation                      | Interpolation de chemin                                                             |
| Position setpoint interface             | Interface de point de consigne de position                                          |
| Position- and speed closed loop control | Asservissement de position en boucle fermée et commande de vitesse en boucle fermée |

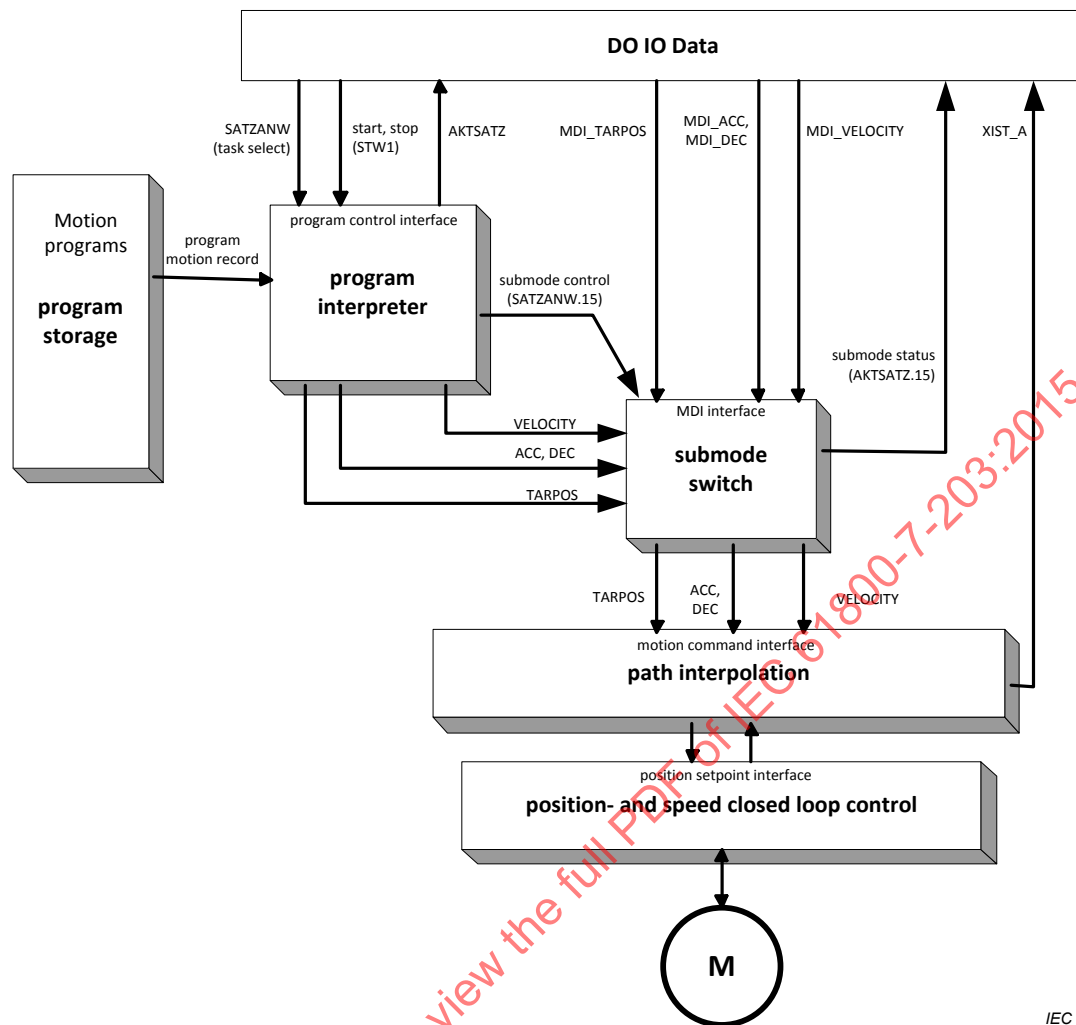
**Figure 33 – Fonctionnalité du contrôleur de mouvement dans le sous-mode Programme**

Le lancement d'un programme de mouvement ou le passage à un nouveau programme en même temps que l'exécution d'un programme est réalisé en sélectionnant le premier registre

de mouvement du nouveau programme via SATZANW (alors que bit 15 SATZANW = 0) et un front positif du Bit6 STW1 conformément à 6.3.3.4.6. Le programme de mouvement est ensuite exécuté par le registre de mouvement de l'interpréteur de programme pour le registre de mouvement, tant qu'il n'y a pas d'état d'arrêt ou de fin dans un registre de mouvement et que le programme n'est pas achevé par Bit4 STW1 = 0 (rejeter la Tâche traversante). Le mouvement de l'axe peut aussi être arrêté de façon intermédiaire par le Bit5 STW1 = 0 (arrêt intermédiaire). Voir également la Figure 35.

#### 6.3.3.4.3 Mode de positionnement avec sous-mode MDI

Le contrôleur de mouvement pour le sous-mode de saisie manuelle de données (MDI) comprend également, en plus des composants du sous-mode Programme, un interrupteur de sous-mode qui permet un accès direct à l'interface de commande de mouvement à partir des données E-S de DO sans utiliser l'interpréteur de programme. Cela permet d'assurer un contrôle immédiat de l'interface de commande de mouvement par le contrôleur via les DONNEES E-S de DO. La permutation entre l'exécution de programme et l'interface MDI et inversement est contrôlée par le Bit15 de SATZANW (voir le Tableau 83). Si le sous-mode MDI est actif, l'entrée pour l'interface de commande de mouvement de l'interpolateur de chemin est extraite des signaux MDI\_TARPOS, MDI\_ACC, MDI\_DEC et MDI\_VELOCITY (voir la Figure 34). Ces valeurs deviennent valides en tant qu'entrée pour le calcul d'un nouveau chemin entre la position réelle de l'axe et la nouvelle position cible avec le front ascendant du Bit6 STW1 (voir la Figure 38 Figure 37). Le contrôle du processus de mouvement est assuré par les bits dédiés de STW1 (voir le Tableau 73) depuis les données E-S de DO. Voir également la Figure 35. Le signal MDI\_ACC définit l'accélération du mouvement au début du chemin, alors que le signal MDI\_DEC définit la décélération à l'extrémité du chemin (indépendamment de la direction absolue de mouvement). Le signal MDI\_MOD définit des attributs supplémentaires pour la commande de mouvement et la permutation entre la commande de mouvement précédente et la nouvelle commande de mouvement (voir le Tableau 85).



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| Anglais                                 | Français                                                           |
|-----------------------------------------|--------------------------------------------------------------------|
| DO IO data                              | Données E-S de DO                                                  |
| (task select)                           | (tâche sélectionnée)                                               |
| Start, stop                             | Démarrage, arrêt                                                   |
| Motion programs                         | Programmes de mouvement                                            |
| Program storage                         | Archivage de programme                                             |
| Program motion record                   | Registre de mouvement de programme                                 |
| Program control interface               | Interface de commande de programme                                 |
| Program interpreter                     | Interpréteur de programme                                          |
| Submode control                         | Commande de sous-mode                                              |
| Submode status                          | État de sous-mode                                                  |
| VELOCITY                                | VITESSE                                                            |
| ACC, DEC                                | ACC, DEC                                                           |
| MDI interface                           | Interface MDI                                                      |
| Submode switch                          | Interrupteur de sous-mode                                          |
| Motion command interface                | Interface de commande de mouvement                                 |
| Path interpolation                      | Interpolation de chemin                                            |
| Position setpoint interface             | Interface de point de consigne de position                         |
| Position- and speed closed loop control | Asservissement de position et commande de vitesse en boucle fermée |

Figure 34 – Fonctionnalité du contrôleur de mouvement dans le sous-mode MDI

**Tableau 83 – Définition du signal SATZANW**

| Bits    | Signification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 à 9   | Numéro de registre de mouvement dans l'archivage de programme dont le lancement est prévu (plage de valeurs: 0 à 1 023)<br>Les bits 0 à 9 ne sont pertinents que dans le sous-mode Programme.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 10 à 14 | Réservé pour utilisation ultérieure par un profil PROFIdrive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 15      | Commande de l'interrupteur de sous-mode pour la sélection des sous-modes (basculer de l'interrupteur de sous-mode avec changement de la source de commande de mouvement uniquement en S41):<br><br>= 1 Activation du sous-mode MDI. Si un programme est encore en cours d'exécution (diagramme d'états étendu qui n'est pas en État de base), l'interface de positionnement passe en sous-mode MDI une fois que le programme s'arrête ou est terminé (STW1 bit4).<br><br>= 0 Désactivation du sous-mode MDI. Si une commande de mouvement MDI est encore en cours d'exécution, l'interpolation de chemin doit s'arrêter et la commande de mouvement MDI doit être rejetée. |

**Tableau 84 – Définition du signal AKTSATZ**

| Bits    | Signification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 à 9   | Numéro de registre de mouvement actuellement actif (exécuté par l'interpolation de chemin).<br>Les bits 0 à 9 ne sont pertinents que dans le sous-mode Programme (en sous-mode MDI et alors qu'aucun programme n'est en cours d'exécution, il convient que le numéro soit 0).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 10 à 14 | Réservé pour utilisation ultérieure par un profil PROFIdrive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 15      | État de l'interrupteur de sous-mode et sous-mode actuellement actif (source de la Tâche traversante actuellement active):<br><br>= 1 sous-mode MDI actif. Les valeurs d'entrée pour la commande de mouvement sont extraites des signaux TARPOS, VELOCITY_A, MDI_ACC et MDI_DEC. Si une commande de mouvement est encore exécutée par l'interpolation de chemin (S45, S43), la source de la commande de mouvement est MDI.<br><br>= 0 sous-mode Programme actif. Le registre de mouvement initial pour le lancement d'un nouveau programme de mouvement est extrait des bits 0 à 9 de SATZANW. Si une commande de mouvement est encore exécutée (S45, S43), la commande de mouvement fait partie intégrante d'un programme de mouvement et le registre de mouvement en cours est transmis dans les bits 0 à 9 AKTSATZ. |

**Tableau 85 – Définition du signal MDI\_MOD**

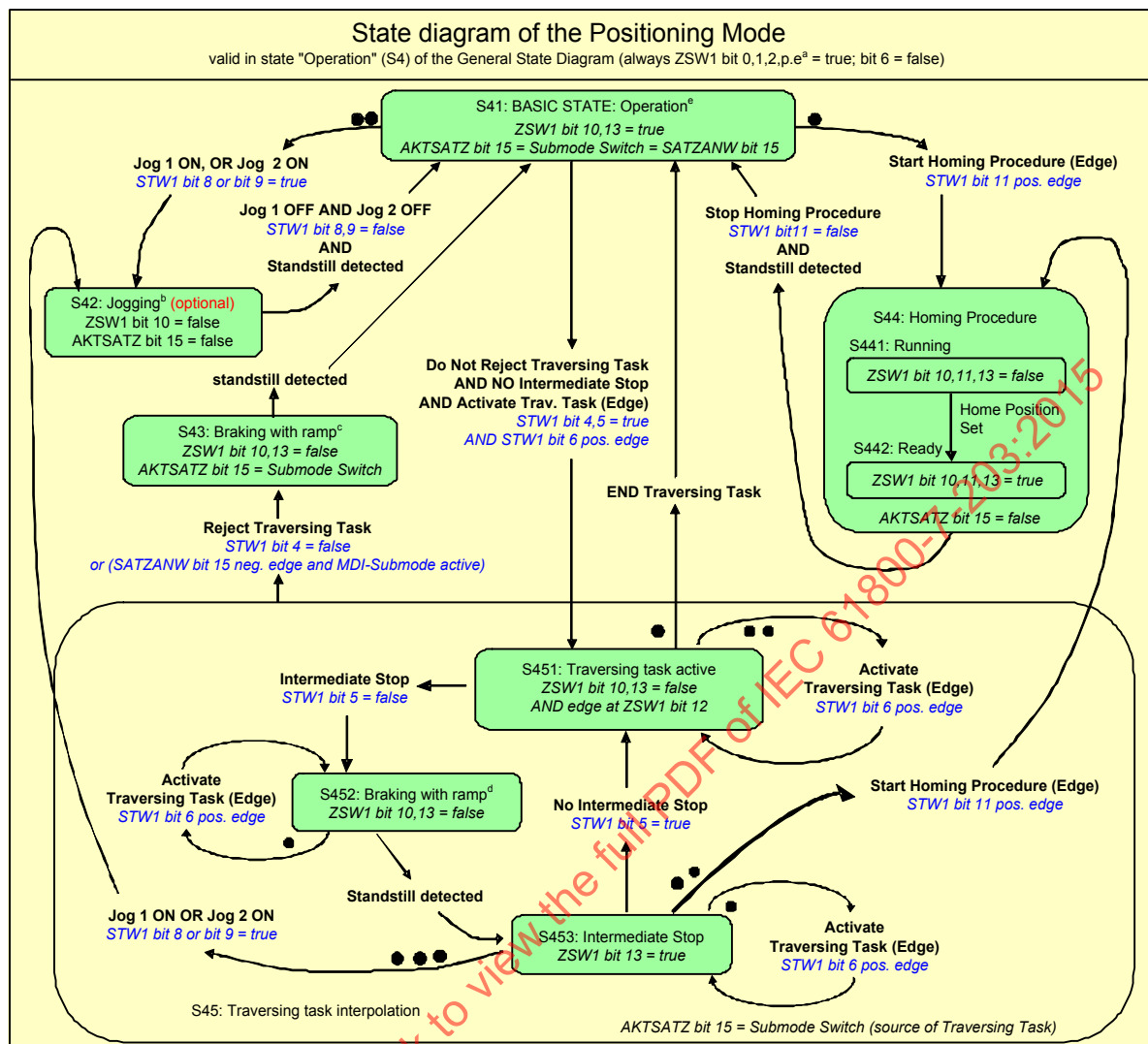
| Bits   | Signification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0      | Mode de positionnement absolu/relatif<br>= 1 Positionnement absolu. La position cible dans le signal TARPOS définit la position cible absolue pour le mouvement.<br>= 0 Positionnement relatif. La position cible dans le signal TARPOS définit la position cible relative pour le mouvement relatif à la position réelle de l'axe.                                                                                                                                                                                                                                                                           |
| 1      | Direction de positionnement de modulo positif (mise en œuvre facultative).<br>Cette commande n'est fonctionnelle que si le type d'axe est un axe modulo rotatif et si le mode de position absolue est activé (MDI_MOD bit 0 = 1).<br>= 1 Pour un axe modulo, la position absolue doit être atteinte par un mouvement dans la direction positive. Si les bits 1 et 2 sont tous les deux 1, la position cible d'un axe modulo doit être atteinte par le chemin le plus court.<br>= 0 Si les bits 1 et 2 sont tous les deux 0, la position cible d'un axe modulo doit être atteinte par le chemin le plus court. |
| 2      | Direction de positionnement de modulo négatif (mise en œuvre facultative).<br>Cette commande n'est fonctionnelle que si le type d'axe est un axe modulo rotatif et si le mode de position absolue est activé (MDI_MOD bit 0 = 1).<br>= 1 Pour un axe modulo, la position absolue doit être atteinte par un mouvement dans la direction négative. Si les bits 1 et 2 sont tous les deux 1, la position cible d'un axe modulo doit être atteinte par le chemin le plus court.<br>= 0 Si les bits 1 et 2 sont tous les deux 0, la position cible d'un axe modulo doit être atteinte par le chemin le plus court. |
| 3 à 15 | Réservé pour utilisation ultérieure par un profil PROFIdrive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

