Altivar Process
PROFINET Manual VW3A3627

04/2015

Schneider Electric

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

ⓘ

Important Information

Qualification Of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used. All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

Intended Use

This product is a drive for three-phase synchronous and asynchronous motors and intended for industrial use according to this manual.The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented.Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design). Any use other than the use explicitly permitted is prohibited and can result in hazards. Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

Product Related Information

Read and understand these instructions before performing any procedure with this drive.

⚡ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit boards, operate with mains voltage. Do not touch. Use only electrically insulated tools.
- Do not touch unshielded components or terminals with voltage present.
- Motors can generate voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors of the motor cable.
- Do not short across the DC bus terminals or the DC bus capacitors or the braking resistor terminals.
- Before performing work on the drive system:
  - Disconnect all power, including external control power that may be present.
  - Place a **Do Not Turn On** label on all power switches.
  - Lock all power switches in the open position.
  - Wait 15 minutes to allow the DC bus capacitors to discharge. The DC bus LED is not an indicator of the absence of DC bus voltage that can exceed 800 Vdc.
    Measure the voltage on the DC bus between the DC bus terminals (PA/+, PC/-) using a properly rated voltmeter to verify that the voltage is <42 Vdc
  - If the DC bus capacitors do not discharge properly, contact your local Schneider Electric representative. Do not repair or operate the product.
- Install and close all covers before applying voltage.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNEXPECTED MOVEMENT

Drive systems may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.
- Carefully install the wiring in accordance with the EMC requirements.
- Do not operate the product with unknown or unsuitable settings or data.
- Perform a comprehensive commissioning test.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Damaged products or accessories may cause electric shock or unanticipated equipment operation.

⚡ ⚠ DANGER

ELECTRIC SHOCK OR UNANTICIPATED EQUIPMENT OPERATION

Do not use damaged products or accessories.

Failure to follow these instructions will result in death or serious injury.

Contact your local Schneider Electric sales office if you detect any damage whatsoever.

⚠ WARNING

LOSS OF CONTROL

● The designer of any control scheme must consider the potential failure modes of control paths and, for critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
● Separate or redundant control paths must be provided for critical control functions.
● System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
● Observe all accident prevention regulations and local safety guidelines (1).
● Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.

NOTICE

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

Before switching on and configuring the product, verify that it is approved for the mains voltage

Failure to follow these instructions can result in equipment damage.

About the Book

At a Glance

Document Scope

The purpose of this document is to:
- Show you how to install the PROFINET fieldbus module on the drive.
- Show you how to configure the drive to use PROFINET fieldbus.

NOTE: Read and understand this document and all related documents (see below) before installing,operating, or maintaining the drive.

Validity Note

This documentation is valid for the Altivar Process drives.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. • Do not include blank spaces in the model number/product range. • To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product Datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Use your tablet or your PC to quickly access detailed and comprehensive information on all our products on www.schneider-electric.com

The internet site provides the information you need for products and solutions
- The whole catalog for detailed characteristics and selection guides
- The CAD files to help design your installation, available in over 20 different file formats
- All software and firmware to maintain your installation up to date
- A large quantity of White Papers, Environment documents, Application solutions, Specifications... to gain a better understanding of our electrical systems and equipment or automation
- And finally all the User Guides related to your drive, listed below:

Title of Documentation	Reference Number
Altivar Process Getting Started	EAV63253 (English), EAV63254 (French), EAV63255 (German), EAV63256 (Spanish), EAV64310 (Italian), EAV64298 (Chinese)
Altivar Process Getting Started Annex (SCCR)	EAV64300 (English)
Altivar Process Installation Manual	EAV64301 (English), EAV64302 (French), EAV64306 (German), EAV64307 (Spanish), EAV63257 (Italian), EAV64317 (Chinese)
Altivar Process Programming Manual	EAV64318 (English), EAV64320 (French), EAV64321 (German), EAV64322 (Spanish), EAV64323 (Italian), EAV64324 (Chinese)
Altivar Process Modbus Serial Link Manual (Embedded)	EAV64325 (English)
Altivar Process Ethernet Manual (Embedded)	EAV64327 (English)
Altivar Process Ethernet IP - Modbus TCP Manual (VW3A3720)	EAV64328 (English)
Altivar Process PROFIBUS DP manual (VW3A3607)	EAV64329 (English)
Altivar Process DeviceNet manual (VW3A3609)	EAV64330 (English)
Altivar Process PROFINET manual (VW3A3627)	EAV64331 (English)
Altivar Process CANopen Serial Link Manual (VW3A3608, 618, 628)	EAV64333 (English)
Altivar Process Communication Parameters	EAV64332 (English)
Altivar Process Safety Function manual	EAV64334 (English)

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Standards and Terminology

The technical terms, terminology, and the corresponding descriptions in this manual normally use the terms or definitions in the relevant standards.

In the area of drive systems this includes, but is not limited to, terms such as **error, error message, failure, fault, fault reset, protection, safe state, safety function, warning, warning message**, and so on.

Among others, these standards include:
- IEC 61800 series: Adjustable speed electrical power drive systems
- IEC 61508 Ed.2 series: Functional safety of electrical/electronic/programmable electronic safety-related
- EN 954-1 safety of machinery - Safety related parts of control systems
- EN ISO 13849-1 & 2 safety of machinery - Safety related parts of control systems.
- IEC 61158 series: Industrial communication networks - Fieldbus specifications
- IEC 61784 series: Industrial communication networks - Profiles
- IEC 60204-1: Safety of machinery - Electrical equipment of machines – Part 1: General requirements

Chapter 1
Presentation

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Hardware Overview	12
Software Overview	13

Hardware Overview

General

The VW3A3627 is a dual port PROFINET fieldbus module that can be used in a PROFINET industrial fieldbus. The VW3A3627 also offers an embedded Web server (in five languages) which offers comfortable displaying and commissioning functions directly from a standard web browser.

The figure shows the hardware presentation of the VW3A3627 dual port PROFINET fieldbus module:

Software Overview

Simplified TCP/IP Model

The table provides the basic software overview according to the simplified TCP/IP model:

Application	Transport	Network	Link
PROFINET / IP services	TCP/UDP	IP	Ethernet
PROFINET RT	–	–	Ethernet

PROFINET Fieldbus Module Features Overview
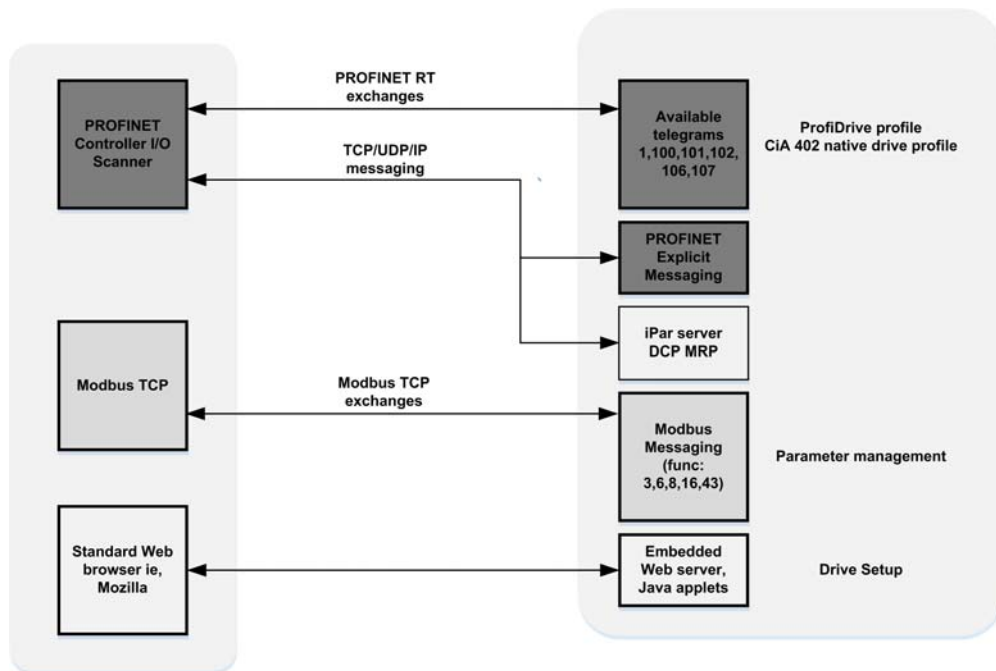
Chapter 2
Basics

What Is in This Chapter?

This chapter contains the following sections:

Section 2.1
Introduction

Introduction

PROFINET

- PROFINET RT extends Ethernet by an advanced industrial protocol management as an application layer for automation applications. In this way, Ethernet protocol is suited for industrial control.
- PROFINET relies on TCP and UDP for non-RT information.
- Products from different manufacturers can be networked by using a PROFINET-compliant switch.

Modbus TCP

The Modbus application layer is standard. Many of the manufacturers are already implementing this protocol. Many have already developed a Modbus TCP/IP connection and numerous products are currently available. With the simplicity of its protocol and the fast Ethernet throughput data rate of 100 Mbit/s, Modbus TCP/IP achieves excellent performance.

PROFINET and Ethernet Features

The product supports the following functions:
- Automatic IP address assignment via DHCP and DCP
- Support of MRP (Media Redundancy Protocol)
- Automatic configuration data via iPar-Server
- Commissioning via DTM-based PC software
- Support of LLDP (Link Layer Discovery Protocol)
- Diagnostics and configuration via integrated Web server

Web Server

The standard Web server provides access to the following pages:
- Drive monitor
- Data viewer/editor
- Save and restore configuration
- Network parameters
- iPar client settings
- Administration
- TCP/UIP statistics
- Modbus statistics

Section 2.2
Common Additional Features

What Is in This Section?

This section contains the following topics:

Identification and Maintenance Data

Overview

Identification & maintenance (I&M) is established through PNO

Supports the user during various scenarios of the device life cycle, such as:
- Configuration
- Commissioning
- Repair and update
- Operation and visualization

NOTE: These fields are read only (index AFF0 hex).

The access to the identification & maintenance data can be achieved using the PROFINET mechanisms (IEC 611458-6).

I&M Record

Description

The table provides the details of I&M record:

Champ	Number of Bytes	Value	Description
HEADER_MANUF_SPEC	10 bytes	(string)	Manufacturer-specific field
MANUFACTURER_ID	2 bytes	01 hex, 29 hex	129 hex: Schneider Electric
ORDER_ID	20 bytes	Identification object ID 1	Commercial name of the drive
SERIAL_NUMBER	16 bytes	Serial number	C1P1, C1P2, C1P3, C1P4
HARDWARE_REVISION	2 bytes	10 hex, 00 hex	–
SOFTWARE_REVISION	4 bytes	'V', A, B, C	A = MSB of software version B = LSB of software version C = MSB of software revision
REVISION_COUNTER	2 bytes	xx hex, yy hex	Rev xy
PROFILE_ID	2 bytes	–	Defined by the PNO (3A00...3AFF, PROFIdrive)
PROFILE_SPECIFIC_TYPE	2 bytes	–	Profile specific number
IM_VERSION	2 bytes	01 hex, 02 hex	Version I&M: 1.2
IM_SUPPORTED	2 bytes	00 hex, 01 hex	Managed index I&M [gs56] I&M0

Section 2.3
PROFIdrive Parameters Channel

What Is in This Section?