#### 6.3.3.4.4 Diagramme d'états étendu de mode de positionnement

Le diagramme d'états étendu pour le mode de positionnement dans le sous-mode Programme et le sous-mode MDI est représenté à la Figure 35. Le sous-mode Programme et le sous-mode MDI ne diffèrent que par la source des commandes de mouvement. La source des commandes de mouvement est contrôlée par l'interrupteur de sous-mode. L'interrupteur de sous-mode est contrôlé par le bit 15 dans le signal SATZANW. Le sous-mode de positionnement actuellement actif (source active des commandes de mouvement) est donné dans le signal Bit15 AKTSATZ (voir aussi le Tableau 84).

La signification de la "tâche traversante active" selon les sous-modes de positionnement est la suivante:

- Sous-mode Programme: Activation du programme de mouvement à partir du numéro de registre de mouvement dans les Bits 0 à 9 SATZANW.
- Sous-mode MDI: Activation d'une nouvelle commande de mouvement. Les points de consigne pour la commande de mouvement sont extraits des signaux TARPOS, VELOCITY\_A, MDI\_ACC et MDI\_DEC.



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<sup>a</sup> p.e. = bit d'état pour les impulsions activées/désactivées.

<sup>b</sup> Effet des bits par à-coups STW1 bit8, bit9 sur le point de consigne de vitesse (Y) conformément à la définition donnée à la Figure 29.

<sup>c</sup> Le freinage avec rampe est avec la valeur maximale de décélération.

<sup>d</sup> La valeur de décélération pour le freinage avec rampe est prise de la tâche traversante actuellement active.

<sup>e</sup> Le basculement de l'interrupteur de sous-mode (changement de la source de commande de mouvement) uniquement à l'état S41.

NOTE 1 Bit STW1 x,y = Ces bits de mot de commande sont définis par la commande.

NOTE 2 Bit ZSW1 x,y = Ces bits de mot d'état indiquent l'état actuel.

NOTE 3 **Arrêt détecté** est un résultat interne d'une opération d'arrêt.



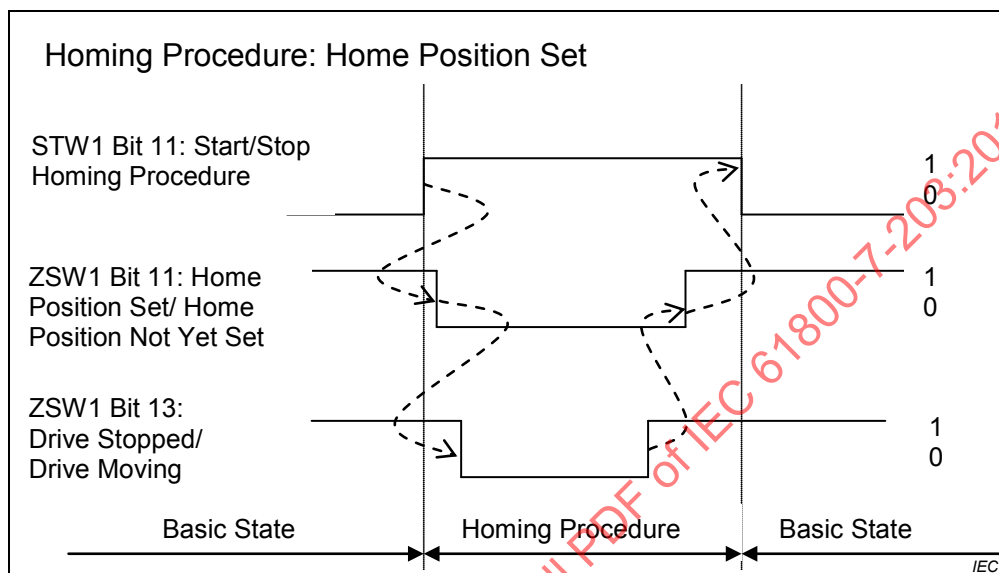
| Anglais                                                                                                                                                      | Français                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| State diagram of the Positioning Mode valid in state "Operation" (S4) of the General State Diagram (always ZSW1 bit 0,1,2, p.e <sup>a</sup> =true;6 = false) | Diagramme d'états du mode de positionnement valide en état "fonctionnement" (S4) du diagramme d'états général (toujours bit 0,1,2 ZSW1, p.e <sup>a</sup> =vrai;6 = faux) |
| Jog 1 ON, OR jog 2 ON<br>STW1 bit 8 or bit 9 = true                                                                                                          | A-coups 1 ON, OU A-coups 2 ON<br>bit 8 ou bit 9 STW1 = vrai                                                                                                              |
| Jog 1 OFF AND Jog2 OFF<br>STW1 bit8,9 = false<br>AND Standstill detected                                                                                     | A-coups 1 OFF ET A-coups 2 OFF<br>bit8,9 STW1 = faux<br>ET Arrêt détecté                                                                                                 |
| BASIC STATE: Operation<br>ZSW1 bit 10,13=true<br>AKTSATZ bit 15 = Submode switch = SATZANW bit 15                                                            | ETAT DE BASE: fonctionnement<br>bit 10,13 ZSW1 =vrai<br>bit 15 AKTSATZ = interrupteur de sous-mode = bit 15SATZANW                                                       |
| Start Homing Procedure (Edge)<br>STW1 bit 11 pos. edge                                                                                                       | Lancer procédure de retour à la position de référence (front)<br>STW1 bit 11 front positif                                                                               |
| Stop Homing Procedure<br>STW1 bit 11 = false                                                                                                                 | Arrêter procédure de retour à la position de référence<br>STW1 bit 11 = faux                                                                                             |
| Jogging <sup>b</sup> (optional)<br>ZSW1 bit 10=false<br>AKTSATZ bit 15 = Submode switch                                                                      | A-coups <sup>b</sup> (facultatif)<br>bit 10 ZSW1 =faux<br>bit 15 AKTSATZ = interrupteur de sous-mode                                                                     |
| Standstill detected                                                                                                                                          | Arrêt détecté                                                                                                                                                            |
| Braking with ramp <sup>c</sup><br>ZSW1 bit10,13=false<br>AKTSATZ bit 15 = Submode switch                                                                     | Freinage avec rampe <sup>c</sup><br>bit10,13 ZSW1 =faux<br>bit 15 AKTSATZ = interrupteur de sous-mode                                                                    |
| Reject traversing task<br>STW1 bit 4 = false<br>or (SATZANW bit 15 neg. edge and MDI-Submode active)                                                         | Rejeter tâche traversante<br>STW1 bit 4 = faux<br>ou (bit 15 SATZANW front nég. Et sous-mode MDI actif)                                                                  |
| Do Not Reject Traversing Task AND NO Intermediate Stop AND Activate Trav. Task (Edge)<br>STW1 bit 4,5=true<br>AND STW1 bit 6 pos.edge                        | Ne pas rejeter la tâche traversante ET pas d'arrêt intermédiaire ET activer tâche trav. (front)<br>bit 4,5 STW1 =vrai<br>ET bit 6 STW1 front pos.                        |
| END Traversing Task                                                                                                                                          | TERMINER tâche traversante                                                                                                                                               |
| Homing Procedure Running<br>ZSW1 bit 10,11,13 = false                                                                                                        | Procédure de retour à la position de référence Exécution<br>bit 10,11,13 ZSW1 = faux                                                                                     |
| Ready                                                                                                                                                        | Prêt                                                                                                                                                                     |
| Home Position Set                                                                                                                                            | Position d'origine définie                                                                                                                                               |
| ZSW1 bit 10,11,13 = true                                                                                                                                     | bit 10,11,13 ZSW1 = vrai                                                                                                                                                 |
| Intermediate Stop<br>STW1 bit 5=false                                                                                                                        | Arrêt intermédiaire<br>bit 5 STW1 =faux                                                                                                                                  |
| No Intermediate Stop<br>STW1 bit 5 = true                                                                                                                    | Pas d'Arrêt intermédiaire<br>bit 5 STW1 = vrai                                                                                                                           |
| Traversing task active<br>ZSW1 bit10,13=false<br>AND edge at ZSW1 bit 12                                                                                     | Tâche traversante active<br>bit10,13 ZSW1 =faux<br>ET bord à bit 12 ZSW1                                                                                                 |
| Activate Traversing Task (Edge)<br>STW1 bit 6 pos.edge                                                                                                       | Activer tâche traversante (front)<br>bit 6 STW1 front positif                                                                                                            |
| Intermediate Stop<br>ZSW1 bit 13= true                                                                                                                       | Arrêt intermédiaire<br>bit 13 ZSW1 = vrai                                                                                                                                |
| Traversing task interpolation                                                                                                                                | Interpolation de tâche traversante                                                                                                                                       |
| AKTSATZ bit 15 = Submode Switch (Source of Traversing Task)                                                                                                  | Bit 15 AKTSATZ = interrupteur de sous-mode (source de la tâche traversante)                                                                                              |

Figure 35 – Diagramme d'états du mode de positionnement

#### 6.3.3.4.5 Procédure de retour à la position de référence

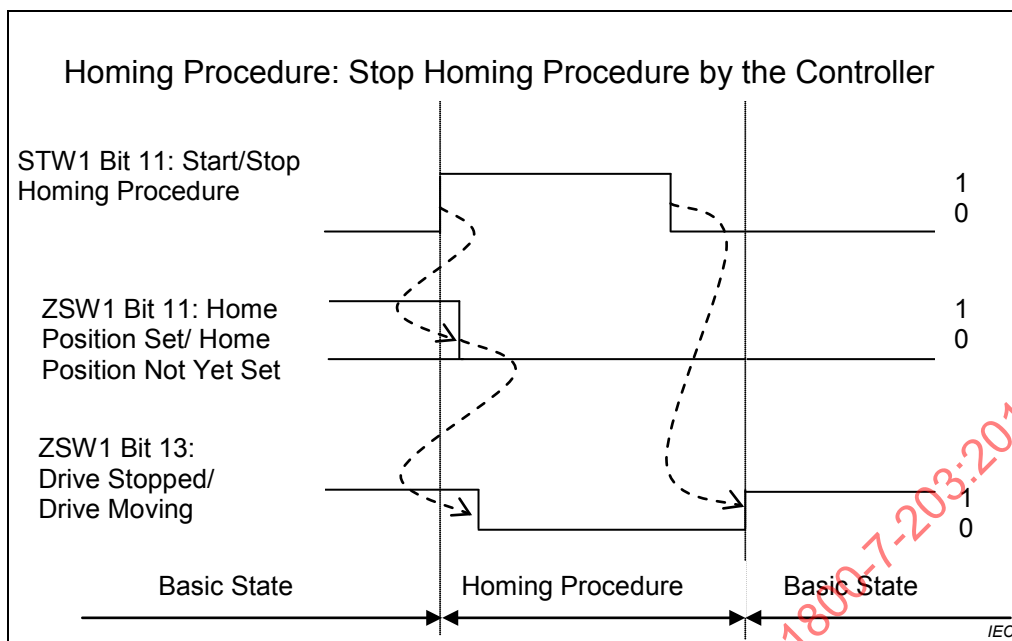
Le dispositif d'entraînement exécute la procédure de retour à la position de référence de façon autonome. La stratégie de la procédure de retour à la position de référence est définie de façon spécifique au constructeur par le paramétrage du dispositif d'entraînement.

La procédure d'activation et d'annulation de la procédure de retour à la position de référence est représentée en détail à la Figure 36 et à la Figure 37.



| Anglais                                                  | Français                                                                       |
|----------------------------------------------------------|--------------------------------------------------------------------------------|
| Homing Procedure: Home Position Set                      | Procédure de retour à la position de référence: Position d'origine définie     |
| STW1 bit 11: Start/Stop Homing Procedure                 | Bit 11 STW1: Démarrer/arrêter procédure de retour à la position de référence   |
| ZSW1 bit 11: Home Position Set/Home Position Not Yet Set | Bit 11 ZSW1: Position d'origine définie/ Position d'origine pas encore définie |
| ZSW1 bit 13: Drive Stopped/Drive Moving                  | Bit 13 ZSW1: Dispositif d'entraînement arrêté/en mouvement                     |
| Basic State                                              | État de base                                                                   |
| Homing Procedure                                         | Procédure de retour à la position de référence                                 |

**Figure 36 – Procédure de retour à la position de référence: Position d'origine définie**

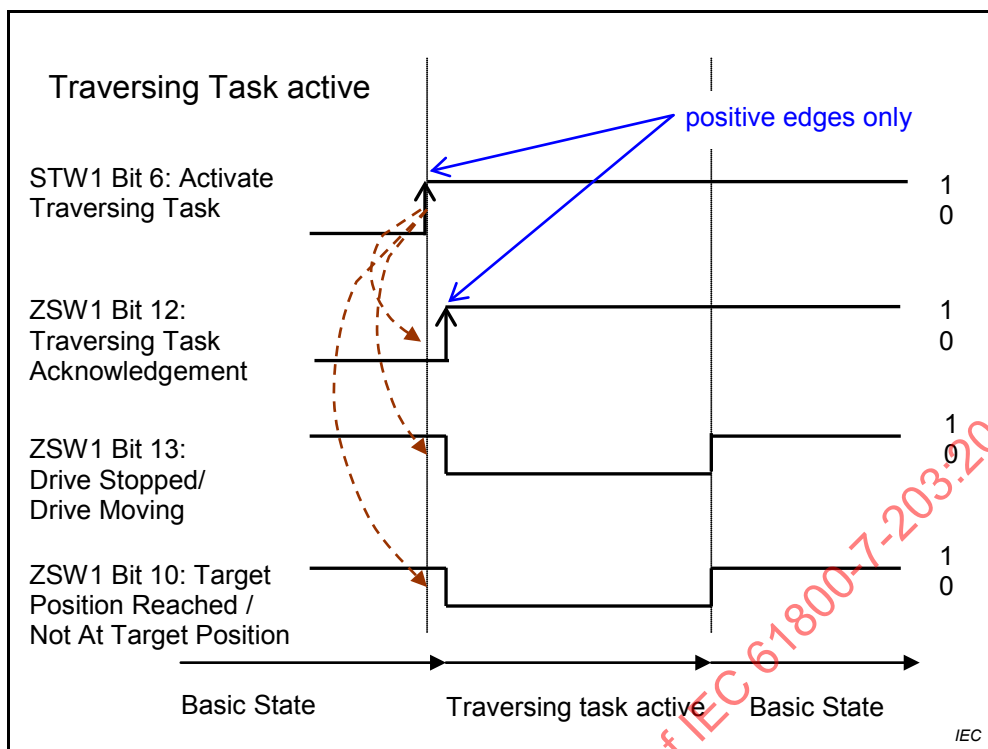


| Anglais                                                   | Français                                                                                                                     |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Homing Procedure: stop homing procedure by the controller | Procédure de retour à la position de référence: arrêt de la procédure de retour à la position de référence par le contrôleur |
| STW1 bit 11: Start/Stop Homing Procedure                  | bit 11 STW1: Démarrer/arrêter procédure de retour à la position de référence                                                 |
| ZSW1 bit 11: Home Position Set/Home Position Not Yet Set  | bit 11 ZSW1: Position d'origine définie/ Position d'origine pas encore définie                                               |
| ZSW1 bit 13: Drive Stopped/Drive Moving                   | bit 13 ZSW1: Dispositif d'entraînement arrêté/en mouvement                                                                   |
| Basic State                                               | État de base                                                                                                                 |
| Homing Procedure                                          | Procédure de retour à la position de référence                                                                               |

**Figure 37 – Procédure de retour à la position de référence:  
Abandon par le contrôleur**

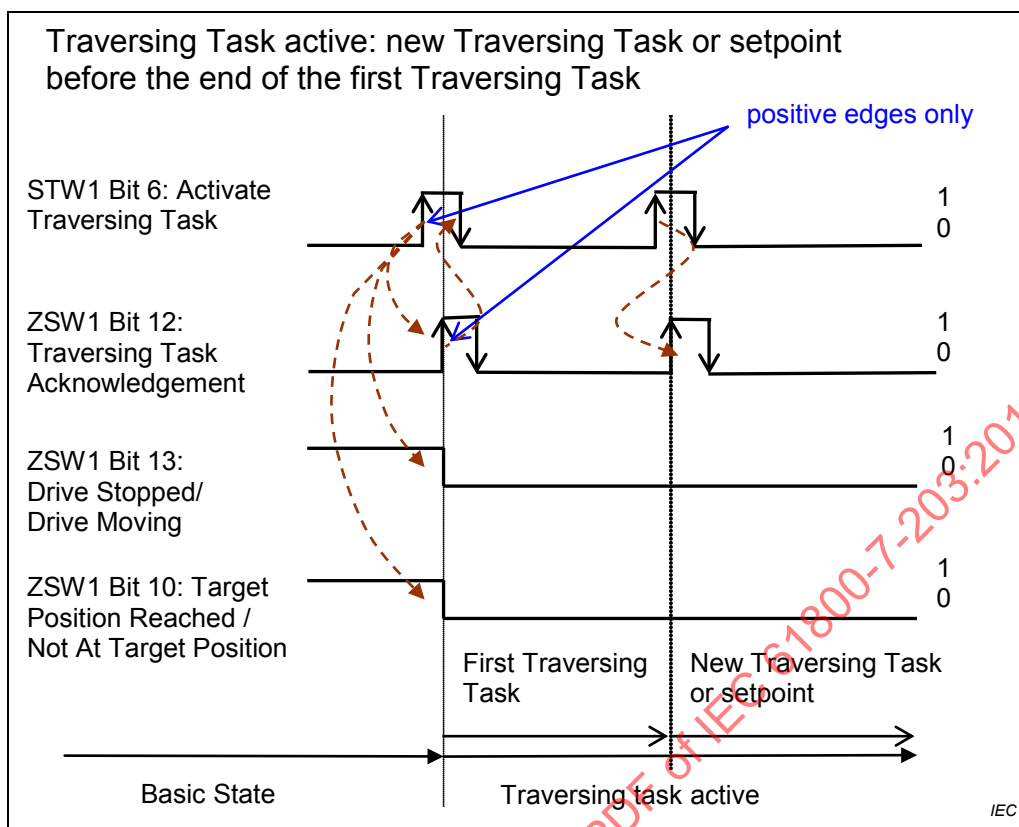
#### 6.3.3.4.6 Contrôle de tâche traversante

La procédure d'activation d'une tâche traversante (programme de mouvement ou commande de mouvement) est représentée en détail à la Figure 38 et à la Figure 39.



| Anglais                                                     | Français                                                   |
|-------------------------------------------------------------|------------------------------------------------------------|
| Traversing Task active                                      | Tâche traversante active                                   |
| Positive edges only                                         | Fronts positifs uniquement                                 |
| STW1 bit 6: Activate Traversing Task                        | Bit 6 STW1: Activer tâche traversante                      |
| ZSW1 bit 12: Traversing Task Acknowledgement                | Bit 12 STW1: Acquiescement de la tâche traversante         |
| ZSW1 bit 13: Drive stopped/Drive moving                     | Bit 13 STW1: Dispositif d'entraînement arrêté/en mouvement |
| ZSW1 bit 10: Target Position Reached/Not At Target Position | ZSW1 bit 10: Position cible atteinte/Pas en position cible |
| Basic State                                                 | État de base                                               |

Figure 38 – Tâche traversante active



| Anglais                                                                                             | Français                                                                                                                |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Traversing Task active: new Traversing Task or setpoint before the end of the first Traversing Task | Tâche traversante active: nouvelle tâche traversante ou point de consigne avant la fin de la première tâche traversante |
| Positive edges only                                                                                 | Fronts positifs uniquement                                                                                              |
| STW1 bit 6: Activate Traversing Task                                                                | bit 6 STW1: Activer tâche traversante                                                                                   |
| ZSW1 bit 12: Traversing Task Acknowledgement                                                        | bit 12 STW1: Acquittement tâche traversante                                                                             |
| ZSW1 bit 13: Drive Stopped/Drive Moving                                                             | bit 13 ZSW1: Dispositif d'entraînement arrêté/en mouvement                                                              |
| ZSW1 bit 10: Target Position Reached/Not At Target Position                                         | bit 10 ZSW1: Position cible atteinte/pas en position cible                                                              |
| Basic State                                                                                         | État de base                                                                                                            |
| Traversing Task active                                                                              | Tâche traversante active                                                                                                |
| First Traversing Task                                                                               | Première tâche traversante                                                                                              |
| New Traversing Task or setpoint                                                                     | Nouvelle tâche traversante ou point de consigne                                                                         |

**Figure 39 – Modification immédiate des tâches traversantes**

La procédure d'activation d'une tâche traversante selon la définition de la Figure 38 et de la Figure 39 est valide dans l'état S4 du diagramme d'états général. Si le diagramme d'états général n'est pas dans l'état S4, toutes les tâches traversantes sont abandonnées et le bit 12 ZSW1 est mis à zéro indépendamment du bit 6 STW1.

### 6.3.4 Données E-S de DO

#### 6.3.4.1 Généralités

Les points de consigne à l'axe ainsi que les valeurs instantanées depuis l'axe sont transférés en tant que données E-S de DO. Les données E-S de DO sont transférées à l'aide du service

d'échange de données cycliques. La représentation des données doit être au format grossiste.

Les points de consigne/valeurs instantanées individuels peuvent être configurés en tant que signaux à inclure dans les données E-S de DO de l'axe. De plus, le contrôleur peut lire la normalisation pour les données E-S de DO individuelles à partir du DO/de l'axe. Il y a quatre éléments descriptifs des données E-S de DO dans la section de paramètre spécifique au profil pour cette configuration de données E-S de DO.

Une description détaillée est donnée en 6.3.4.4 et en 6.3.4.5.

Les avantages suivants sont obtenus en raison de la configuration et de la normalisation de message.

- Interopérabilité et interchangeabilité des contrôleurs et des objets d'entraînement PROFIdrive.
- Les composants normalisés peuvent être simplement mis en service.
- Mécanismes d'automatisation dans l'application du contrôleur. En lisant les paramètres, le contrôleur peut adapter son interface cyclique à l'axe. Cette procédure de lecture doit être prise en compte lors de l'exécution.

#### 6.3.4.2 Signaux

Une série de signaux avec des numéros de signaux appropriés est définie pour configurer les données E-S du DO (points de consigne, valeurs instantanées).

Les valeurs suivantes sont autorisées pour les numéros de signaux:

- 0 -> non affecté.
- 1 à 99 -> numéros de signaux normalisés (spécifiques au profil).
- 100 à 61 999 -> numéros de signaux (spécifiques au dispositif).
- 62 000 à 65 535 -> numéros de signaux normalisés (spécifiques au profil).

Tous les numéros de signaux définis sont énumérés dans le Tableau 86.