This section contains the following topics:

PROFIdrive Profile

Overview

When operated with the PROFIdrive profile, the drive parameters are organized as defined by PNU numbering and addressing modes. However, for people who are familiar with the Altivar parameters, this addressing mode keeps the native structure of the device (based on Modbus addressing). PNU is numbered from 0...65535 and each PNU represents a parameter (from single type as words to complex data structure or arrays). PROFIdrive parameters from PNU 900 ...PNU 999 are standardized, they are described below. All others PNUs are manufacturer-specific.

In the case of this drive, parameters can be separated in two groups:
● Standardized PNUs (900...999)
● Drive parameters which are gathered in a single PNU entry point: PNU1000.It is also possible to access the parameters using the Modbus address as PNU for each parameter (1001...59999) and Modbus address as subindex.
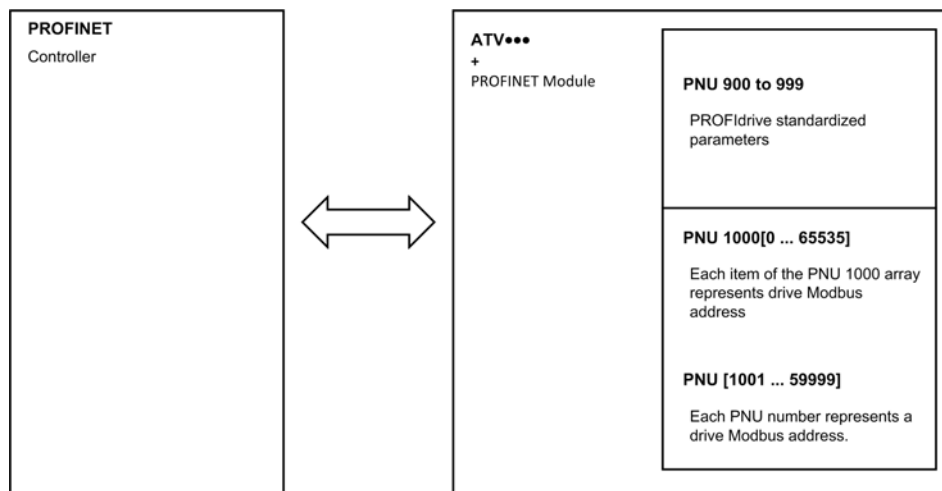
PROFIdrive Based on PROFINET

When the drive is operated in PROFIdrive profile, the parameter management takes benefit of the PROFINET acyclic messaging features. With PROFINET, it is possible to exchange messages of variable length between the controller and the supervisor. These messages come in addition of the periodic data exchange.
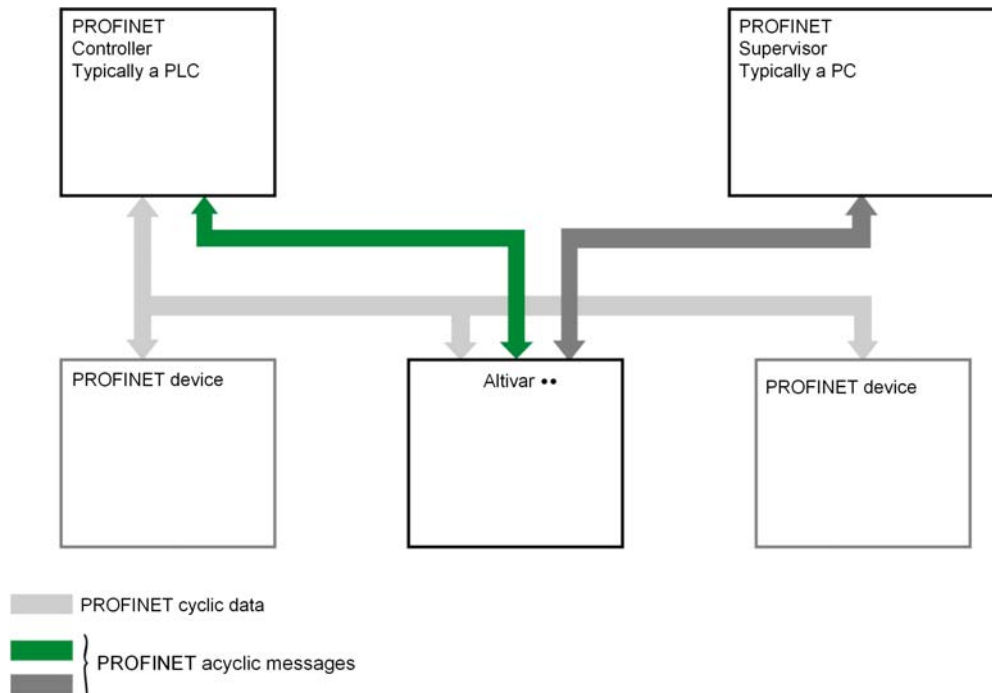
Parameter Structure

PROFIdrive Telegram

The table describes the PROFIdrive header:

DU	Byte Nr	Request
Function code	0	–
Slot_num	1	0: global parameters
Index	2	47: Reserved for PROFIdrive
Length	3	Length of PROFIdrive parameter channel frame
Data	4...5	PROFIdrive parameter channel frame: check

PROFIdrive Parameter Structure

A parameter is defined with its PNU number from 1...65535.

Each parameter consists of 3 main areas:
- **PWE**: the value
- **PBE**: describes the parameter attributes
- Text area

The access to the 3 different areas of a parameter is specified by the **attribute field** of the parameter request.

The following diagram summarizes the parameter model (For more information, refer to the profile drive technology V4 standard).

The parameters and their sub parts are identified as follows:

PNU number + attribute	10 hex	PWE	+ Sub index
	20 hex	PBE	+ Sub index
	30 hex	Text	+ Sub index

Detail of the PBE Attribute

The diagram describes the PBE attribute:
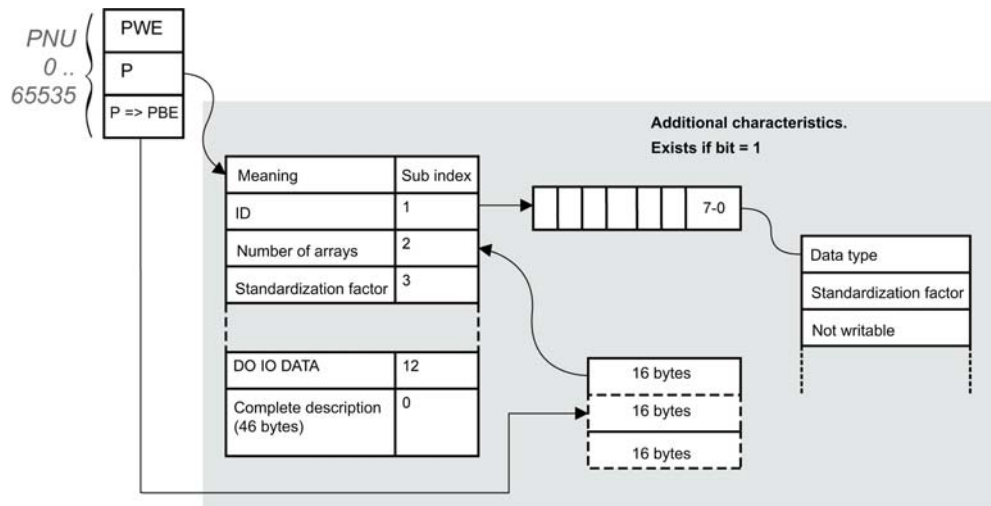
Drive Parameters

Each drive parameter can be represented according to the PNU standard structure. Drive parameters are part of the PNU 1000 or can be accessed using the Modbus address as PNU number.

The table provides the possible values of a parameter according to the PNU properties:

Parameter Property	Drive Implementation	Example
PNU number	1000	–
Sub index	Modbus address	CMD address: 8501
PWE	Value of the parameter 0...65535	–
PBE	Describes an array of 65535 words	Constant
Text	–	Drive parameter

PROFIdrive Parameters

PROFIdrive Standard Parameters

Parameters 900 to 999 are defined in accordance with the PROFIdrive profile.

The table describes the required parameters:

PNU	Sub -ID	Definition	Data Type	R/W	Comments
900	–	Controller > DO PNU900 contains the cyclical frame if supervisor handles the DO	–	R	Control telegram. Image of PZD
907	–	Controller < DO PNU900 contains the cyclical frame if supervisor handles the DO	–	R	Status telegram. Image of PZD
922	–	Telegram selection	UINT	R	1,100,101,102,106,107
927	–	Operation priority	UINT	R/W	Enables control
928	–	Control priority	UINT	R	=1
930	–	Operating mode	UINT	R	=1
944	–	Error message counter	UINT	R	The value of PNU944 is incremented each time an error is detected (+1 for each new detected error)
947	–	Error number	UINT	R	This parameter contains the error code value (error code = error number) of an error detected by the drive.
963	–	Actual baud rate	UNIT	R	Current baud rate
964	–	Drive unit identification			
	0	Manufacturer ID	–	R	Defined by PNO (PROFINET organization)
	1	Drive unit	String	R	This UNIT contains the value xx commercial catalog number (character string)
	2	Version (drive)	–	R	This parameter contains the firmware version of the host drive XXyy version, IE
	3	Firmware date (year)	INT	R	–
	4	Firmware date (day/month)	INT	R	This parameter contains the firmware date (day/month)
	Sub index 5 and 6 are not available.				
965	–	Profile identification number	UINT	R	Profile identification numbers: Byte 1 = 03: PROFIdrive Byte 2 = 40: V4.01
980...989	–	Number list of defined parameter (mandatory parameter + PNU1000)	UINT	R	–

PROFIdrive Parameter Access

Parameters Requests

There are 2 types of request:
- Request parameter (parameters are PNU number, attribute, and sub index)
- Change parameter (parameters are PNU number, attribute, and sub index)

These requests are able to manage one or more parameters or several attributes of one parameter. In order to access to a specific attribute of a parameter, the request header contains: the PNU, the sub index, and an attribute. This attribute defines whether the request mentions the value, the description area, or the text area.

Parameter Reading

Request

	Byte n+1	Byte n
Request data	Request reference = 01	Request ID = 01
	Axis = 01 hex	Number of parameters = 01
	Attribute = 10 hex *	Number of elements = 01
	PNU number = 3E8 hex	
	Sub index = C81 hex (3201) ETA Modbus address	
*refers to field value (PWE), 20 hex refers to the description field (PBE) and 30 hex to the text field.		

Response

	Byte n+1	Byte n
Response header	Request reference = 01	Request ID = 01
	Axis = 01 hex	Number of parameters = 01
Response data	Format = 42 hex *	Number of elements = 01
	PNU value = xxxx hex (value of ETA)	
*format 42 hex specified that the returned value is a WORD.		

NOTE: byte 41 hex, word 42 hex, standard integer 03 hex, double word 43 hex.

Parameter Writing

Request

	Byte n+1	Byte n
Request header	Request reference = 01	Request ID = 02
	Axis = 01 hex	Number of parameters = 01
Parameter number	Attribute = 10 hex *	Number of elements = 01
	PNU number = 3E8 hex	
	Sub index = 2329 hex (9001) ACC Modbus address	
Parameter value	Format = 42 hex	Amount values = 01
	Value = 50 (ACC is set to 5 s)	
*refers to field value (PWE), 20 hex refers to the description field (PBE) and 30 hex to the text field.		

Response

	Byte n+1	Byte n
Response header	Request reference = 01	Request ID = 02
	Axis = 01 hex	Number of parameters = 01

Request for Negative Response

The table lists the items of a negative response:

	Byte n+1	Byte n
Request header	Request reference = 01	Request ID = 82*
	Axis = 01 hex	Number of parameters = 01
Parameter number	Format = error 44 hex *	Number of values
Value	0x00: Impermissible PNU 0x01: Cannot change value 0x02: Low or high limit exceeded + sub index 0x03: Sub index detected error + sub index 0x04: No array 0x05: Incorrect data type 0x06: Setting not permitted + sub index 0x07: Cannot change description + sub index 0x09: No description 0x0B: No operation priority 0x0F: No text array available 0x11: Cannot execute the request. Reason not specified 0x14: Value impermissible 0x15: Response too long 0x16: Parameter address impermissible 0x17: Illegal format 0x18: Number of values inconsistent 0x19: Axis/DO nonexistent 0x20: Cannot change text 0x65: Invalid request reference 0x66: Invalid request ID 0x67: Invalid axis number / DO-ID 0x68: Invalid number of parameters 0x69: Invalid attribute 0x6B: Request too short	
*for all negative responses the ID equals to response code or 80 hex.		

With the sub index in addition to the detected error value, the total length of the answer is 10 bytes.

Section 2.4
iPar Service

iPar Service

Description

The PROFINET fieldbus module is compliant with iPar server function.

This is managed by the function block FB24 **IPARSERV**.

The purpose of this function is to save (upload) the parameters (iParameter) of any PROFIBUS DP slave, PROFINET I/O device, or module within the same host controller that is maintaining the GSD-based parameters and diagnosis messages.

This allows, for example, fast device replacement due to maintenance or repair.

The function block can restore (download) the iParameter set to the component upon its request.

The figure shows the universal-Parameter-Server principle.
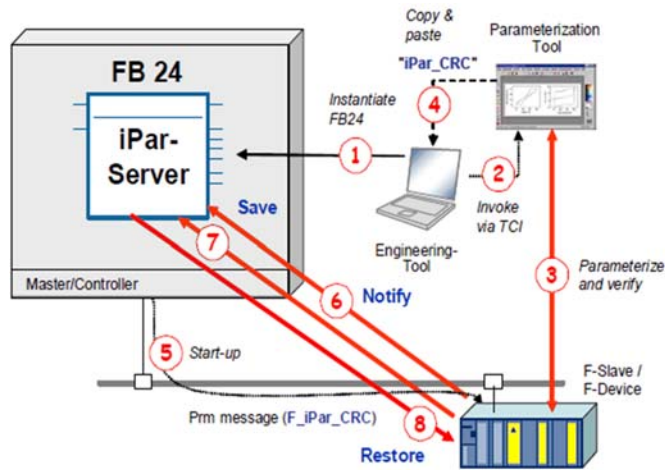
Per upload request, the function block reads the data record with the iParameter out of the drive, creates a data block, and stores the data record therein.

Per download request, the function block uses the data block and writes down a data record to the drive.

The FB is instantiated once per component. It must be started within OB1 and additionally in OB 100 (the start-up OB).

With PROFINET I/O, a device sends a request to save or restore iParameter set to the host controller via a new alarm, called upload & retrieval (User structure identifier = 0x8201).

With a PROFINET I/O device, the function block FB 24 must additionally be started within OB 56 (the **update alarm** OB).

To configure the iPar function, it is necessary to use the diagnostic address of the **slot 0** present on the device.

Select **Support device replacement without exchangeable medium** to activate the iPar function.
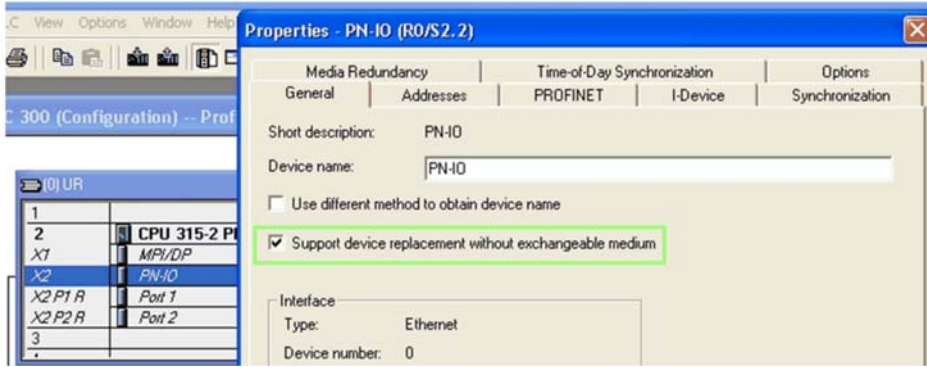
The answer of the iPar request is stored in a data block. The size of the array shall be set to 8192.

Modbus TCP Settings

The Modbus channel is only used for commissioning tools and for the embedded Web server (Unit ID 251: Fieldbus module, unit ID 248: Variable speed drive).

Function Name	Code		Description	Comments
	Dec	Hex		
Read Multiple Register	03	03 hex	Read multiple register	Maximum PDU length: 63 words
Write Single Register	06	06 hex	Write single register	–
Diagnostic	08	08 hex	Diagnostic	–
Write multiple register	16	10 hex	Write multiple register	Maximum PDU length: 63 words
Read device Identification	43	2B hex	Schneider identification	(subfunction 14/0E hex)See the table below

The following table provides the details of device identification

Byte(s)	Meaning	With the VW3A3627 PROFINET Module	
0	Function code = 2B hex	2B hex	
1	Type of MEI	0E hex	
2	ReadDeviceId code	01 hex	
3	Degree of conformity	02 hex	
4	Number of additional frames	00 hex	
5	Next object ID	00 hex	
6	Number of objects	3 for basic 4 for regular or extended	
7	Object 1 ID	00	
8	Length of object 1 (A)	13	
9...21	Value of object 1 (A ASCII character)	**Schneider Electric**	
22	Object 2 ID	01 hex = Product Code	
23	Length of object 2 (B)	11 (for the following example only)	
24...23+B	Value of object 2 (B ASCII characters) (1)	Example: **ATVxxxxxxxx**	
24+B	Object 3 ID	02 hex = Major.Minor revision	
25+B	Length of object 3 (C)	4	
26+B...29+B	Value of object 3 (C ASCII characters)	Example: **0201** for version 2.1	
30+B	Object 4 ID	06 hex = Application name(2)	For regular and extended
31+B	Length of object 4 (D)	8 (for the following example only)	
32+B...31+B+D	Value of object 4 (D ASCII characters)(1)	Example: **Machine 4**	
(1) The length of this field is variable. Use the **Length of object X** field associated with it to determine the length. (2) In the case of the drive, this data item corresponds to **[DEVICE NAME]**. The response to a **drive identification** request does not cause an exception response			

Chapter 3
Hardware Setup

What Is in This Chapter?

This chapter contains the following topics:

Hardware Presentation

PROFINET Fieldbus Module

The figure shows a PROFINET fieldbus module with 2 RJ45 connectors:
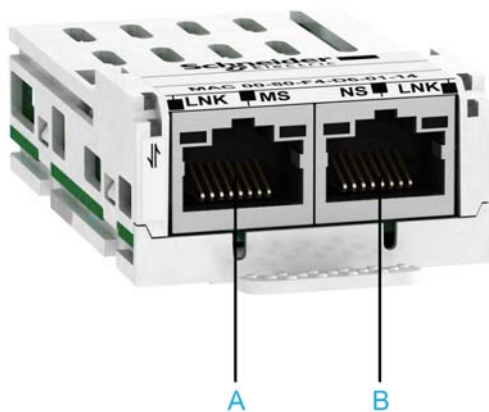
Item	Description	Comment
A	Port A	RJ45 connector
B	Port B	RJ45 connector

Firmware and Description File

Compatibility

The VW3A3627 option module version 1.2 and higher is compliant with all Altivar process product range.

The associated GSDML is named as the following example:

GSDML-V2.3-Schneider-ATV6xx-20140612.xml

The files are available on www.schneider-electric.com.

Installation of the Module

Before Starting

Check that the module catalog number marked on the label is the same as that on the delivery note corresponding to the purchase order.

Remove the fieldbus module from its packaging and check that it has not been damaged in transit.

Insertion of the Fieldbus Module

The table provides the procedure for insertion of the PROFINET option module in the drive:

Step	Action
1	Ensure that the power is off.
2	Locate the fieldbus module slot (A) on the bottom of the control part.
3	Add the corresponding sticker on the LED front panel of the drive.
4	Insert the module.
5	Check that the module is correctly inserted and locked mechanically in the drive.
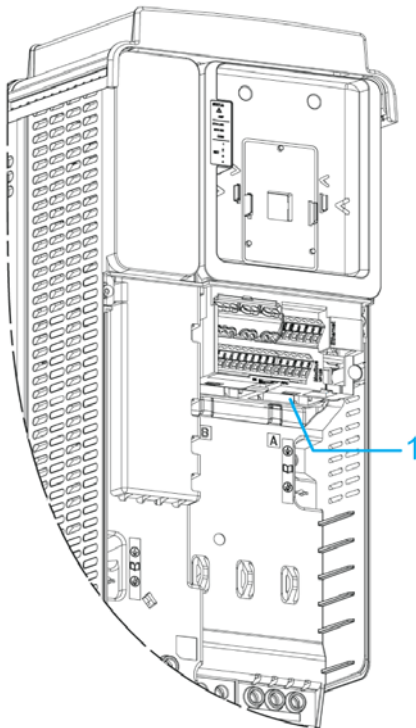
1 Slot A

Removal of the Fieldbus Module

The table provides the procedure for removal of the PROFINET option module from the drive:

Step	Action
1	Ensure that the power is off.
2	Press the strip.
3	Remove the module while maintaining the strip pressed,

Electrical Installation

Pin Layout

The VW3A3627 option module is equipped with 2 RJ45 female sockets for the PROFINET connection.
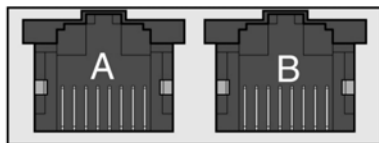
8 7 6 5 4 3 2 1 8 7 6 5 4 3 2 1

The table provides the pin out details of each RJ45 connector:

Pin	Signal	Meaning
1	Tx+	Ethernet transmit line +
2	Tx-	Ethernet transmit line –
3	Rx+	Ethernet receive line +
4	–	–
5	–	–
6	Rx-	Ethernet receive line –
7	–	–
8	–	–

Cable Specification

Cable specifications are as follows:
- Minimum Cat 5e,
- Use equipotential bonding conductors (100 BASE-TX, category 5e or industrial Ethernet fast connect)
- Connector RJ45, no crossover cable
- Shield: both ends grounded
- Twisted-pair cable
- Verify that wiring, cables, and connected interfaces meet the PELV requirements.
- Maximum cable length per segment = 100 m (328 ft) / 6 plugs