**Tableau 86 – Liste de signaux – affectation**

| N° Signal | Signification                                    | Abréviation  | Longueur<br>16-/32 bits | Signe | Description                           |
|-----------|--------------------------------------------------|--------------|-------------------------|-------|---------------------------------------|
| 1         | Mot de commande 1                                | STW1         | 16                      |       | Se reporter à 6.3.2.2                 |
| 2         | Mot d'état 1                                     | ZSW1         | 16                      |       | Se reporter à 6.3.2.5                 |
| 3         | Mot de commande 2                                | STW2         | 16                      |       | Se reporter à 6.3.2.3                 |
| 4         | Mot d'état 2                                     | ZSW2         | 16                      |       | Se reporter à 6.3.2.6                 |
| 5         | Point de consigne de vitesse A                   | NSOLL_A      | 16                      | avec  | N2 normalisé<br>se reporter à 6.3.4.5 |
| 6         | Valeur instantanée de vitesse A                  | NIST_A       | 16                      | avec  | N2 normalisé<br>se reporter à 6.3.4.5 |
| 7         | Point de consigne de vitesse B                   | NSOLL_B      | 32                      | avec  | N4 normalisé<br>se reporter à 6.3.4.5 |
| 8         | Valeur instantanée de vitesse B                  | NIST_B       | 32                      | avec  | N4 normalisé<br>se reporter à 6.3.4.5 |
| 9         | Mot de commande du capteur 1                     | G1_STW       | 16                      |       | Se reporter à 6.3.6                   |
| 10        | Mot d'état du capteur 1                          | G1_ZSW       | 16                      |       | Se reporter à 6.3.6                   |
| 11        | Valeur instantanée de position 1<br>du capteur 1 | G1_XIST1     | 32                      |       | Se reporter à 6.3.6                   |
| 12        | Valeur instantanée de position 2<br>du capteur 1 | G1_XIST2     | 32                      |       | Se reporter à 6.3.6                   |
| 13        | Mot de commande du capteur 2                     | G2_STW       | 16                      |       | Se reporter à 6.3.6                   |
| 14        | Mot d'état du capteur 2                          | G2_ZSW       | 16                      |       | Se reporter à 6.3.6                   |
| 15        | Valeur instantanée de position 1<br>du capteur 2 | G2_XIST1     | 32                      |       | Se reporter à 6.3.6                   |
| 16        | Valeur instantanée de position 2<br>du capteur 2 | G2_XIST2     | 32                      |       | Se reporter à 6.3.6                   |
| 17        | Mot de commande du capteur 3                     | G3_STW       | 16                      |       | Se reporter à 6.3.6                   |
| 18        | Mot d'état du capteur 3                          | G3_ZSW       | 16                      |       | Se reporter à 6.3.6                   |
| 19        | Valeur instantanée de position 1<br>du capteur 3 | G3_XIST1     | 32                      |       | Se reporter à 6.3.6                   |
| 20        | Valeur instantanée de position 2<br>du capteur 3 | G3_XIST2     | 32                      |       | Se reporter à 6.3.6                   |
| 21        | Entrée (numérique)                               | E_DIGITAL    | 16                      |       | Se reporter à 6.3.7                   |
| 22        | Sortie (numérique)                               | A_DIGITAL    | 16                      |       | Se reporter à 6.3.7                   |
| 23        | Entrée (analogique)                              | E_ANALOG     | 16                      |       | Se reporter à 6.3.7                   |
| 24        | Sortie (analogique)                              | A_ANALOG     | 16                      |       | Se reporter à 6.3.7                   |
| 25        | Déviation du système                             | XERR         | 32                      | avec  | Se reporter à 6.3.5                   |
| 26        | Contrôleur de position, facteur<br>de gain       | KPC          | 32                      | avec  | Se reporter à 6.3.5                   |
| 27        | Valeur de point de consigne de<br>position A     | XSOLL_A      | 32                      | avec  |                                       |
| 28        | Valeur instantanée de position A                 | XIST_A       | 32                      | avec  |                                       |
| 29        | Valeur instantanée de position B                 | XIST_B       | 32                      | avec  |                                       |
| 30        | Valeur instantanée de position C                 | XIST_C       | 32                      | avec  |                                       |
| 31        | Valeur instantanée de position D                 | XIST_D       | 32                      | avec  |                                       |
| 32        | Choix du bloc traversant                         | SATZANW      | 16                      |       | Se reporter à 6.3.3.4.2               |
| 33        | Bloc traversant réel                             | AKTSATZ      | 16                      |       | Se reporter à 6.3.3.4.2               |
| 34        | Position cible MDI                               | MDI_TARPOS   | 32                      | avec  | Se reporter à 6.3.3.4.3               |
| 35        | Vitesse MDI                                      | MDI_VELOCITY | 32                      |       | Se reporter à 6.3.3.4.3               |

| N° Signal          | Signification                                      | Abréviation  | Longueur<br>16-/32 bits | Signe | Description                                                                                                    |
|--------------------|----------------------------------------------------|--------------|-------------------------|-------|----------------------------------------------------------------------------------------------------------------|
| 36                 | Accélération MDI                                   | MDI_ACC      | 16                      |       | Se reporter à 6.3.3.4.3                                                                                        |
| 37                 | Décélération MDI                                   | MDI_DEC      | 16                      |       | Se reporter à 6.3.3.4.3                                                                                        |
| 38                 | Mode MDI                                           | MDI_MOD      | 16                      |       | Se reporter à 6.3.3.4.3<br>et au Tableau 85                                                                    |
| 39                 | Valeur instantanée 3 de position<br>de capteur 1   | G1_XIST3     | 64                      |       | Se reporter à 6.3.6                                                                                            |
| 40 – 50            | Spécifique au profil                               |              |                         |       | Réservé                                                                                                        |
| 51                 | Courant de sortie lissé                            | IAIST_GLATT  | 16                      |       | Se reporter à 6.5                                                                                              |
| 52                 | Courant actif<br>(proportionnel au couple)         | ITIST_GLATT  | 16                      | avec  | Se reporter à 6.5                                                                                              |
| 53                 | Valeur instantanée de couple<br>lissée             | MIST_GLATT   | 16                      | avec  | Se reporter à 6.5                                                                                              |
| 54                 | Puissance active lissée                            | PIST_GLATT   | 16                      |       | Se reporter à 6.5                                                                                              |
| 55                 | Point de consigne de fréquence                     | FSOLL        | 16                      |       | Se reporter à 6.5                                                                                              |
| 56                 | Valeur instantanée de fréquence<br>lissée          | FIST_GLATT   | 16                      |       | Se reporter à 6.5                                                                                              |
| 57                 | Valeur instantanée de vitesse A                    | NIST_A_GLATT | 16                      | avec  | Se reporter à 6.5                                                                                              |
| 58                 | État du dispositif<br>d'entraînement/mot de défaut | MELD_NAMUR   | 16                      |       | Se reporter à 6.5                                                                                              |
| 59                 | Courant de sortie                                  | IAIST        | 16                      |       | Se reporter à 6.5                                                                                              |
| 60                 | Valeur instantanée de couple                       | MIST         | 16                      | avec  | Se reporter à 6.5                                                                                              |
| 61                 | Courant actif lissé<br>(proportionnel au couple)   | ITIST        | 16                      | avec  | Se reporter à 6.5                                                                                              |
| 62                 | Puissance active                                   | PIST         | 16                      |       | Se reporter à 6.5                                                                                              |
| 63                 | Valeur instantanée de fréquence                    | FIST         | 16                      |       | Se reporter à 6.5                                                                                              |
| 80                 | Mot de commande 2 de codeur                        | STW2_ENC     | 16                      |       | Se reporter à 6.3.2.3                                                                                          |
| 81                 | Mot d'état 2 de codeur                             | ZSW2_ENC     | 16                      |       | Se reporter à 6.3.2.6                                                                                          |
| 82 à 89            | Signaux de codeur (profil de<br>codeur)            |              |                         |       | Réservé                                                                                                        |
| 90 à 99            | Spécifique au profil (sécurité)                    |              |                         |       | Réservé                                                                                                        |
| 100 à<br>59 999    | Spécifique au dispositif<br>(PROFIdrive)           |              |                         |       | Recommandé pour les<br>signaux de dispositif<br>d'entraînement<br>spécifiques au<br>fournisseur                |
| 60 000 à<br>60 999 | Spécifique au dispositif (codeur)                  |              |                         |       | Recommandé pour les<br>signaux de codeur<br>spécifiques au<br>fournisseur                                      |
| 61 000 à<br>61 999 | Spécifique au dispositif<br>(sécurité)             |              |                         |       | Recommandé pour les<br>signaux de sécurité de<br>dispositif<br>d'entraînement<br>spécifiques au<br>fournisseur |
| 62 000 à<br>65 535 | Spécifique au profil                               |              |                         |       | réservé                                                                                                        |



### 6.3.4.3 Messages préconfigurés

#### 6.3.4.3.1 Généralités

Les messages préconfigurés 1 à 4 sont définis pour les opérations de l'interface de point de consigne de vitesse (AC1 et AC4). Les messages préconfigurés sont sélectionnés lors de la configuration des données E-S de DO (se reporter à 6.3.4.4).

Les messages préconfigurés ont une structure conforme au Tableau 87, au Tableau 95 et au Tableau 147.

#### 6.3.4.3.2 Message préconfiguré 1

Contenu: interface de point to consigne n, 16 bits

**Tableau 87 – Définition du message préconfiguré 1**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | NSOLL_A           | NIST_A             |

#### 6.3.4.3.3 Message préconfiguré 2

Contenu: interface de point to consigne n, 32 bits, sans capteur

**Tableau 88 – Définition du message préconfiguré 2**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | NSOLL_B           | NIST_B             |
| 3                     |                   |                    |
| 4                     | STW2              | ZSW2               |

#### 6.3.4.3.4 Message préconfiguré 3

Contenu: interface de point to consigne n, 32 bits, avec un capteur

**Tableau 89 – Définition du message préconfiguré 3**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | NSOLL_B           | NIST_B             |
| 3                     |                   |                    |
| 4                     | STW2              | ZSW2               |
| 5                     | G1_STW            | G1_ZSW             |
| 6                     |                   | G1_XIST1           |
| 7                     |                   |                    |
| 8                     |                   | G1_XIST2           |
| 9                     |                   |                    |

#### 6.3.4.3.5 Message préconfiguré 4

Contenu: interface de point to consigne n, 32 bits, avec deux capteurs

**Tableau 90 – Définition du message préconfiguré 4**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | NSOLL_B           | NIST_B             |
| 3                     |                   |                    |
| 4                     | STW2              | ZSW2               |
| 5                     | G1_STW            | G1_ZSW             |
| 6                     | G2_STW            | G1_XIST1           |
| 7                     |                   |                    |
| 8                     |                   | G1_XIST2           |
| 9                     |                   |                    |
| 10                    |                   | G2_ZSW             |
| 11                    |                   | G2_XIST1           |
| 12                    |                   |                    |
| 13                    |                   | G2_XIST2           |
| 14                    |                   |                    |

#### 6.3.4.3.6 Message préconfiguré 5

Les messages préconfigurés 5 et 6 sont déterminés à partir des messages préconfigurés 3 et 4 pour utilisation supplémentaire du contrôleur asservi dynamique (DSC/se reporter à 6.3.5).

Contenu: interface de point to consigne n, 32 bits, avec un capteur; de plus, différence de position et gain de contrôleur de position dans la direction du point de consigne pour le DSC

**Tableau 91 – Définition du message préconfiguré 5**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | NSOLL_B           | NIST_B             |
| 3                     |                   |                    |
| 4                     | STW2              | ZSW2               |
| 5                     | G1_STW            | G1_ZSW             |
| 6                     | XERR              | G1_XIST1           |
| 7                     |                   |                    |
| 8                     | KPC               | G1_XIST2           |
| 9                     |                   |                    |

#### 6.3.4.3.7 Message préconfiguré 6

Contenu: interface de point to consigne n, 32 bits, avec deux capteurs; de plus, différence de position et gain de contrôleur de position dans la direction du point de consigne pour le DSC

**Tableau 92 – Définition du message préconfiguré 6**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | NSOLL_B           | NIST_B             |
| 3                     |                   |                    |
| 4                     | STW2              | ZSW2               |
| 5                     | G1_STW            | G1_ZSW             |
| 6                     | G2_STW            | G1_XIST1           |
| 7                     | XERR              |                    |
| 8                     |                   | G1_XIST2           |
| 9                     | KPC               |                    |
| 10                    |                   | G2_ZSW             |
| 11                    |                   | G2_XIST1           |
| 12                    |                   |                    |
| 13                    |                   | G2_XIST2           |
| 14                    |                   |                    |

**6.3.4.3.8 Message préconfiguré 7**

Le message préconfiguré 7 est défini pour le mode de positionnement (AC 3).

Contenu: Interface de positionnement (sous-mode Programme)

**Tableau 93 – Définition du message préconfiguré 7**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | SATZANW           | AKTSATZ            |

**6.3.4.3.9 Message préconfiguré 9**

Le message préconfiguré 9 est aussi défini pour le mode de positionnement (AC 3).

Contenu: Interface de positionnement (sous-mode Programme et sous-mode MDI)

**Tableau 94 – Définition du message préconfiguré 9**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | SATZANW           | AKTSATZ            |
| 3                     | STW2              | ZSW2               |
| 4                     | MDI_TARPOS        | XIST_A             |
| 5                     |                   |                    |
| 6                     | MDI_VELOCITY      |                    |
| 7                     |                   |                    |
| 8                     | MDI_ACC           |                    |
| 9                     | MDI_DEC           |                    |
| 10                    | MDI_MOD           |                    |

#### 6.3.4.3.10 Message préconfiguré 8

Le message préconfiguré 8 est défini pour l'interface de point de consigne de position (AC 5).

Contenu: interface de point de consigne x, 32 bits (interface de point de consigne de position)

**Tableau 95 – Définition du message préconfiguré 8**

| Numéro de données E-S | Point de consigne | Valeur instantanée |
|-----------------------|-------------------|--------------------|
| 1                     | STW1              | ZSW1               |
| 2                     | XSOLL_A           | XIST_A             |
| 3                     |                   |                    |
| 4                     | STW2              | ZSW2               |
| 5                     | NSOLL_A           | NIST_A             |

#### 6.3.4.3.11 Message préconfiguré 20

Le message préconfiguré 20 est exclusivement défini pour l'utilisation de l'interface de point de consigne de vitesse conformément aux recommandations VIK-NAMUR pour la technologie de processus (AC 1).

Contenu: interface de point de consigne n pour technologie de processus, 16 bits  
(Définition: se reporter à 6.5).