Cable Routing Practices

Installation Topology

The VW3A3627 option module, with its 2 RJ45 connector, enables several wiring solutions:
- **Daisy chain and/or Star topology**
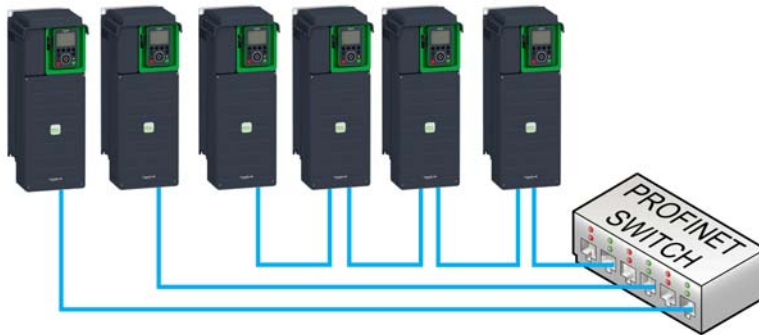
- **Ring topology**
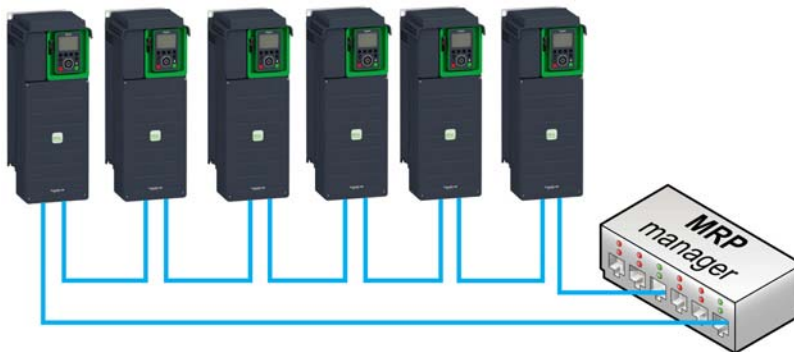
The ring topology can only be used with a media redundancy protocol (MRP) capable managed device. The bus watchdog shall be increased when using MRP function in order to avoid triggering untimely **[Fieldbus Com Interrupt]** ($C \, n \, F$) .

Chapter 4
Software Setup

What Is in This Chapter?

This chapter contains the following sections:

Section 4.1
Basic Settings

What Is in This Section?

This section contains the following topics:

Introduction

Overview

The parameters are described according to the graphic display terminal. These settings are also possible from commissioning software or from the PROFINET embedded Web server.

Access

The parameters are accessible in the **[Communication]** ($\mathcal{L}\,\mathit{o}\,\mathit{\Pi}\,\mathit{-}$)/**[Comm Parameters]** ($\mathcal{L}\,\mathit{\Pi}\,\mathit{P}\,\mathit{-}$), **[Profinet]** ($\mathit{P}\,\mathit{n}\,\mathcal{L}\,\mathit{-}$) menu.

[DEVICE NAME] (*P A n -*)

About This Parameter

This parameter defines the name of the device.

Access

This is a read/write parameter

The parameter numbers are from 3340...3347

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
–	–	–	Maximum 16 characters

[IP mode] (*ı P Π*)

About This Parameter

This parameter is used to select the IP address assignment method.

Access

This is a read/write parameter

The parameter number is 64250.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[Fixed]	*Π A n υ*	0	Manually type the IP address.
[DHCP]	*d H C P*	2	Automatically gets the IP address from the DHCP server.
[DCP]	*d C P*	3	Automatically gets the IP address from the DCP server.

[IP Module] (ı P C) (ı P C ı) (ı P C ₂) (ı P C ₃) (ı P C ₄)

About This Parameter

This parameter can be edited only when IP mode is set to fixed address.

Access

This is a read/write parameter

The parameter number for IPC1 is 64212

The parameter number for IPC2 is 64213

The parameter number for IPC3 is 64214

The parameter number for IPC4 is 64215

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0.0.0.0]	ı P C ı ı P C ₂ ı P C ₃ ı P C ₄	0...255 0...255 0...255 0...255	First byte of IP address. Second byte of IP address Third byte of IP address Fourth byte of IP address **Factory setting**: 0.0.0.0

[IP Mask] (*ı P П*) (*ı P П l*) (*ı P П 2*) (*ı P П 3*) (*ı P П 4*)

About This Parameter

This parameter can be edited only when IP mode is set to fixed address.

Access

This is a read/write parameter

The parameter number for IPM1 is 64216

The parameter number for IPM2 is 64217

The parameter number for IPM3 is 64218

The parameter number for IPM4 is 64219

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[255.255.254.0]	*ı P П l* *ı P П 2* *ı P П 3* *ı P П 4*	0...255 0...255 0...255 0...255	First byte of IP mask. Second byte of IP mask. Third byte of IP mask. Fourth byte of IP mask. **Factory setting**: 0.0.0.0

[IP Gate] (*ı P G*) (*ı P G 1*) (*ı P G 2*) (*ı P G 3*) (*ı P G 4*)

About This Parameter

This parameter can be edited only when IP mode is set to fixed address.

Access

This is a read/write parameter

The parameter number for IPG1 is 64220

The parameter number for IPG2 is 64221

The parameter number for IPG3 is 64222

The parameter number for IPG4 is 64223

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0.0.0.0]	*ı P G 1* *ı P G 2* *ı P G 3* *ı P G 4*	0...255 0...255 0...255 0...255	First byte of IP gateway Second byte of IP gateway Third byte of IP gateway Fourth byte of IP gateway **Factory setting**: 0.0.0.0

[Actual IP] (ı P A ı) (ı P A 2) (ı P A 3) (ı P A 4)

About This Parameter

This parameter can be accessed only when IP mode is set to fixed address.

This is the current IP setting taken into account by the drive.

Access

This is a read-only parameter

The parameter number for IPA1 is 64252

The parameter number for IPA2 is 64253

The parameter number for IPA3 is 64254

The parameter number for IPA4 is 64255

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0.0.0.0]	ı P A ı	0...255	First byte of IP address
	ı P A 2	0...255	Second byte of IP address
	ı P A 3	0...255	Third byte of IP address
	ı P A 4	0...255	Fourth byte of IP address
			Factory setting: 0.0.0.0

[Actual mask] (*IPS1*) (*IPS2*) (*IPS3*) (*IPS4*)

About This Parameter

This parameter can be accessed only when IP mode is set to fixed address.

This is the current IP setting taken into account by the drive.

Access

This is a read-only parameter

The parameter number for IPS1 is 64256

The parameter number for IPS2 is 64257

The parameter number for IPS3 is 64258

The parameter number for IPS4 is 64259

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0.0.0.0]	*IPS1*	0...255	First byte of IP mask
	IPS2	0...255	Second byte of IP mask
	IPS3	0...255	Third byte of IP mask
	IPS4	0...255	Fourth byte of IP mask
			Factory setting: 0.0.0.0

[Actual gate.] (*IPt 1*) (*IPt 2*) (*IPt 3*) (*IPt 4*)

About This Parameter

This parameter can be accessed only when IP mode is set to fixed address.

This is the current IP setting taken into account by the drive.

Access

This is a read-only parameter

The parameter number for IPT1 is 64260

The parameter number for IPT2 is 64261

The parameter number for IPT3 is 64262

The parameter number for IPT4 is 64263

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0.0.0.0]	*IPt 1*	0...255	First byte of IP gateway
	IPt 2	0...255	Second byte of IP gateway
	IPt 3	0...255	Third byte of IP gateway
	IPt 4	0...255	Fourth byte of IP gateway
			Factory setting: 0.0.0.0

[Ethernet Error Code] ($E \, r \, r$)

About This Parameter

This parameter displays the Ethernet error codes. This parameter can be accessed in **[Display]** ($\Pi \, o \, n$ -), **[Communication map]** ($\Box \, \Pi \, \Pi$ -), **[PROFINET DIAG]** ($P \, r \, n$ -) menu

Access

This is a read-only parameter

The parameter number is 64270

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
–	–	0	No error detected
		1	PROFINET I/O timeout
		2	Network overload
		3	Loss of Ethernet carrier
		9	Duplicated IP address.
		10	No valid IP.
		12	IPAR unconfigured state
		13	IPAR unrecoverable error detected
		17	Application I/O configuration error detected

[EnableWebserver] (*E W E*)

About This Parameter

This parameter is used to enable Web services.

Access

This is a read/write parameter.

The parameter number is 64264.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
–	–	0 1	No Web services. Web server enabled **Factory setting**: 1

[PPO profile used] ($P \, r \, F \, L$)

About This Parameter

This parameter is used to select the actual profile for the device.

Access

This is a read parameter

The parameter number is 6665

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[UnCG]	$u \, n \, C \, G$	0	UNCFG
[1]	I	1	Profidrive
[100]	$I \, 0 \, 0$	100	Device specific
[101]	$I \, 0 \, I$	101	Device specific
[102]	$I \, 0 \, 2$	102	Device specific
[106]	$I \, 0 \, 6$	106	Device specific
[107]	$I \, 0 \, 7$	107	Device specific
			Factory setting: 0

[MAC @] (*ПАС*)

About This Parameter

This parameter displays the MAC address of the device.

Access

This is a read-only parameter

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[xx-xx-xx-XX-XX-XX]	–	xx-xx-xx-XX-XX-XX	Left port MAC address is +1. Right port MAC address is + 2.

IP Parameter Settings

Assigning IP Parameters

The drive needs three IP parameters:
- The drive IP address.
- The subnet mask.
- The gateway IP address.

When the **[IP mode]** (*ıPΠ*) is set to **[Fixed]** (*ΠAnu*), you can directly type the IP address using the graphic display terminal or using the commissioning software.

When the **[IP mode]** (*ıPΠ*) is set to **[DHCP]** (*dHCP*), you can get IP address from a DHCP server (correspondence between the device name and the IP addresses

When the **[IP mode]** (*ıPΠ*) is set to **[DCP]** (*dCP*), you can use DCP (Discovery control protocol) protocol to discover PROFINET devices.

Entering IP Parameters in the Terminal

In the **[Communication]** (*CoΠ-*)/**[Comm Parameters]** (*CΠP-*)/, **[Profinet]** (*PnC-*) menu, enter the following IP parameters:
- **[IP Module]** (*ıPC 1*) (*ıPC 2*) (*ıPC 3*) (*ıPC 4*)
- **[IP Mask]** (*ıPΠ 1*) (*ıPΠ 2*) (*ıPΠ 3*) (*ıPΠ 4*),
- **[IP Gate]** (*ıPG 1*) (*ıPG 2*) (*ıPG 3*) (*ıPG 4*).

Turn off the drive and then back on again (control voltage if a separate power supply is being used), otherwise the IP parameters are not taken into account.

If this address is modified, the new IP address entered is displayed. This IP address will be effective the next time the drive is turned on.

Case of Manual Switching of [IP mode] (*ıPΠ*)

When switching **[IP mode]** (*ıPΠ*) to **[DCP]** (*dCP*)
- IP settings are no longer editable
- Turn off the drive supply and then back on again, including the control voltage if a separate power supply is being used
- The new configuration is applied, the device is waiting for IP settings from the PROFINET controller

When switching **[IP mode]** (*ıPΠ*) to **[Fixed]** (*ΠAnu*)
- IP settings become editable
- Set IP settings with valid values
- Turn off the drive and then back on again, including the control voltage if a separate power supply is being used
- The new configuration is applied

NOTE: If the IP settings are not valid, the drive triggers **[Fieldbus Error]** (*EPF 2*) after the next power-on.