#### 6.3.4.4 Configuration des données E-S de DO

Les points de consigne individuels/les valeurs instantanées peuvent être affectés aux données E-S dans le message de données à l'aide de la configuration des données E-S de DO (configuration de message). Les signaux normalisés de 6.3.4.2 ainsi que les signaux spécifiques au constructeur peuvent être configurés comme points de consigne/valeurs instantanées.

Il existe quatre numéros de paramètre (PNU) dans la section de paramètre spécifique au profil permettant de configurer ces données E-S de DO (voir le Tableau 96).

**Tableau 96 – Paramètres de configuration d'un message**

| PNU    | Signification                                                                         | Autorisation d'accès | Type de données    |
|--------|---------------------------------------------------------------------------------------|----------------------|--------------------|
| 915[x] | Configuration des données E-S de DO (message de point de consigne)                    | lecture/écriture     | Array[y]Unsigned16 |
| 916[x] | Configuration des données E-S de DO (message de valeur instantanée)                   | lecture/écriture     | Array[y]Unsigned16 |
|        |                                                                                       |                      |                    |
| 922    | Sélection de messages                                                                 | lecture/écriture     | Unsigned16         |
|        |                                                                                       |                      |                    |
| 923[y] | Liste de tous les paramètres pour les signaux (spécifique au profil et au dispositif) | lecture uniquement   | Array[y]Unsigned16 |

**P922: Sélection de messages**

P922 doit être lisible dans toutes les classes d'application.

Si la sélection de messages est définie avec la configuration du système de communication ou de façon spécifique au constructeur, le paramètre P922 doit pouvoir lire la configuration réelle.

Les valeurs autorisées sont données dans le Tableau 97.

**Tableau 97 – Codage de P922**

| Valeur          | Signification                                                                                                                                                                                                                        |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0               | Le message peut être configuré librement (P915[x], P916[x])                                                                                                                                                                          |
| 1               | Message préconfiguré 1: interface définie n, 16 bits (profil PROFIdrive, version 2)                                                                                                                                                  |
| 2               | Message préconfiguré 2: interface définie n, 32 bits, sans capteur                                                                                                                                                                   |
| 3               | Message préconfiguré 3: interface définie n, 32 bits, avec un capteur                                                                                                                                                                |
| 4               | Message préconfiguré 4: interface définie n, 32 bits, avec deux capteurs                                                                                                                                                             |
| 5               | Message préconfiguré 5: interface définie n, 32 bits, avec un capteur; de plus, la différence de position et le gain de contrôleur de position sont transférés dans la direction du point de consigne pour mettre en œuvre le DSC    |
| 6               | Message préconfiguré 6: interface définie n, 32 bits, avec deux capteurs; de plus, la différence de position et le gain de contrôleur de position sont transférés dans la direction du point de consigne pour mettre en œuvre le DSC |
| 7               | Message préconfiguré 7: interface de positionnement (sous-mode programme)                                                                                                                                                            |
| 8               | Message préconfiguré 8: interface de point to consigne x, 32 bits (interface de point de consigne de position)                                                                                                                       |
| 9               | Message préconfiguré 9: interface de positionnement (sous-mode programme et MDI)                                                                                                                                                     |
| 10 à 19         | Messages préconfigurés 10 à 19 (réservé pour le profil PROFIdrive)                                                                                                                                                                   |
| 20              | Messages préconfigurés 20: interface définie n pour la technologie de processus, 16 bits, voir 6.5                                                                                                                                   |
| 21 à 29         | Messages préconfigurés 21 à 29 (réservé pour le profil PROFIdrive)                                                                                                                                                                   |
| 30 à 39         | Messages préconfigurés 30 à 39 (réservé pour l'amendement de sécurité du profil PROFIdrive)                                                                                                                                          |
| 40 à 80         | Messages préconfigurés 40 à 80 (réservé pour le profil PROFIdrive)                                                                                                                                                                   |
| 81 à 98         | Messages préconfigurés de codeur 81 à 98 (réservé pour le profil du codeur)                                                                                                                                                          |
| 99              | Message préconfiguré 99 (réservé pour le profil PROFIdrive)                                                                                                                                                                          |
| 100 à 60 000.   | Message spécifique au dispositif                                                                                                                                                                                                     |
| 60 001 à 65 535 | Messages préconfigurés 60 001 à 65 535 (réservé pour le profil PROFIdrive)                                                                                                                                                           |

Les définitions suivantes sont valides si un message avec P922 est sélectionné.

- Il convient que la préaffectation normalisée de P922 présente une valeur de 1 à 99 pour un message préconfiguré 1 à 99.
- Si P922 passe à 0, les réglages précédents de P915[x], P916[x] sont conservés.
- Si P922 passe à 1 à 65 535, alors P915[x], P916[x] sont également modifiés – s'ils ont été mis en œuvre.
- Pour modifier P915 et P916, P922 doit être défini sur 0.

**P915[x], P916[x]: Configuration des DONNÉES E-S de DO dans le message (x = numéro de DONNÉES E-S de DO -1)**

Au lieu de sélectionner un message avec le paramètre P922, un message peut aussi être configuré en utilisant P915[x] et P916[x].

Les définitions suivantes sont valides lors de la configuration des messages.

- Tous les signaux qui peuvent être configurés comme des données E-S de DO sont représentés par un numéro de paramètre défini de façon spécifique au constructeur.
- Le message réel est configuré en renseignant le numéro de paramètre spécifique au constructeur dans les paramètres P915[x] (message de point de consigne) et P916[x] (message de valeur instantanée). Le numéro de données E-S de DO (1 à n) est sélectionné via l'index de matrice x (0 à (n-1)).

- Il est permis de déterminer le contenu de P 915 et P 916.
- Il convient qu'un message configuré avec P915[x], P916[x] corresponde à la configuration du message réel (c'est-à-dire la longueur), sinon une alarme ou une réponse d'erreur spécifique au dispositif est émise.
- La taille de la matrice dépend de la façon dont le message a été configuré.
- Pour les DONNEES E-S de DO 1, seul le mot de commande ou le mot d'état 1 est autorisé.
- Les données E-S de DO qui ne sont pas utilisées sont marquées d'un zéro (P915[x] = 0 ou P916[x] = 0).

#### **P923[y]: Liste de tous les paramètres pour les signaux (y = numéro de signal)**

À l'aide d'un paramètre P923[y], une affectation est réalisée entre les numéros de signal et les numéros de paramètre associés spécifiques au constructeur. L'index de matrice y est le numéro du signal. Les index de matrice 1 à 99 sont constitués des signaux normalisés définis dans le profil (se reporter à 6.3.4.2), les index de matrice 100 à 65 535 contiennent les signaux spécifiques au dispositif s'ils sont définis.

Les informations suivantes sont valides pour le paramètre P923[y]:

- Il existe une entrée pour tous les signaux normalisés pris en charge par le dispositif et pour les signaux spécifiques au dispositif.
- Les signaux normalisés qui ne sont pas pris en charge sont identifiés par l'entrée 0.
- Les vides entre les numéros de signal spécifiques au dispositif sont remplis de zéros.

#### **Exemple de configuration d'un message**

L'exemple suivant (voir la Figure 40) spécifie une configuration de message préconfiguré (se reporter à P922) pour le point de consigne avec les numéros de signal 1 (STW1) et 5 (NSOLL\_A) qui sont représentés par les paramètres spécifiques au constructeur P833 et P711 (se reporter à P915[x], P923[y]).

Le contrôleur peut déterminer les affectations suivantes en lisant les paramètres P915[x], P923[y].

- P915[x] -> affectation: Numéro de paramètre/numéro de données E-S de DO.
- P923[y] -> affectation: Numéro de paramètre/numéro de signal.

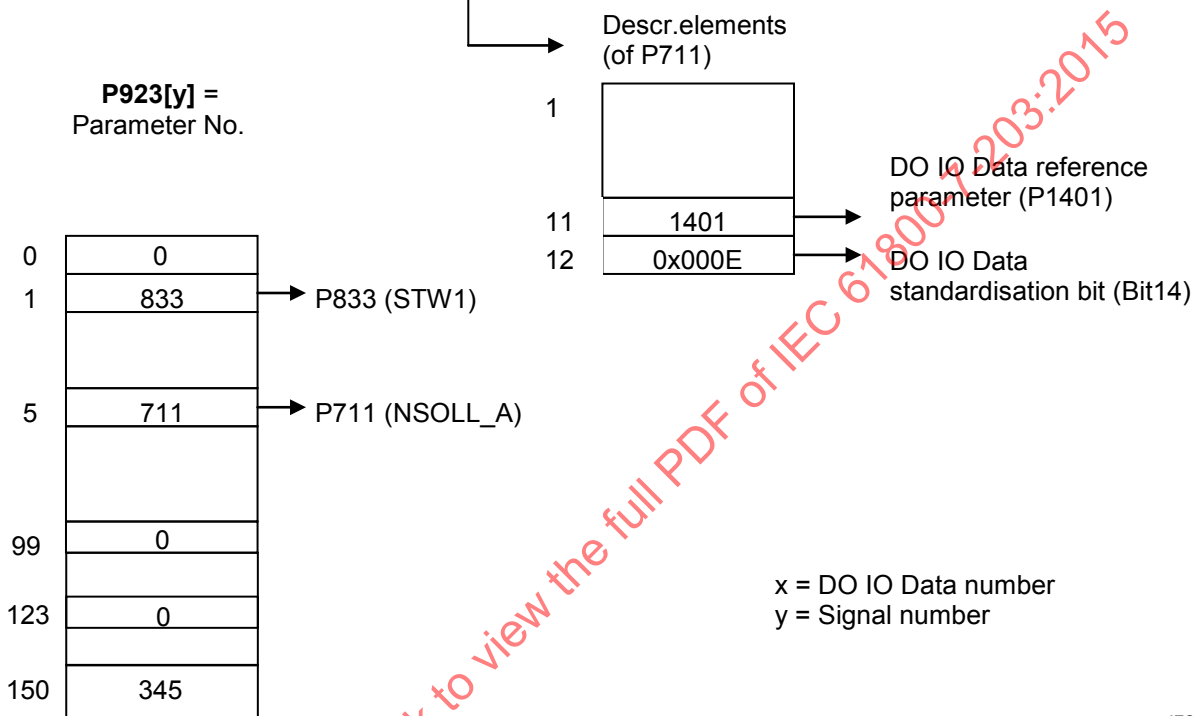
Les éléments de description de P711 contiennent des informations pour la normalisation de données E-S de DO (se reporter à 6.3.4.5).

- Se reporter au paramètre de normalisation spécifique au constructeur P1401 (paramètre de référence de données E-S de DO).
- Position binaire pour la normalisation (normalisation de données E-S de DO).

**P922** = 1 (Standard telegram 1) -> IO Data 1 = STW1 / IO Data 2 = NSOLL\_A

|                   |           |              |     |           |
|-------------------|-----------|--------------|-----|-----------|
| DO IO Data number | 1<br>STW1 | 2<br>NSOLL_A | ... | 10<br>--- |
|-------------------|-----------|--------------|-----|-----------|

|                                   |     |     |     |   |
|-----------------------------------|-----|-----|-----|---|
| <b>P915[x]</b> =<br>Parameter No. | 833 | 711 | ... | 0 |
|-----------------------------------|-----|-----|-----|---|



IEC

| Anglais                                                                  | Français                                                                            |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| P922 = 1 (standard telegram 1) -> IO Data 1 = STW1 / IO Data 2 = NSOLL_A | P922 = 1 (message préconfiguré 1) -> données E-S 1 = STW1 / données E-S 2 = NSOLL_A |
| DO IO Data number                                                        | Numéro de données E-S de DO                                                         |
| P915[x] = Parameter No.                                                  | P915[x] = numéro de paramètre                                                       |
| Descr. Elements (of P711)                                                | Eléments de description (de P711)                                                   |
| DO IO Data reference parameter (P1401)                                   | Paramètre de référence des données E-S de DO (P1401)                                |
| DO IO Data standardization bit (Bit14)                                   | Bit de normalisation de données E-S de DO (Bit14)                                   |
| x = DO IO Data number                                                    | x = Numéro de données E-S de DO                                                     |
| y = Signal number                                                        | y = numéro de signal                                                                |

**Figure 40 – Exemple de configuration d'un message**

#### 6.3.4.5 Normalisation de données E-S de DO

Les données E-S de DO du type de données suivant sont normalisées:

- toujours: N2, N4, X2, X4;



- facultatif: Integer16, Integer32, Floating Point.

Si aucun P923 n'est disponible ou si le dispositif d'entraînement ne prend pas en charge une description des paramètres, la normalisation de défaut doit être N2 ou N4. Les signaux normalisés PROFIdrive ont toujours une normalisation définie fixe.

### **Données E-S de DO non normalisées (par exemple type de données Unsigned16)**

Les valeurs physiques peuvent être calculées à partir de la valeur transférée de données E-S de DO pour des variables non normalisées (par exemple, le type de données Unsigned16) à l'aide du facteur de normalisation des éléments de description des paramètres (sous-index 3, se reporter à 6.2.1.3) ainsi que l'attribut de variable (sous-index 4, se reporter à 6.2.1.3).