When switching **[IP mode]** (*ıPΠ*) to **[DHCP]** (*dHCP*)
- IP settings are no longer editable.
- Set the device name with a valid value.
- Turn off the drive and then back on again, including the control voltage if a separate power supply is being used.
- The new configuration is applied, the device is waiting for IP settings from DHCP server.

NOTE: If the device name is not valid, the drive triggers **[Fieldbus Error]** (*EPF 2*) after the next power-on.

Case of Automatic Switching of [IP Mode] (*ıPΠ*) to [DCP] (*dCP*)

The following condition should be fulfilled:
- The device has a station name configured and validated
- The device is connected to a PROFINET controller
- The PROFINET controller has the station name in its own configuration
- The settings are in local configuration of the PROFINET controller

If the all above mentioned conditions are fulfilled:
- **[IP mode]** (*ıPΠ*) is automatically set to **[DCP]** (*dCP*)
- IP settings are replaced by the one set in local PROFINET controller
- The new configuration is applied immediately

Section 4.2
Additional Settings

What Is in This Section?

This section contains the following topics:

Introduction

Overview

The parameters are described according to the graphic display terminal. These settings are also possible from commissioning software or from the PROFINET embedded Web server.

Access

The parameters are accessible in the **[Communication]** (ς ω Π -)/**[Comm Parameters]** (ς Π P -), **[Profinet]** (P $\sqcap$ ς -) menu.

[iPar Activation](ı P A ப)

About This Parameter

This parameter is used to enable the iPar service.

Access

This is a read/write parameter

The parameter number is 64274.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[No]	n o	0	Indicates that the iPar service is disabled.
[Yes]	Y E 5	1	Indicates that the iPar service is enabled.

[iPar Autosave Act] (*iPAS*)

About This Parameter

This parameter is used to enable the iPar autosave service.

Access

This is a read/write parameter

The parameter number is 64275.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[No]	*no*	0	Indicates that the iPar autosave service is disabled
[Yes]	*YES*	1	Indicates that the iPar autosave service is enabled **Factory setting**: 0

[iPar Autosave Timer] (ı P Я ᵻ)

About This Parameter

This parameter is used to set the interval for periodic saving of the iPar service.

Access

This is a read/write parameter

The parameter number is 64278.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
–	–	0 1...9999 min	No autosave iPar service is saved after specified interval of time. **Factory setting**: 10 min

[iPar Error Response] (ı P A F)

About This Parameter

This parameter is used to enable the iPar error handling.

Access

This is a read/write parameter

The parameter number is 64277.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[No]	n o	0	Indicates that the iPar error handling is disabled
[Yes]	Y E S	1	Indicates that the iPar error handling is enabled **Factory setting**: 1

[iPar Local Conf] (ı C F G)

About This Parameter

This parameter is used to select local or server configuration.

Access

This is a read/write parameter

The parameter number is 64276.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[No] [Yes]	n o Y E 5	0 1	Indicates that the drive configuration is downloaded from the iPar server at power-on of the drive. Indicates that the drive configuration is available locally in the drive. **Factory setting**: 0

[iPar Status] ($\iota P A E$)

About This Parameter

This parameter displays the iPar service status. This parameter can be accessed in **[Display]** ($\Pi o n$ -), **[Communication map]** ($L \Pi \Pi$ -), **[PROFINET DIAG]** ($P r n$ -) menu.

Access

This is a read-only parameter

The parameter number is 64279.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[Idle State]	($\iota d L E$)	0	Idle state
[Init]	($\iota n \iota t$)	1	Initialization
[Configuration]	($L o n F$)	2	Configuration
[Ready]	($r d Y$)	3	Ready
[Operational]	($o P E$)	4	Operational
[Not Configured]	($u L F L$)	5	Not configured
[Unrecoverable Error]	($u r E L$)	6	Unrecoverable error state

[iPar Error Code] ($\iota P H d$)

About This Parameter

This parameter displays the error code. This parameter can be accessed in **[Display]** ($\Pi \, o \, n \, -$), **[Communication map]** ($C \, \Pi \, \Pi \, -$), **[PROFINET DIAG]** ($P \, r \, n \, -$) menu.

Access

This is a read-only parameter

The parameter number is 64280.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0]	($\varPi$)	0	No error
[1]	(I)	1	Stored configuration is not ok
[2]	($\varXi$)	2	No configuration file on the IPAR server or configuration is not compatible. (Served configuration is not ok)
[3]	($\varXi$)	3	Connection error to the IPAR configuration file on the server.
[4]	($\varUpsilon$)	4	Writing error the configuration file to the server.
			Factory settings: 0

Section 4.3
Embedded Web Server

What Is in This Section?

This section contains the following topics:

Embedded Web Server

Overview

The VW3A3627 provides an integrated Web server which allows several functions like: displaying, parameter settings, and diagnostics. This chapter describes the services provided by this Web server.

The Web server can be accessed from standard browsers like Internet Explorer or Firefox.

Connection to the Web Server

In the following example, the drive has received the IP address 10.0.0.5:
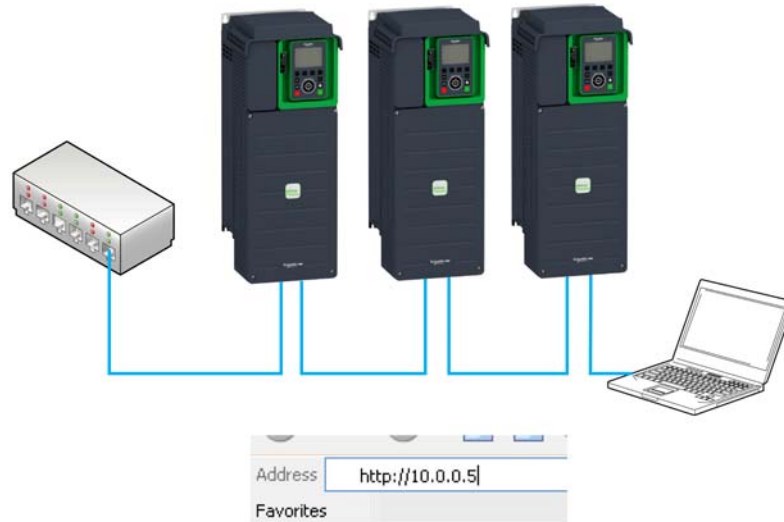
First connect the computer to the drive by typing `http://` followed by the drive IP address. You have to enter the **User Name** and a **Password**.

The factory setting for the user name is **USER** and the password is also **USER** .

Once connected, the Web server home page is displayed.

Access Rights - Password and User Names

- **Web read password**: Access to the different pages requires a user access level. This is the first level of password, you can display and access to all the pages of the Web server, but not modify data.
    - **User name**: USER (factory setting)
    - **Password**: USER (factory setting)

- **Web write password**: Access to data or settings change, an administrator access level is required.
    - **Password**: USER (factory setting)

Web Server Site Map

It contains:

Home	Monitoring	Drive monitor Data Viewer/Editor Save and restore
	Network setup	Network parameters iPar client settings Administration
	Diagnostics	TCP/IP statistics Modbus statistics

Home Page

Overview

The home page or **Home** menu includes a **Languages** submenu that contains a link to the different available language page.

Each link in the **Languages** submenu sends the user to the home page in the chosen language and configures the web browser to open the HTML pages located in the corresponding directory. (example: the `http://10.0.0.5` directory becomes the standard directory in the case of English).

Note About Java Applets

The Web server downloads java programs called applets to your computer. These applets communicate with the drive using Modbus services (on port 502), establishing one or more connections between the computer and the drive. Until an applet has been fully transmitted from the drive to the browser, a gray rectangle appears in the place reserved for it in the page.

The applet associated with the web pages displays the communication with the drive. When the drive no longer responds to requests to update the data, the message "Link down" is displayed in one field and all the other field contents are emptied.

The description of each page indicates the data refresh period requested by the applet loaded on the computer. The refresh period actually observed depends on:
- The performance of the computer on which the web browser is running,
- The communication system response time,
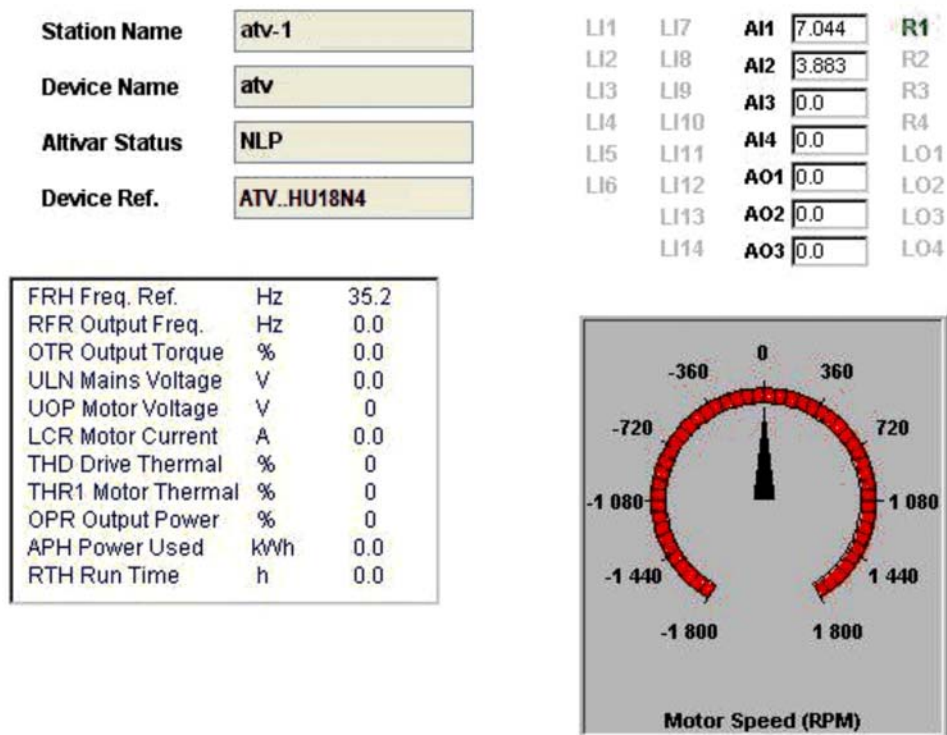- The amount of data to be refreshed on the page.

Display

Monitoring Menu

The **Monitoring** menu contains the following items:
- **Drive Monitor**
- **Data viewer/editor**
- **Save and restore configuration**

Drive Monitor Page

The figure shows the **Drive Monitor** page:

Station Name	atv-1
Device Name	atv
Altivar Status	NLP
Device Ref.	ATV..HU18N4

LI1	LI7	AI1	7.044	R1
LI2	LI8	AI2	3.883	R2
LI3	LI9	AI3	0.0	R3
LI4	LI10	AI4	0.0	R4
LI5	LI11	AO1	0.0	LO1
LI6	LI12	AO2	0.0	LO2
	LI13	AO3	0.0	LO3
	LI14			LO4

FRH Freq. Ref.	Hz	35.2
RFR Output Freq.	Hz	0.0
OTR Output Torque	%	0.0
ULN Mains Voltage	V	0.0
UOP Motor Voltage	V	0
LCR Motor Current	A	0.0
THD Drive Thermal	%	0
THR1 Motor Thermal	%	0
OPR Output Power	%	0
APH Power Used	kWh	0.0
RTH Run Time	h	0.0

Motor Speed (RPM)

The state displayed in the **Altivar Status** field corresponds to the display on the graphic display terminal. A delay may be noticed between the displays on the Web server and the display terminal. This delay depends on the performance of the computer used to display the pages using a web browser and the communication system performance.

The motor speed displayed on the **Motor Speed (RPM)** gauge is calibrated according to the drive and motor settings.
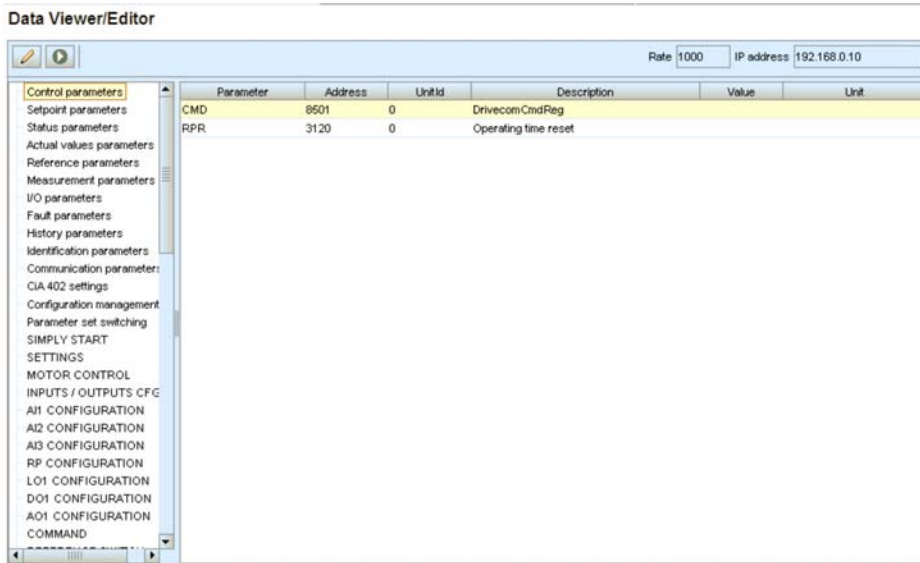
The LI... Gives the state of the drive terminal
- **DI1...DI6**, **DI11...DI16**: Logical inputs
- **R1...R6**: Relay outputs
- **AI1...AI5**: Analog inputs
- **DO11...DO12**: Analog/digital output

Green LED indicates that the logical input is active.

Red LED indicates that logical output is active

Data Viewer/ Editor Page

The figure shows the **Data viewer/editor** page:

This page is used to display the drive parameters and to modify their values.

The parameters are arranged in groups, and are consistent with the keypad and user manuals.

The display mode for each value depends on the nature of the parameter:
- The unit for the physical values is displayed in the **Unit** column.
- The registers (bit fields) are displayed in hexadecimal format (xxxx hex).
- Signed values are displayed as such.

To display the values, click the **Start animation** button.

To modify the parameter value, click the **Write value if selected row** button then select the parameter to modify.

It is only possible to modify the parameter values after entering the **Write password**, for details, refer to Access Rights - Password and User Name *(see page 63)*.

Click the **Password** button to enter this password. An entry field then appears in the parameter table, and also a **Cancel** button, for canceling the password entry. After entering the password, press the **Enter** key so that it is taken into account by the web browser.
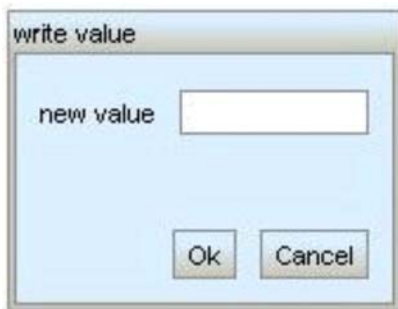
When the value of a parameter cannot be modified, the following window appears:
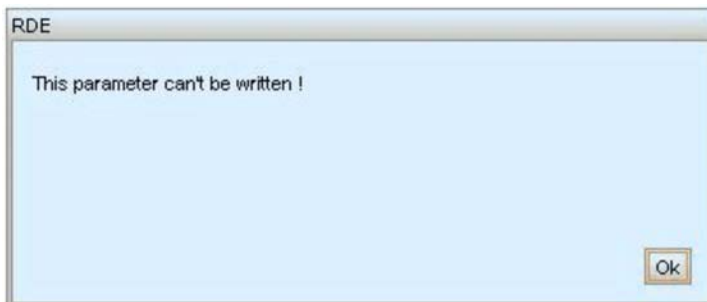
Save and Restore Configuration Page

The figure shows the **Save and restore configuration** page:

This page is used to save on the local computer (save `Backup.cfg` file) and restore from the local computer the drive parameters by using the embedded Web server. Restore operation is possible when the motor is stopped.

Save as   Restore
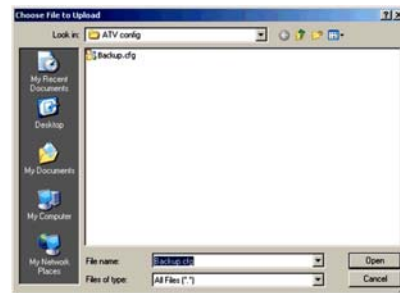
Network Setup

Network Setup Menu

The **Network Setup** menu contains the following items:
- **Network Parameters**
- **iPar Client Settings**
- **Administration**

Network Parameters Page

The figure shows the **Network Parameters** page:

IPar Client Settings Page

This page displays the main parameters used by the VW3A3627 PROFINET module iPar function and is used to configure these parameters.

The figure shows **iPar Client Settings** page:

Administration Page

This page is used to modify the Web read and the Web write password, for details, refer to Access Rights - Password and User Name .

The figure shows the **Administration** page:

Diagnostics

Diagnostic Menu

The **Diagnostics Menu** contains the following items:
- **TCP/IP Statistics**
- **Modbus Statistics**

TCP/IP Statistics Page

This page gives detailed information about the Ethernet status and settings.

The figure shows the **TCP/IP Statistics** page:

TCP/IP parameters		Receive statistics	
IP address	192.168.0.10	Frames received OK	27
Subnet mask	255.255.0.0	CRC errors	0
Default gateway	0.0.0.0	**Transmit statistics**	
IP Mode	Manual	Frames transmitted OK	26
Ethernet parameters		Collisions	0
MAC address	80-00-D9-F4-8C-00	Carrier sense errors	0
Ethernet frame format		Excessive collisions	0
Ethernet II, IEEE 802.3 sender, IEEE 802.3 receiver		Late collisions	0

Reset counters

Modbus Statistics

This page gives detailed information about the Modbus server.

The figure shows the **Modbus Statistics** page:

Inbound/Outbound Statistics	
Opened TCP Connections	1
Send Modbus msg	6745
Received Modbus msg	6745
Modbus error message	0

Reset Counters

Section 4.4
Communication Profile

What Is in This Section?

This section contains the following topics:

Definition of a Profile

Types of Profiles

There are 3 types of profile:
● Communication profiles
● Functional profiles
● Application profiles

Communication Profile

A communication profile describes the characteristics of a bus or network:
● Cables
● Connectors
● Electrical characteristics
● Access protocol
● Addressing system
● Periodic exchange service
● Messaging service
● ...

A communication profile is unique to a type of fieldbus (such as Modbus, PROFIBUS DP, and so on) and is used by different types of devices.

Functional Profile

A functional profile describes the behavior of a type of device:
● Functions
● Parameters (such as name, format, unit, type, and so on.)
● Periodic I/O variables
● State chart
● ...

A functional profile is common to all members of a device family (such as variable speed drives, encoders, I/O modules, displays, and so on).

They can feature common or similar parts. The standardized (IEC 61800-7) functional profiles of variable speed drives are:
● CiA402
● PROFIDRIVE
● CIP

DRIVECOM has been available since 1991.

CiA402 device profile for drives and motion control represents the next stage of this standard development and is now part of the IEC 61800-7 standard.

Some protocols also support the Open DeviceNet Vendor Association profile (ODVA).

Application Profile

Application profile defines the services to be provided by the devices on a machine. For example, CiA DSP 417-2 V 1.01 part 2: CANopen application profile for lift control systems - virtual device definitions.

Interchangeability

The aim of communication and functional profiles is to achieve interchangeability of the devices connected via the fieldbus.

Functional Profiles Supported by the Drive

I/O Profile

Using the I/O profile simplifies PLC programming.

The I/O profile mirrors the use of the terminal strip for control by utilizing 1 bit to control a function.

The I/O profile for the drive can also be used when controlling via a fieldbus.The drive starts up as soon as the `run` command is sent.15 bits of the control word (bits 1...15) can be assigned to a specific function.

This profile can be developed for simultaneous control of the drive via:
● The terminals
● The Modbus control word
● The CANopen control word
● Ethernet Modbus TCP embedded
● The fieldbus module control word

The I/O profile is supported by the drive itself and therefore in turn by all the communication ports (integrated Modbus, CANopen, Ethernet, PROFIBUS DP, PROFINET, and DeviceNet fieldbus modules).

CiA402 Profile

The drive only starts up following a command sequence.

The control word is standardized.

5 bits of the control word (bits 11...15) can be assigned to a function.

The CiA402 profile is supported by the drive itself and therefore by all the communication ports (Modbus, CANopen, Ethernet, PROFIBUS DP, PROFINET, and DeviceNet).

The drive supports the `velocity` mode of CiA402 profile.

In the CiA402 profile, there are two modes that are specific to the drive and characterize commands and references value management:
● `Separate` **[Separate]** (*5 E P*)
● `Not separate` **[Not separ.]** (*5 ,П*),

Functional Description

Introduction

Drive operation involves two main functions, which are illustrated in the diagrams below.

CiA402

The main parameters are shown with their CiA402 name and their CiA402/Drivecom index (the values in brackets are the CANopen addresses of the parameter).

The following figure shows the control diagram for drive operation:
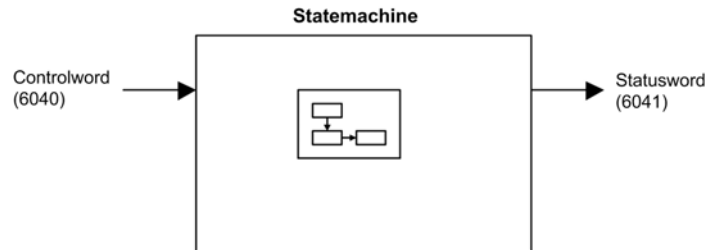
Simplified diagram for speed control in `Velocity` mode:
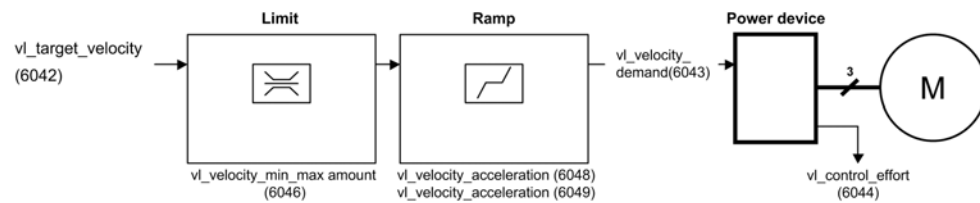
Altivar Drive

These diagrams translate as follows for the Altivar drive.