### **Données E-S de DO normalisées (types de données N2, N4, X2, X4 ou Integer16, Integer32, Floating Point facultatifs)**

Des éléments de description supplémentaires sont exigés pour calculer la valeur physique à partir de la valeur transférée de données E-S de DO pour des variables normalisées (types de données N2, N4 ou X2, X4 ou Integer16, Integer32, Floating Point facultatifs).

Des points de consigne et des valeurs instantanées (par exemple, NSOLL\_A, NIST\_A, NSOLL\_B, NIST\_B) doivent être transférés en tant que données E-S de DO normalisées qui font souvent référence à différentes variables de caractéristique de moteur, comme la vitesse maximale ou le courant maximal. Souvent ces variables de caractéristique de moteur sont enregistrées dans un paramètre spécifique au constructeur (par exemple, le transfert de la vitesse NSOLL\_A = 0x4000 correspond à 100 % de P2000 = 3 000 r/min).

Bien qu'elle permette au contrôleur de fournir des points de consigne aux dispositifs d'entraînement de différents constructeurs, la normalisation est établie pour les messages préconfigurés. De plus et également pour les messages et les signaux spécifiques au fournisseur, cette information de normalisation doit pouvoir être lue. Pour réaliser cela, les éléments de description de paramètre déjà existants sont complétés par les composants "paramètre de référence des données E-S de DO" (sous-index 11, se reporter à 6.2.1.3) et "normalisation de données E-S de DO" (sous-index 12, se reporter à 6.2.1.3).

Le composant "paramètre de référence de données E-S de DO" contient le numéro de paramètre de la valeur de référence et le composant "normalisation de données E-S de DO" (le numéro de bit du bit) qui fait référence à la valeur de référence.

### **Exemples de normalisation de données E-S de DO**

Un contrôleur lit la normalisation d'un signal de point de consigne de vitesse du DO afin de renseigner un point de consigne de vitesse de 1 500 r/min:

- Exemple A: type de données = N2      100 % = 0x4000 (NSOLL\_A est toujours N2)
- Exemple B: type de données = X2      100 % = 0x1000 (pour X = bit 12)
- Exemple C (voir le Tableau 100 et le Tableau 101): type de données = Float 100 % = 1,0 E+0

Les exemples A et B (voir le Tableau 98 et le Tableau 99) s'appliquent aussi au type de données Integer16.

Pour réaliser cela, les étapes suivantes sont exigées.

- Le contrôleur doit d'abord déterminer le paramètre spécifique au constructeur pour le signal de point de consigne de vitesse avec le numéro de signal (dans l'exemple A: 5, dans les exemples B: 100 et dans l'exemple C: 101) de P923[x] (dans les exemples A: P923[5] = 711, dans les exemples B: P923[100] = 712 et C: P923[101] = 713).

- Le paramètre de référence de données E-S de DO (dans l'exemple: P2000) et le bit de normalisation de données E-S de DO (dans l'exemple A: le bit 14 correspond à 0x4000; dans l'exemple B: le bit 12 correspond à 0x1000) peuvent être déterminés à partir de l'élément de description de ce paramètre.
- Le contrôleur peut calculer le point de consigne à saisir en lisant le contenu de P2000 (dans l'exemple: 3 000,0) et l'attribut de variable de P2000 (dans l'exemple: r/min). (dans l'exemple A: 0x2000 correspond à 1 500 r/min; dans l'exemple B: 0x0800 correspond à 1 500 r/min).

**Tableau 98 – Exemple A/B pour la normalisation des données E-S de DO, valeurs de paramètre**

| Signification | Exemple A contenu P711 | Exemple B contenu P711 | Contenu P2000 |
|---------------|------------------------|------------------------|---------------|
| Valeur        | par exemple 0x2000     | par exemple 0x0800     | 3 000,0       |

**Tableau 99 – Exemple A/B pour la normalisation des données E-S de DO, éléments de description des paramètres**

| Signification                                                                                              | Exemple A contenu P711               | Exemple B contenu P712               | Contenu P2000    |
|------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|------------------|
| Identificateur<br>Bit 0-7 = type de données                                                                | 113 (N2)<br>ou 3 (Integer16)         | 123 (X2)<br>ou 3 (Integer16)         | 8 (float)        |
| Nombre d'éléments                                                                                          | 1                                    | 1                                    | 1                |
| Facteur de normalisation                                                                                   | 0,006 1 ( $100/2^{14}$ )             | 0,024 4 ( $100/2^{14}$ )             | 1,0              |
| Attribut de variable:<br>Index de variable / index de conversion                                           | 24/0 ( % )                           | 24/0 ( % )                           | 11/67 (r/min)    |
| Nom                                                                                                        | ,nset'                               | ,nset'                               | ,nnorm'          |
| Valeur inférieure limite                                                                                   | 0x8000 (-200 %)                      | 0x8000 (-800 %)                      | 1 000,0          |
| Valeur supérieure limite                                                                                   | 0x7FFF<br>[(200 % - $2^{-14}$ ) %]   | 0x7FFF<br>[(800 % - $2^{-14}$ ) %]   | 10 000,0         |
| Paramètre de référence de données E-S de DO                                                                | 2000                                 | 2000                                 | 0                |
| Normalisation de données E-S de DO<br>Bit 0-5 = bit de normalisation 0-31<br>Bit 15 = Normalisation valide | 14 (bit 14 -> 0x4000)<br><br>1 (oui) | 12 (bit 12 -> 0x1000)<br><br>1 (oui) | 0<br><br>0 (non) |

Exemple C (Floating Point):

**Tableau 100 – Exemple C pour la normalisation des données E-S de DO, valeurs de paramètre**

| Signification                     | Exemple C Contenu P713 | Contenu P2000 |
|-----------------------------------|------------------------|---------------|
| Valeur                            | par exemple 0,5        | 3 000,0       |
| NOTE 0,5 correspond à 1 500 r/min |                        |               |

**Tableau 101 – Exemple C pour la normalisation  
de données E-S de DO, éléments de description des paramètres**

| Signification                                                    | Exemple C Contenu P713  | Contenu P2000 |
|------------------------------------------------------------------|-------------------------|---------------|
| Identificateur<br>Bit 0-7 = type de données                      | 8 (float)               | 8 (float)     |
| Nombre d'éléments                                                | 1                       | 1             |
| Facteur de normalisation                                         | 100,0 (100/1,0)         | 1,0           |
| Attribut de variable:<br>Index de variable / index de conversion | 24/0 ( %)               | 11/67 (r/min) |
| Nom                                                              | ,nset'                  | ,nnorm'       |
| Valeur inférieure limite                                         | -4,0 (-400 %)           | 1 000,0       |
| Valeur supérieure limite                                         | 4,0 (400 %)             | 10 000,0      |
| Paramètre de référence de données E-S de DO                      | 2000                    | 0             |
| Normalisation de données E-S de DO                               |                         |               |
| Bit 0-5 = bit de normalisation 0-31                              | 0 (toujours avec float) | 0             |
| Bit 15 = Normalisation valide                                    | 1 (oui)                 | 0 (non)       |

### 6.3.5 Contrôleur asservi dynamique (DSC)

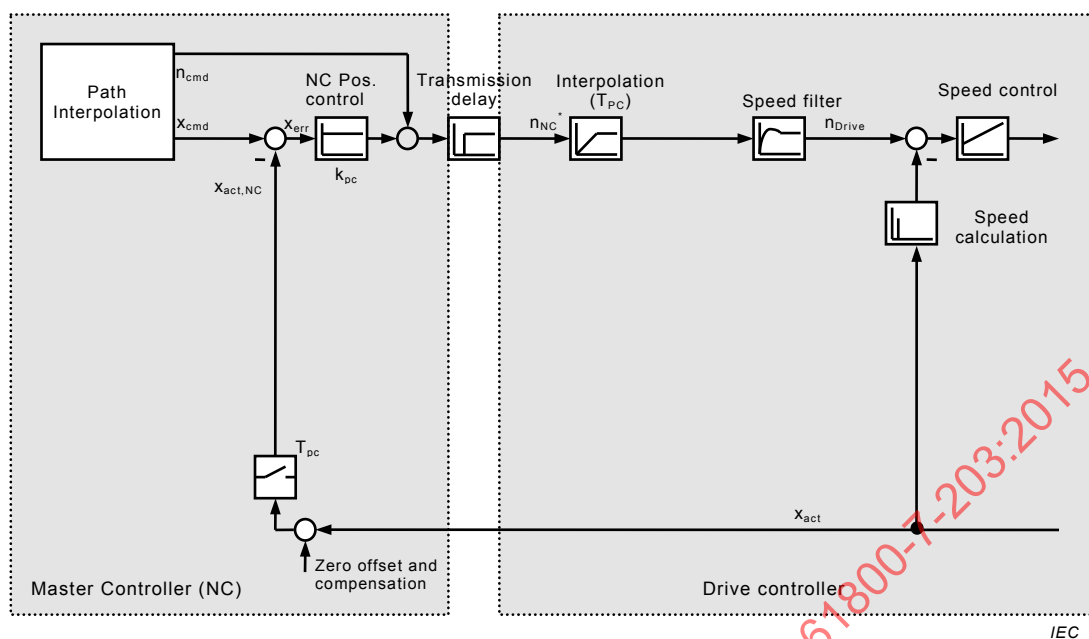
#### 6.3.5.1 Caractéristiques

Cette fonction améliore les performances dynamiques de la boucle d'asservissement de position en minimisant les délais qui se produisent normalement avec une interface de point de consigne de vitesse. Dans ce cas, seuls une expansion relativement simple des points de consigne transférés et un réseau de réaction supplémentaire sont exigés dans le dispositif d'entraînement.

Cette fonction est à compatibilité ascendante avec l'interface de point de consigne de vitesse. Si c'est exigé, un basculement est possible pendant le fonctionnement vers l'interface de point de consigne de vitesse.

#### 6.3.5.2 Structure

La boucle d'asservissement basée sur l'interface de point de consigne de vitesse a généralement la structure présentée à la Figure 41.



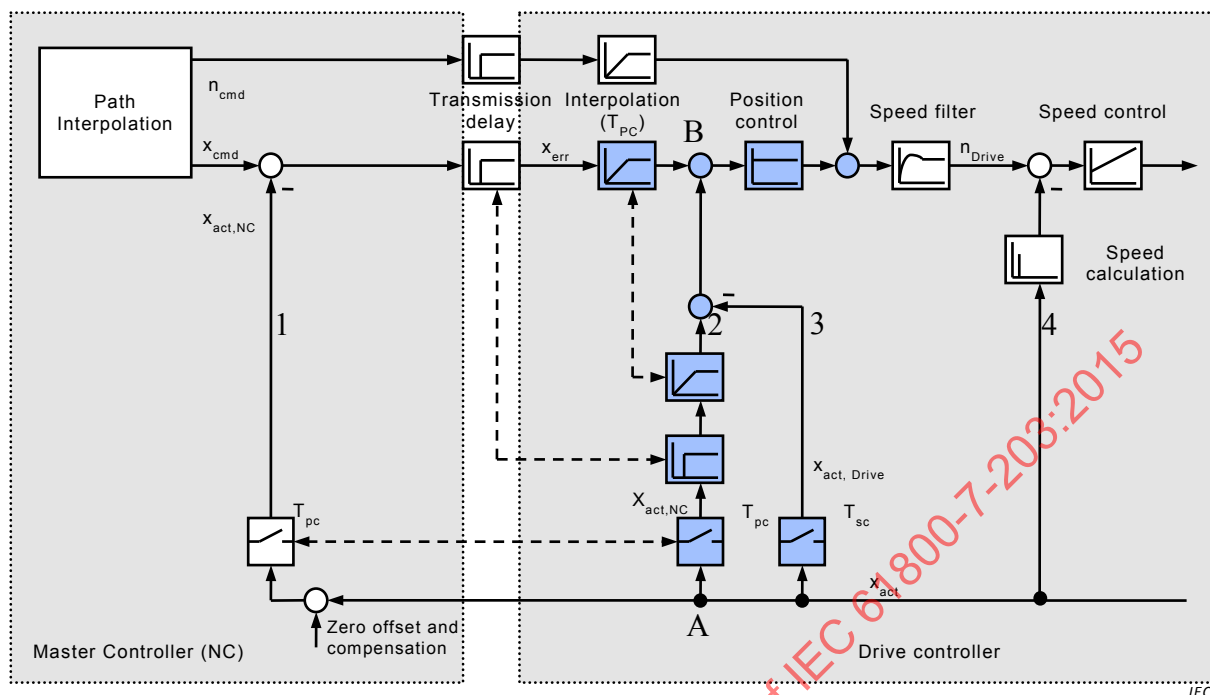
Légende:

|           |                               |          |                                                                  |
|-----------|-------------------------------|----------|------------------------------------------------------------------|
| $n_{cmd}$ | commande de vitesse           | $T_{pc}$ | temps d'échantillonnage du contrôleur de position (= $T_{CAC}$ ) |
| $x_{cmd}$ | commande de position          | $k_{pc}$ | gain du contrôleur de position                                   |
| $x_{err}$ | commande d'erreur de position |          |                                                                  |
| $x_{act}$ | position réelle               |          |                                                                  |

| Anglais                      | Français                           |
|------------------------------|------------------------------------|
| Path Interpolation           | Interpolation de chemin            |
| NC Pos. control              | Asservissement de position NC      |
| Master Controller (NC)       | Contrôleur maître (NC)             |
| Zero offset and compensation | décalage d'origine et compensation |
| Transmission delay           | Délai de transmission              |
| Speed filter                 | Filtre de vitesse                  |
| Speed control                | Commande de vitesse                |
| Speed calculation            | Calcul de vitesse                  |
| Drive controller             | Contrôleur d'entraînement          |

**Figure 41 – Structure du circuit de commande de position basé sur l'interface de point de consigne de vitesse sans DSC**

La position réelle calculée dans le dispositif d'entraînement est aussi directement retournée avec le DSC (voir la Figure 42).



Légende:

$n_{cmd}$  commande de vitesse

$x_{cmd}$  commande de position

$x_{err}$  commande d'erreur de position

$x_{act}$  position réelle

$T_{sc}$  temps d'échantillonnage du contrôleur de vitesse

$T_{nc}$  temps d'échantillonnage du contrôleur de position ( $= T_{MARC}$ )

$k_{pc}$  gain du contrôleur de position

| Anglais                      | Français                           |
|------------------------------|------------------------------------|
| Path Interpolation           | Interpolation de chemin            |
| Master Controller (NC)       | Contrôleur maître (NC)             |
| Zero offset and compensation | décalage d'origine et compensation |
| Transmission delay           | Délai de transmission              |
| Position control             | Asservissement de position         |
| Speed filter                 | Filtre de vitesse                  |
| Speed control                | Commande de vitesse                |
| Drive controller             | Contrôleur d'entraînement          |
| Speed calculation            | Calcul de vitesse                  |

**Figure 42 – Structure du circuit de commande de position basé sur l'interface de point de consigne de vitesse avec DSC**

Afin de réaliser cette fonction, la déviation du système calculée dans le contrôleur est transférée en supplément du point de consigne de vitesse. Le réseau de réaction supplémentaire (grisé) peut utiliser les formats d'entraînement interne pour représenter la position et est donc indépendant de la représentation de la position dans le contrôleur. Le diagramme ci-dessus suppose que le réseau est calculé dans le cycle d'horloge  $T_{SC}$  de commande de vitesse, ce qui est possible dans bien des cas. Cela signifie qu'il est possible d'améliorer les performances dynamiques maximales. L'augmentation des durées  $T$  du cycle d'horloge est aussi possible si le temps de calcul est critique ( $T_{SC} \leq T \leq T_{PC}$ ).

### 6.3.5.3 Mode de fonctionnement

La structure contient un total de trois branches de réaction pour la valeur instantanée de position (No. 1, 2 et 3). La branche de réaction No. 2 compense entièrement l'effet du No. 1 en ce qui concerne la valeur instantanée  $x_{act}$  envoyée depuis le dispositif d'entraînement. Cela signifie que la durée du délai dans la branche No. 1 n'a pas d'influence sur la stabilité de la boucle d'asservissement de position. Au départ la boucle d'asservissement de position est donc ouverte. La branche de réaction No. 3 referme ensuite la boucle mais avec un délai plus court, de façon à pouvoir définir des gains plus élevés.

La référence absolue des valeurs instantanées de position est d'abord déterminée dans le contrôleur (emplacement supplémentaire "Décalage d'origine et compensation"). La même référence absolue est contenue dans le point de consigne de position  $x_{cmd}$ . Cela signifie que la déviation du système  $x_{err}$ , calculée dans le contrôleur, n'a pas de point zéro. Le dispositif d'entraînement ne nécessite pas d'informations sur les points zéro et les positions d'origine.

### 6.3.5.4 Caractéristiques supplémentaires

Pour une vitesse constante, la déviation du système transféré  $x_{err}$  est également constante. Cela rend extrêmement simple la génération d'une valeur équivalente si un message échoue (la valeur précédente est réutilisée).

Le contrôleur peut sélectionner un format pour les valeurs instantanées de position et la valeur de point de consigne de position autre que celui du dispositif d'entraînement (par exemple, afin d'afficher une plage traversante plus large que le dispositif d'entraînement) sans charger les caractéristiques informatiques du dispositif d'entraînement ni augmenter les formats des messages ni modifier les performances dynamiques de la boucle d'asservissement. Il est aussi possible de calculer la branche de réaction 1 faisant référence au côté charge et les branches de réaction 2 et 3 faisant référence au côté moteur, sans modifier le comportement du système.

Il est admis que la valeur instantanée de position fournie à partir du dispositif d'entraînement déborde de façon cyclique, tant que le contrôleur est échantillonné suffisamment souvent pour que de tels débordements soient reconnus. Le réseau de réaction (branches 2 et 3) ne doit pas répondre aux débordements avec des réactions transitoires.

Le débordement cyclique des valeurs instantanées de position dans le dispositif d'entraînement ne doit pas être synchronisé avec un débordement mécanique au niveau de la machine, mais peut, par exemple, être sélectionné à l'aide du format numérique.

### 6.3.5.5 Utilisation de plusieurs capteurs

La branche de réaction 4 pour la valeur instantanée de vitesse utilise toujours le capteur du moteur.

Il y a trois situations de fonctionnement pour les branches de réaction 1, 2 et 3 de la Figure 42:

- les branches de réaction 1, 2 et 3 utilisent le capteur du côté moteur;
- les branches de réaction 2 et 3 utilisent le capteur du moteur, la branche de réaction 1 utilise le capteur côté charge;
- les branches de réaction 1, 2 et 3 utilisent le capteur du côté charge.

S'il n'y a pas de chargeur côté charge, le cas 1 s'applique toujours. Dans ce cas, les branches de réaction 1, 2 et 3 utilisent la valeur instantanée du capteur du moteur, une représentation différente étant possible dans la branche 1 (format numérique, référence de charge). Ce cas s'applique par exemple aux dispositifs d'entraînement directs linéaires ou rotatifs.

Les branches de réaction 2 et 3 peuvent calculer la valeur instantanée côté moteur dans un format favorable au dispositif d'entraînement; la pondération physique d'un incrément du capteur côté moteur du côté charge ne doit pas être connue.

S'il y a un capteur côté charge qu'il convient d'utiliser pour la boucle d'asservissement de position, les deux autres cas de fonctionnement sont pratiques.

Dans le cas 2, la branche 1 n'est pas complètement compensée par la branche 2, dans la mesure où normalement, les valeurs instantanées des deux capteurs ne se chevauchent pas. Cependant, le réseau de réaction reste stable par rapport aux boucles d'asservissement conventionnelles, dans la mesure où la valeur instantanée côté charge mais également les deux valeurs instantanées sont retournées. Le principal avantage de cette version est que la valeur instantanée côté charge ne doit pas être fournie à partir du dispositif d'entraînement mais qu'elle peut aussi venir d'un capteur directement connecté au bus ou au contrôleur.

Le cas 2 est traité dans le dispositif d'entraînement comme s'il n'y avait pas de capteur côté charge, c'est-à-dire de la même manière que dans le cas 1 (sans tenir compte du fait que dans la mesure du possible, une valeur instantanée de ce capteur est fournie au contrôleur).

Dans le cas 3, les branches de réaction 2 et 3 peuvent calculer la valeur instantanée côté charge dans un format favorable au dispositif d'entraînement. La pondération physique d'un incrément du capteur côté charge ne doit pas être connue. Le contrôleur doit aussi garantir que dans ce cas la normalisation de  $x_{err}$  et de  $x_{act}$  sont identiques à l'interface, de façon à ce qu'un calcul simple soit possible dans le dispositif d'entraînement. La transition du côté charge au côté moteur est effectuée à l'aide du facteur de gain du contrôleur de position  $k_{pc}$ .

### 6.3.5.6 Interface

Deux signaux supplémentaires sont transférés dans la direction du point de consigne:

- déviation du système  $x_{err}$ .
- facteur de gain du contrôleur de position  $k_{pc}$ .

Ces deux signaux ont leur propre index affecté dans la liste de signal P923. Ils peuvent être situés dans toute position du message utilisant le paramètre P915. Il est préférable de les situer à la fin du message de point de consigne afin de simplifier la mise en œuvre dans le contrôleur et le dispositif d'entraînement.

Les messages préconfigurés 5 et 6 définis pour la fonction du contrôleur asservi dynamique (DSC) sont décrits plus en détail en 6.3.4.3.

Si les deux signaux  $x_{err}$  et  $k_{pc}$  ont été configurés, le réseau de réaction dans le dispositif d'entraînement est activé. Si un seul des deux signaux est configuré, il est supposé qu'il est utilisé pour d'autres besoins et le réseau de réaction reste inactif.

La normalisation de XERR est identique à la normalisation de G1\_XIST1. Exception: Si la valeur instantanée côté charge est transférée en G1\_XIST1 et si le cas de fonctionnement 2 est présent, la normalisation de XERR correspond à la valeur instantanée côté moteur.

L'unité de KPC est  $(1/1\ 000)\ s^{-1}$ .

### 6.3.5.7 États de fonctionnement

Du point de vue du dispositif d'entraînement, il y a deux états de fonctionnement, qui sont différents selon que  $k_{pc} = 0$  ou  $k_{pc} \neq 0$ .

- $k_{pc} = 0$ : Le réseau de réaction est inefficace. La boucle d'asservissement de position dans le dispositif d'entraînement est ouverte. Généralement, le contrôleur utilise cela pour ouvrir entièrement la boucle d'asservissement de position, par exemple pour un

fonctionnement de broche ou en cas d'erreur. Le contrôleur peut aussi sélectionner une commande de position conventionnelle en boucle fermée sans la nécessité d'une reconfiguration du dispositif d'entraînement.  $X_{err}$  est non valide. Il est recommandé d'envoyer  $X_{err} = 0$ . Le point de consigne de vitesse est fourni via  $n_{cmd}$ .

- $k_{pc} \neq 0$ : Le réseau de réaction est efficace. La boucle d'asservissement de position dans le dispositif d'entraînement est fermée. Une valeur antérieure à la commande de vitesse est saisie via  $n_{cmd}$ ; cette valeur peut aussi être zéro.

Le contrôleur peut passer d'un état à l'autre à tout moment. De plus, le contrôleur peut modifier la valeur de  $k_{pc}$  à tout moment (par exemple, afin d'adapter les performances dynamiques lorsque le rapport d'engrenage est modifié ou afin de compenser des engrenages non linéaires).

### 6.3.5.8 Informations sur la mise en œuvre

Si la fonctionnalité DSC est utilisée, le contrôleur doit fonctionner avec le cycle optimisé  $T_{DP}$  ( $T_M > T_{DX}$ ) qui est réalisé dans le mode isochrone synchronisé renforcé (se reporter à l'IEC 61800-7-303:2015, 4.9.2).

La branche de réaction 2 doit précisément émuler l'effet de la branche de réaction 1 entre les points A et B. Les deux branches doivent:

- fonctionner avec une valeur instantanée obtenue au même instant et qui est échantillonnée avec la même fréquence,
- avoir le même délai,
- contenir la même interpolation fine.

Cela est spécifié dans le schéma de structure (schéma fonctionnel) qui utilise les flèches en pointillés.

Le réseau de réaction peut aussi être reconfiguré par des échanges d'éléments, tant que les conditions sont maintenues et que la branche 2 compense la branche 1 et que la branche 3 ferme la boucle d'asservissement. Ces versions, structurées de façon différente, dans certains cas, sont mieux émulées sur du matériel existant.

Il est possible par exemple de calculer la branche 2 et de traiter  $x_{err}$  jusqu'au point B sur une CPU de communication qui se trouve dans une position intermédiaire. Cependant, cette solution implique que les caractéristiques informatiques sont toujours disponibles et que seuls la branche 3 et le traitement à partir du point B sont calculés sur le processeur du dispositif d'entraînement. Au lieu d'une CPU de communication, un créneau temporel plus lent peut être utilisé sur le processeur du dispositif d'entraînement.

Cependant, lors de la reconfiguration du réseau, il convient d'observer que les valeurs instantanées qui débordent de façon cyclique ne peuvent pas démarrer des réactions transitoires de la boucle d'asservissement de position.

Il est recommandé que le réseau de réaction soit également calculé de façon continue pendant  $k_{pc} = 0$ . La mémoire, contenue par le réseau, est toujours localisée de cette façon et la transition à  $k_{pc} \neq 0$ , qui peut avoir lieu à tout moment, est plus facile à mettre en œuvre.

Pour une transition à  $k_{pc} \neq 0$ , les filtres d'interpolation dans la branche  $x_{err}$  et dans la branche  $n_{cmd}$  doivent être contournés pendant un cycle d'horloge ( $T_{PC}$ ).

Pour une transition à  $k_{pc} = 0$ , la sortie du contrôleur interne au dispositif d'entraînement passe à zéro en tant que fonction de saut. Simultanément le contrôleur augmente aussi  $n_{cmd}$  de la même valeur absolue qu'une fonction en échelon, de sorte que la somme des vitesses à l'entrée du contrôleur de vitesse s'exécute toujours en continu. Pour que cela fonctionne



également en mouvement, le filtre d'interpolation doit être contourné dans la branche  $n_{cmd}$  pendant un cycle d'horloge ( $T_{PC}$ ).

Le filtre de point de consigne de vitesse ("filtre de vitesse") spécifié dans le schéma fonctionnel est facultatif et n'a rien à voir avec la fonction DSC. Il a été ajouté uniquement pour éviter toute confusion avec les structures conventionnelles d'asservissement de position en boucle fermée.