The following figure shows the control diagram for drive operation:
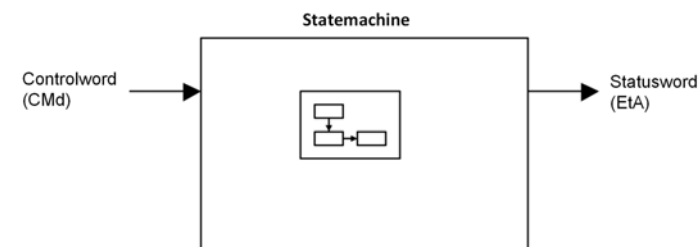
Simplified diagram for speed control in `Velocity` mode:
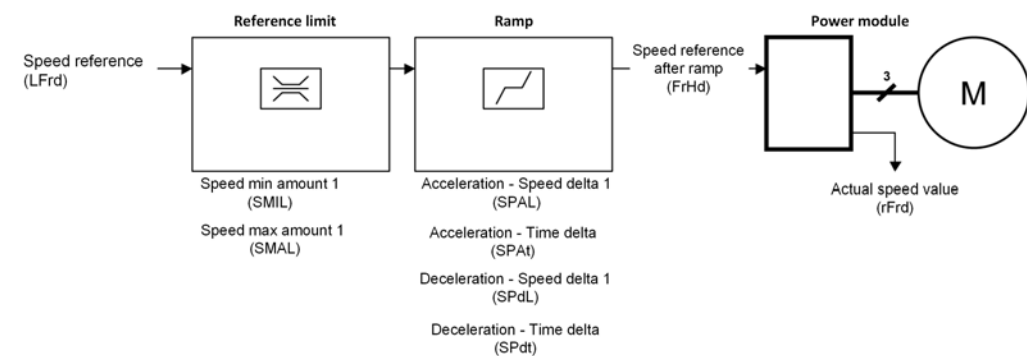
CIA402 Operating State Diagram

State Diagram

After switching on and when an operating mode is started, the product goes through a number of operating states.

The state diagram (state machine) shows the relationships between the operating states and the state transitions. The operating states are internally monitored and influenced by monitoring functions.

The following figure shows the CIA402 state diagram:

Description of Operating States

Drive Operating State

The operating state of the drive changes depending on whether the control word **[Cmd Register]** (*C П d*) , is sent or an event occurs (an error detection, for example).

The drive operating state can be identified by the value of the status word **[CIA402 State Reg]** (*E t A*) .

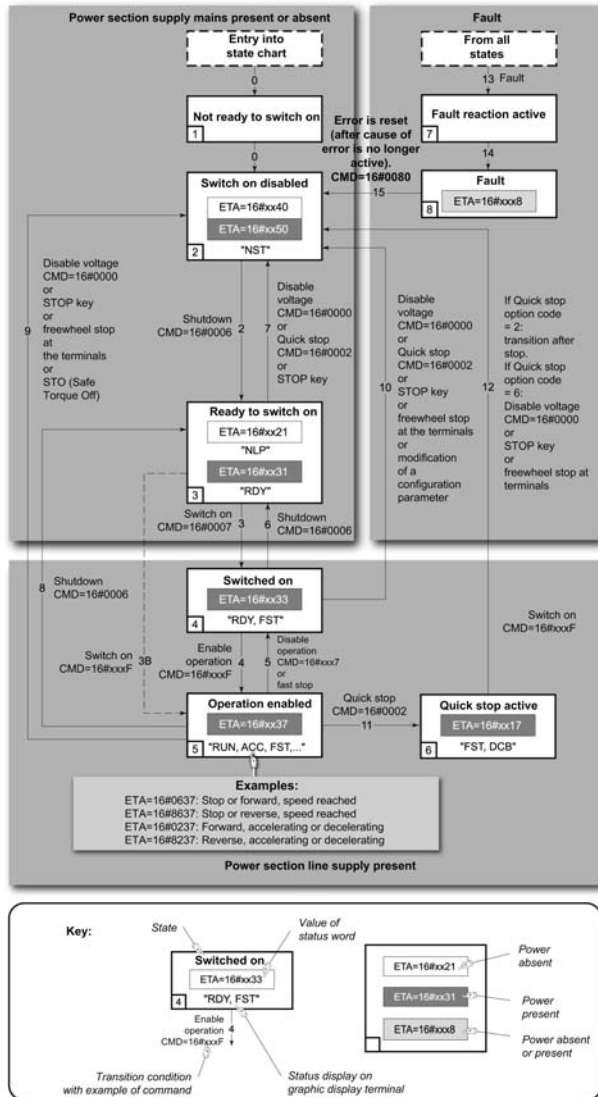| Operating State	Description
1 – Not ready to switch on	Initialization starts. This is a transient state invisible to the communication network.
2 - Switch on disabled	The power stage is not ready to switch on. The drive is locked, no power is supplied to the motor. For a separate control stage, it is not necessary to supply the power. For a separate control stage with mains contactor, the contactor is not closed. The configuration and adjustment parameters can be modified.
3 - Ready to switch on	The power stage is ready to switch on and awaiting power stage supply mains. For a separate control stage, it is not necessary to supply the power stage, but the system expects it in order to change to state 4 - Switched on. For a separate control stage with mains contactor, the contactor is not closed. The drive is locked, no power is supplied to the motor. The configuration and adjustment parameters can be modified.
4 – Switched on	Power stage is switched on. For a separate control stage, the power stage must be supplied. For a separate control stage with mains contactor, the contactor is closed. The drive is locked, no power is supplied to the motor. The power stage of the drive is ready to operate, but voltage has not yet been applied to the output. The adjustment parameters can be modified. If a configuration parameter is modified, the drive returns to the state 2 – Switch on disable .
5 - Operation enabled	Power stage is enabled. The drive is in running state For a separate control stage, the power stage must be supplied. For a separate control stage with mains contactor, the contactor is closed. The drive is unlocked, power is supplied to the motor. The drive functions are activated and voltage is applied to the motor terminals. If the reference value is zero or the Halt command is applied, no power is supplied to the motor and no torque is applied. To perform **[Auto tuning]** (*t u n*) , the drive must be in state 5 - Operation enabled. The adjustment parameters can be modified. The configuration parameters cannot be modified. **NOTE:** The command 4 – Enable operation must be taken into consideration only if the channel is valid. In particular, if the channel is involved in the command and the reference value, transition 4 is possible only after the reference value has been received once. The reaction of the drive to a Disable operation command depends on the value of the **[SwitchOnDisable Stp]** (*d o t d*) parameter: ● If the **[SwitchOnDisable Stp]** (*d o t d*) parameter is set to 0, the drive changes to operating state 4 – Switched on and stops in freewheel stop. ● If the **[SwitchOnDisable Stp]** (*d o t d*) parameter is set to 1, the drive stops on ramp and then changes to operating state 4 – Switched on.

Operating State	Description
6 – Quick stop active	The drive performs a fast stop and remains locked in the operating state `6-Quick stop active`. Before restarting the motor, it is required to go to the operating state `2-switch on disabled`. During fast stop, the drive is unlocked and power is supplied to the motor. The configuration parameters cannot be modified. The condition for transition 12 to state `2 – Switch on disabled` depends on the value of the parameter Quick stop mode (QStd): If the `Quick stop` mode parameter has the value FST2, the drive stops according to the fast stop ramp and then changes to state `2 – Switch on disabled`. If the `Quick stop` mode parameter has the value FST6, the drive stops according to the fast stop ramp and then remains in state `6 – Quick stop active` until: ● A `Disable voltage` command is received or ● The **STOP** key is pressed or ● A freewheel stop command via the digital input of the terminal.
7 – Fault reaction active	Transient state during which the drive performs an action corresponding to the selected error response.
8 – Fault	Error response terminated. Power stage is disabled. The drive is locked, no power is supplied to the motor.

Summary

Device Status Summary

Operating State	Power Stage Supply for Separate Control Stage	Power Supplied to Motor	Modification of Configuration Parameters
`1 - Not ready to switch on`	Not required	No	Yes
`2 - Switch on disabled`	Not required	No	Yes
`3 - Ready to switch on`	Not required	No	Yes
`4 - Switched on`	Required	No	Yes, return to `2 - Switch on disabled` operating state
`5 - Operation enabled`	Required	Yes	No
`6 - Quick stop active`	Required	Yes, during fast stop	No
`7 - Fault reaction active`	Depends on error response configuration	Depends on error response configuration	–
`8 - Fault`	Not required	No	Yes

Cmd Register (*C П d*)

Bit Mapping of the Control Word

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Fault reset	Reserved (=0)	Reserved (=0)	Reserved (=0)	Enable operation	Quick stop	Enable voltage	Switch on
0 to 1 transition = Error is reset (after cause of error is no longer active)				1 = Run command	0 = Quick stop active	Authorization to supply AC power	Mains contactor control

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Manufacturer specific assignable	Manufacturer specific assignable	Manufacturer specific assignable	Manufacturer specific assignable	Manufacturer specific	Reserved (=0)	Reserved (=0)	Halt
				0 = Forward direction asked 1= Reverse direction asked			Halt

Command	State Transition	Final Operating State	Bit 4 Fault Reset	Bit 3 Enable Operation	Bit 2 Quick Stop	Bit 1 Enable Voltage	Bit 0 Switch On	Example Value
Shutdown	2, 6, 8	3 – Ready to switch on	X	X	1	1	0	0006 hex
Switch on	3	4 – Switched on	X	X	1	1	1	0007 hex
Enable operation	4	5 – Operation enabled	X	1	1	1	1	000F hex
Disable operation	5	4 – Switched on	X	0	1	1	1	0007 hex
Disable voltage	7, 9, 10, 12	2 – Switch on disabled	X	X	X	0	X	0000 hex
Quick stop	11	6 – Quick stop active	X	X	0	1	X	0002 hex
	7, 10	2 – Switch on disabled						
Fault reset	15	2 – Switch on disabled	0 [gs56] 1	X	X	X	X	0080 hex
X: Value is of no significance for this command. 0[gs56] 1: Command on rising edge.								

Stop Commands

Halt Command

The `Halt` command enables movement to be interrupted without having to leave the `5 - Operation enabled` state. The stop is performed in accordance with the **[Type of stop] (** `5 ⊦ ⊦` **)** parameter.

If the `Halt` command is active, no power is supplied to the motor and no torque is applied.

Regardless of the assignment of the **[Type of stop] (** `5 ⊦ ⊦` **)** parameter **[Fast stop Assign] (** `F 5 ⊦` **)**, **[Ramp stop] (** `ⁿ ⁿ P` **)**, **[Freewheel Stop] (** `ⁿ 5 ⊦` **)**, or **[DC Injection Assign] (** `ⁿ ⁿ` **)**, the drive remains in the `5 - Operation enabled` state.

Fast Stop Command

A `Fast Stop` command at the terminals or using a bit of the control word assigned to `Fast Stop` causes a change to the `4 - Switched on`

Freewheel Command

A `Freewheel Stop` command using a digital input of the terminal or a bit of the control word assigned to `Freewheel Stop` causes a change to operating state `2 - Switch on disabled`.