### 6.3.6 Interface de retour en position

#### 6.3.6.1 Présentation générale

L'interface de retour en position définie dans ce profil est une interface entre l'axe et un contrôle de niveau supérieur. L'interface offre la possibilité au dispositif de commande d'obtenir des informations concernant le retour en position par l'interface PROFIdrive, ces informations provenant des capteurs connectés au dispositif d'entraînement (voir la Figure 43). La fonctionnalité décrite dans l'interface de retour en position est mise en œuvre dans le dispositif d'entraînement, et non dans le capteur lui-même.

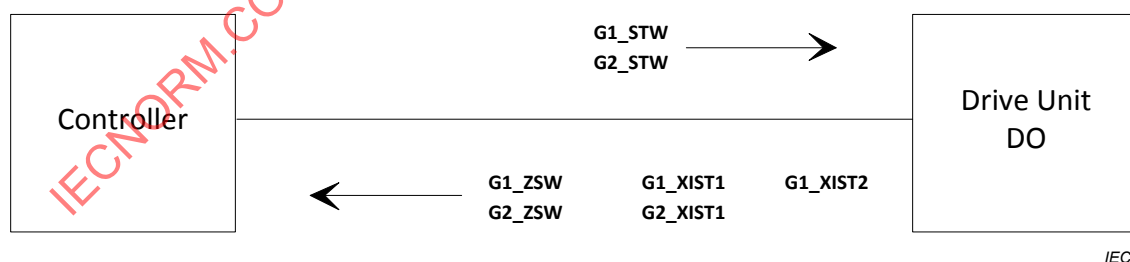
Une interface de retour en position est constituée des objets suivants qui peuvent être utilisés pour la configuration du message (se reporter à 6.3.4.4) par affectation (numéro de données E-S de DO/numéro de paramètre):

- Gx\_STW Mot de commande Contrôle de la fonctionnalité du capteur
- Gx\_ZSW Mot d'état États du capteur, Acquittements du capteur, messages d'erreur du capteur, etc.
- Gx\_XIST1 Position réelle-1 Valeur de position réelle
- Gx\_XIST2 Position réelle-2 Valeur de position réelle supplémentaire

Ces objets Gx\_\* sont disponibles pour un maximum de 3 capteurs (Gx = capteur 1 à 3) et peuvent aussi être utilisés individuellement (par exemple, uniquement G1\_STW).

Les capteurs sont paramétrés via les paramètres spécifiques au dispositif.

L'interface de retour en position est définie pour l'application avec une interface de point de consigne de vitesse cyclique.



IEC

| Anglais          | Français                   |
|------------------|----------------------------|
| Controller       | Contrôleur                 |
| Drive unit<br>DO | Unité d'entraînement<br>DO |

**Figure 43 – Exemple d'interface du capteur (Capteur-1: deux valeurs instantanées/Capteur-2: une valeur instantanée)**

### 6.3.6.2 Positions réelles

#### 6.3.6.2.1 Généralités

Du fait de la défaillance possible des données de l'utilisateur, les positions réelles (Gx\_XISTx) ne peuvent être transmises en tant que valeurs instantanées partielles. Pour cette raison, les valeurs de position réelle absolue cyclique sont toujours transmises (c'est-à-dire après un certain nombre de tours, il y a un débordement de position réelle).

Dans Data\_Exchange, le dispositif d'entraînement envoie toujours – indépendamment des modes de fonctionnement du contrôleur Clear et Operate – les positions réelles (Gx\_XISTx).

Les points suivants s'appliquent à l'évaluation des positions réelles (Gx\_XISTx).

- Le récepteur peut évaluer une position réelle par incréments, le point zéro étant défini en approchant une position d'origine et en la définissant, ou par la lecture par le contrôleur d'une valeur absolue (se reporter à l'explication ci-dessous). Cela peut s'appliquer à tous les types de capteur.
- Une valeur de position réelle peut aussi être considérée comme une valeur absolue (qui peut, si nécessaire, être chargée uniquement par rapport à un décalage du zéro dans le contrôleur), si elle est limitée aux capteurs absolus sur les axes avec une plage traversante finie (inférieure à la plage d'affichage du capteur).
- Dans le cas des axes en rotation permanente, une évaluation par incréments est préférable (pas de traitement modulo dans le dispositif d'entraînement).
- Il convient que le contrôleur ait la possibilité de sélectionner la plage et la stratégie du modulo (il convient qu'il n'y en ait aucun dans le dispositif d'entraînement). Si le dispositif d'entraînement permet le traitement du modulo, il convient qu'il soit possible de le désactiver via un paramètre.

Explication:

La valeur de la position réelle transmise en Gx\_XISTx est une valeur instantanée absolue que le dispositif d'entraînement peut simplement définir sur 0 au démarrage et après la désactivation du capteur de stationnement. C'est pour cette raison qu'il convient qu'un contrôle de niveau supérieur n'utilise que les différences de position entre les deux cycles du contrôleur de position afin de calculer sa valeur de position réelle interne.

- Un capteur doit fournir Gx\_XIST1. Si un capteur utilise uniquement un protocole série et a donc uniquement une valeur absolue, cette valeur est fournie en Gx\_XIST2 ainsi qu'en Gx\_XIST1.
- Une augmentation du facteur de décalage résulte automatique en une augmentation de la résolution. Il convient que cela s'applique à Gx\_XIST1 et à la valeur absolue dans Gx\_XIST2 dans la mesure du possible selon la technique.  
(Cela signifie qu'il n'y a pas de remplissage avec des zéros insérés si les valeurs sont décalées plus à gauche.)
- La valeur absolue en Gx\_XIST2 doit être valide au même moment que pour Gx\_XIST1. C'est seulement là que la valeur absolue doit être utilisable pour corriger la valeur incrémentale.

Cela signifie que le dispositif d'entraînement doit aussi corriger la valeur absolue via la valeur incrémentale: plusieurs périodes d'échantillonnage peuvent s'écouler avant que la valeur absolue ne soit disponible auprès du capteur. Cette "ancienne" valeur absolue doit être compensée avec la nouvelle position incrémentale afin de créer le même instant valide dans le temps pour les deux valeurs.

- L'affectation des différentes fonctions à Gx\_XIST2 (ainsi que la normalisation de Gx\_XIST2 aux différentes fonctions) est régie par une hiérarchie par ordre de priorité des fonctions (se reporter au Tableau 106).

Le paramètre de profil P979 "format de capteur" contient les propriétés importantes des capteurs. Les propriétés sont par exemple la normalisation de Gx\_XIST1 et de Gx\_XIST2.

### 6.3.6.2.2 Structure du paramètre 979 "format de capteur"

La structure du paramètre 979 est donnée du Tableau 102 au Tableau 105.

**Tableau 102 – Structure du paramètre 979 (format de capteur)**

| Sous-index | Signification                                         | Commentaires                     |
|------------|-------------------------------------------------------|----------------------------------|
| 0          | En-tête                                               | Informations sur les index 1 à n |
| 1          | Type de capteur                                       | 1. capteur (G1)                  |
| 2          | Résolution du capteur                                 | 1. capteur (G1)                  |
| 3          | "facteur de décalage" pour G1_XIST1                   | 1. capteur (G1)                  |
| 4          | "facteur de décalage" pour valeur absolue en G1_XIST2 | 1. capteur (G1)                  |
| 5          | Tours déterminables                                   | 1. capteur (G1)                  |
| 6 à 10     | Réservé pour une utilisation ultérieure.              | 1. capteur (G1)                  |
| 11 à 20    | Égal au sous-index 1 à 10                             | 2. capteur (G2)                  |
| 21 à 30    | Égal au sous-index 1 à 10                             | 3. capteur (G3)                  |
| 31 à n     | Réservé pour le profil                                |                                  |

### Sous-index 0: En-tête

**Tableau 103 – Sous-index 0 (en-tête) du paramètre 979**

| Bits    | Signification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 à 3   | Version de la structure de paramètre, nombre de poids faible (plage de valeurs: 0 à 15)<br>Ce champ de version est incrémenté lors de l'ajout d'informations de description des données supplémentaires ou lors de l'affectation des bits précédemment non affectés (extension compatible).<br>0: réservé<br>1: Identificateur pour la structure précédente associée à la version de profil 4.1<br>2: Identificateur pour la structure présentée (prise en charge des bits 29 et 30 dans 979[1])<br>>8: spécifique au constructeur (le constructeur a inclut des index supplémentaires alors que ceux définis dans le profil restent inchangés) |
| 4 à 7   | Version de la structure de paramètre, nombre de poids fort (plage de valeurs: 0 à 15)<br>Ce champ de version est incrémenté lors de la modification des informations de description des données précédemment définies (modification incompatible).<br>0: réservé<br>1: Identificateur pour la structure présente<br>>8: spécifique au constructeur                                                                                                                                                                                                                                                                                              |
| 8 à 11  | Nombre de capteurs décrits (Gx) dans le paramètre. (plage de valeurs: 0 à 15)<br>Il est recommandé de limiter le nombre des capteurs décrits au nombre des interfaces de capteur actives afin de réduire la surcharge de communication entre le contrôleur et le DO.                                                                                                                                                                                                                                                                                                                                                                            |
| 12 à 15 | Nombre d'index affectés décrivant un capteur (sous-structure du capteur) (plage de valeurs: 5 à 10).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 16 à 31 | Réservé pour une utilisation ultérieure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Sous-index 1: Type de capteur

**Tableau 104 – Sous-index 1 (type de capteur) du paramètre 979**

| Bits   | Signification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0      | = 0 capteur rotatif<br>= 1 capteur linéaire                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 1      | = 0 Une haute résolution en Gx_XIST1 affiche une position relative (aucune référence à la période de signal). Cela signifie que la position du signal du capteur au sein du signal sinusoïdal n'est pas affichée à l'instant de mise sous tension.<br><br>= 1 Une haute résolution en Gx_XIST1 affiche la position absolue dans une période de signal. La valeur transférée peut être interprétée comme une valeur absolue car les résolutions fines sont synchrones à chaque instant de mise sous tension.                                                                                                                                                                                                                                                                                                              |
| 2      | = 0 Aucune information absolue disponible sur le bit numéro 64.<br>= 1 Réserve pour des extensions ultérieures: Informations absolues disponibles sur le bit numéro 64.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3 à 28 | Réserve pour une utilisation ultérieure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 29     | = 0: Les données dans la sous-structure Gx du paramètre 979 sont statiques et ne changent pas après la transition d'état de l'état de stationnement à l'état de fonctionnement normal.<br><br>= 1: Les données dans la sous-structure Gx du paramètre 979 peuvent changer après la transition d'état de l'état de stationnement à l'état de fonctionnement normal. Ceci signifie que le contrôleur est tenu de lire le contenu de cette sous-structure à chaque changement d'état de "stationnement" ou "stationnement & erreur" à "fonctionnement normal". Cette fonctionnalité permet de gérer les dispositifs d'entraînement qui sont capables de traiter différents systèmes de mesure à une interface. Cette fonctionnalité n'est disponible qu'avec la version de la structure 1.2 du paramètre 979 ou supérieure. |
| 30     | = 0: Si les données actuelles dans la sous-structure Gx du paramètre 979 sont non valides (paramètre 979[1] bit 31 = 0), cet état peut devenir valide (paramètre 979[1] bit 31 = 1) ultérieurement. Le changement de validité de non valide à valide ne doit être possible que lorsque le système de mesure est dans l'état "stationnement". Cette fonctionnalité n'est disponible qu'avec la version de la structure 1.2 du paramètre 979 ou supérieure.<br><br>= 1: La validité des données dans la sous-structure Gx du paramètre 979 qui est actuellement signalée dans le paramètre 979[1] bit 31 est statique et ne change pas.                                                                                                                                                                                    |
| 31     | = 0 Les données dans la sous-structure Gx du paramètre 979 sont non valides.<br>= 1 Les données dans la sous-structure Gx du paramètre 979 sont valides.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## Sous-index 2: Résolution du capteur

**Tableau 105 – Sous-index 2 (résolution du capteur) du paramètre 979**

| Type de capteur <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                             | Signification                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Capteur rotatif                                                                                                                                                                                                                                                                                                                                                                          | Nombre d'impulsions (=période de signal) par tour <sup>b</sup> |
| Capteur linéaire                                                                                                                                                                                                                                                                                                                                                                         | Longueur d'une période de signal en nanomètres <sup>b</sup>    |
| <sup>a</sup> Le type de capteur résulte du sous-index 1 bit 0.<br><sup>b</sup> Si le capteur ne fournit aucune période de signal (= pistes A et B) mais un protocole série, la proposition suivante est valide: pour un capteur rotatif, le paramètre contient le nombre d'incrément par tour. Pour un capteur linéaire, le paramètre contient la longueur de l'incrément en nanomètres. |                                                                |

La résolution du capteur donnée dans le sous-index 2 du paramètre 979 est également valide pour Gx\_XIST1 et la valeur absolue en Gx\_XIST2. Cela implique que Gx\_XIST1 et la valeur absolue en Gx\_XIST2 doivent pouvoir être décomposés en une même unité élémentaire en présence de différentes résolutions physiques dans la partie incrémentale et absolue du capteur du codeur.