Assigning Control Word Bits

Function Codes

In the CiA402 profile, fixed assignment of a function input is possible using the following codes:

Bit	Fieldbus Module for PROFINET, PROFIBUS, Ethernet option, DeviceNet
Bit 11	C311
Bit 12	C312
Bit 13	C313
Bit 14	C314
Bit 15	C315

For example, to assign the DC injection braking to bit13 of the fieldbus module, simply configure the **[DC Injection Assign]** (*dC i*) parameter with the **[C313]** (*C 3 1 3*) value.

Bit 11 is assigned by default to the operating direction command **[Reverse Assign]** (*r r S*).

[CIA402 State Reg] ($E\,t\,A$)

Bit Mapping of the Status Word

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to switch on
A warning is active	Power stage supply disabled	0 = Quick stop is active	Power stage supply present	Error detected	Running	Ready	1 = Awaiting power Stage supply

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Manufacturer -specific Direction of rotation	Manufacturer-specific Stop via STOP key	Reserved (=0)	Reserved (=0)	Internal limit active	Target reached	Remote	Reserved (=0)
				Reference value outside limits	Reference value reached	Command or reference value via fieldbus	

Operating State	Bit 6 Switch On Disabled	Bit 5 Quick Stop	Bit 4 Voltage Enabled	Bit 3 Fault	Bit 2 Operation Enabled	Bit 1 Switched On	Bit 0 Ready to Switch On	ETA Masked by 006F H [1]
1 –Not ready to switch on	0	X	X	0	0	0	0	–
2 –Switch on disabled	1	X	X	0	0	0	0	0040 hex
3 –Ready to switch on	0	1	X	0	0	0	1	0021 hex
4 – Switched on	0	1	1	0	0	1	1	0023 hex
5 – Operation enabled	0	1	11	0	1	1	1	0027 hex
6 –Quick stop active	0	0		0	1	1	1	0007 hex
7 –Fault reaction active	0	X	X	1	1	1	1	–
8 –Fault	0	X	X	1	0	0	0	0008 hex[2].. .0028 hex

[1] This mask can be used by the PLC program to test the diagram state.

[2] detected error following operating state 6 – Quick stop active.
X: In this state, the value of the bit can be 0 or 1.
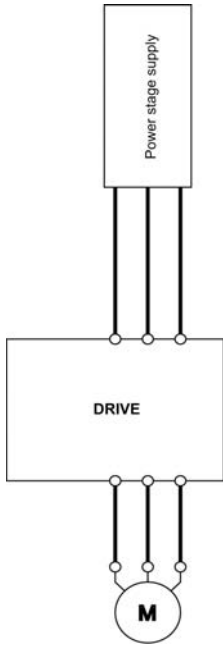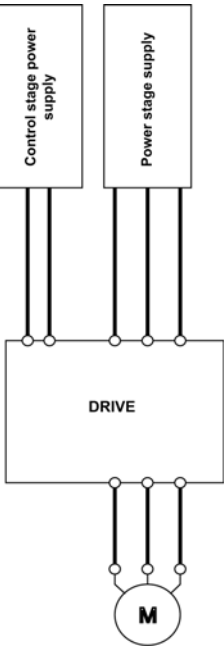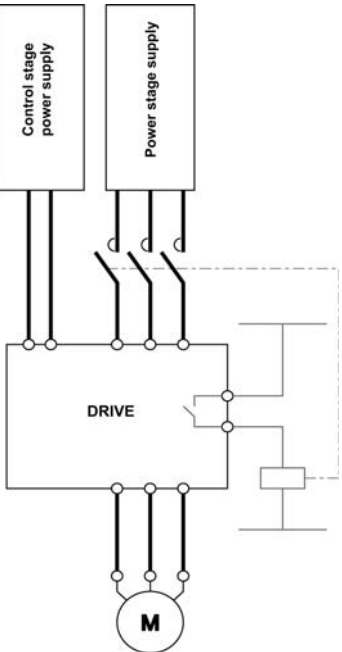
Starting Sequence

Description

The command sequence in the state diagram depends on how power is being supplied to the drive.

There are 3 possible scenarios:

Power stage supply	Direct	Direct	Mains contactor controlled by the drive
Control stage supply	Not separate [1]	Separate	Separate
[1] The power stage supplies the control stage.			

Sequence for a Drive Powered by the Power Stage Supply

Description

Both the power and control stages are powered by the power stage supply.

If power is supplied to the control stage, it has to be supplied to the power stage as well.

The following sequence must be applied:

Step 1

Apply the `2 - Shut down` command
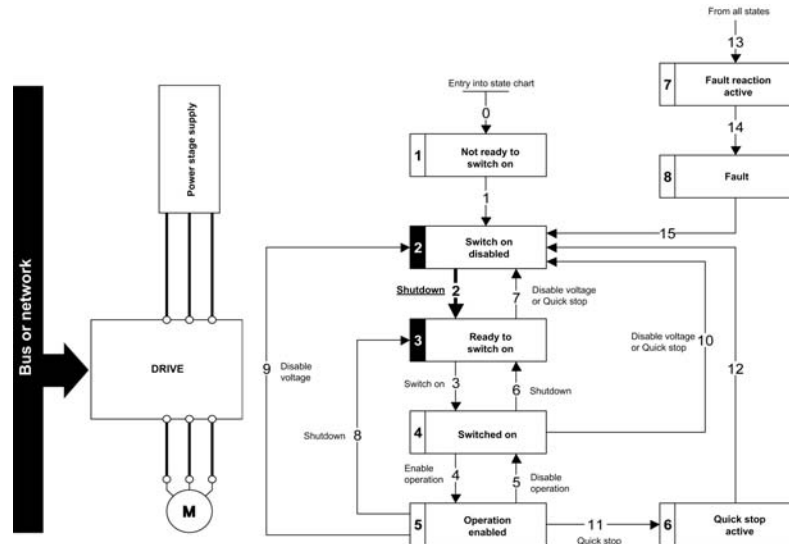
Step 2

- Check that the drive is in the operating state `3 - Ready to switch on`.
- Then apply the `4 - Enable operation` command.
- The motor can be controlled (send a reference value not equal to zero).
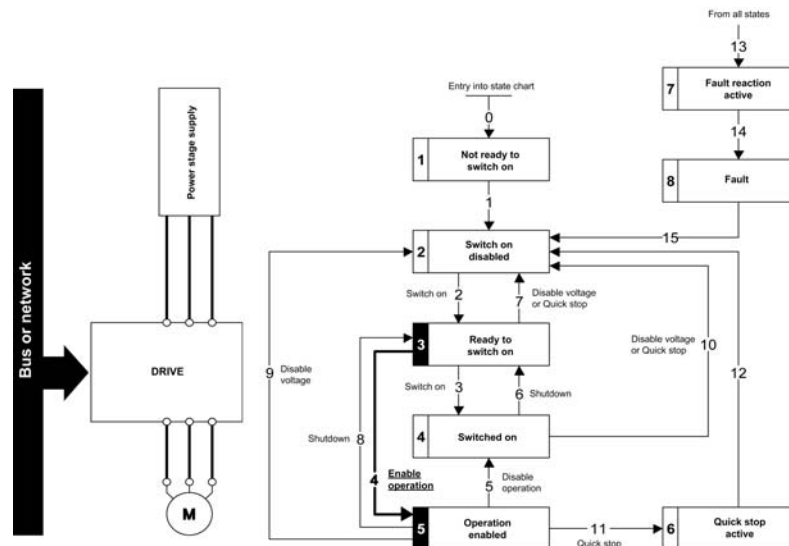
NOTE: It is possible, but not necessary to apply the `3 - Switch on` command followed by the `4 - Enable Operation` command to switch successively into the operating states `3 - Ready to Switch on`, `4 - Switched on` and then `5 - Operation Enabled`. The `4 - Enable operation` command is sufficient.

Sequence for a Drive with Separate Control Stage

Description

Power is supplied separately to the power and control stages.

If power is supplied to the control stage, it does not have to be supplied to the power stage as well.

The following sequence must be applied:

Step 1

- The power stage supply is not necessarily present.
- Apply the 2 – Shut down command
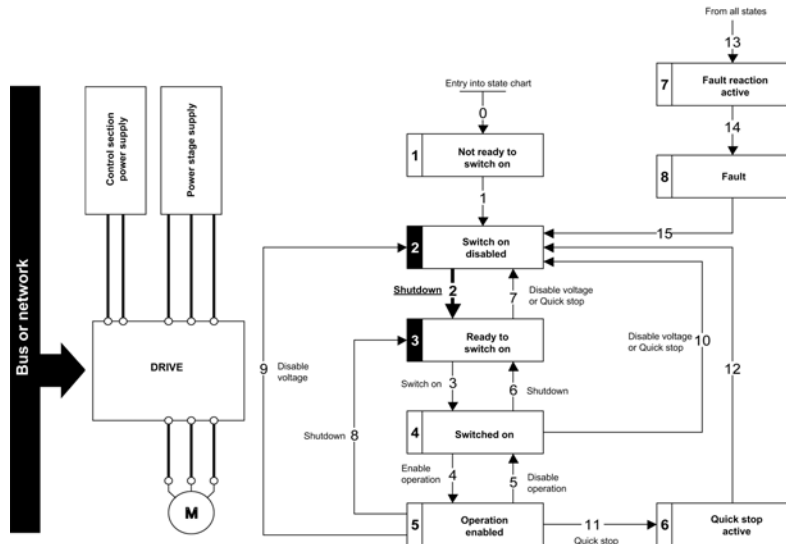
Step 2

- Check that the drive is in the operating state 3 – Ready to switch on.
- Check that the power stage supply is present (Voltage enabled of the status word).

| Power Stage Supply	Terminal Display	Status Word
Absent	n L P	21 hex
Present	r d Y	31 hex

- Apply the 3 – Switch on command
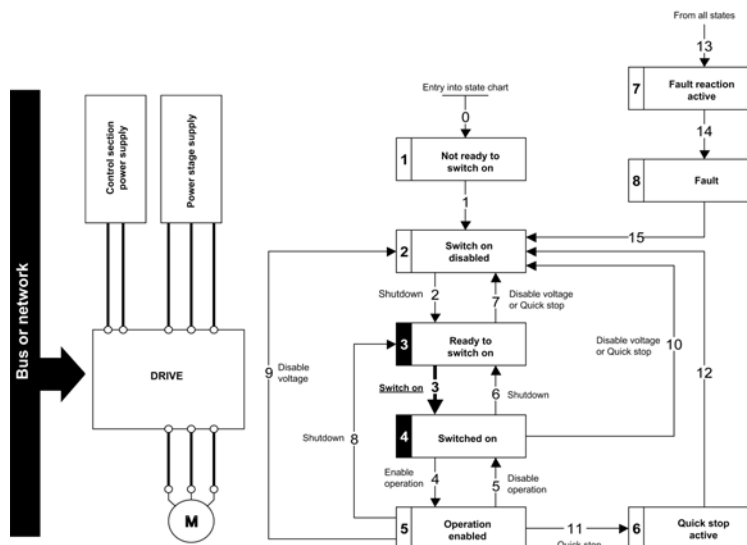
Step 3

- Check that the drive is in the operating state `4 - Switched on`.
- Then apply the `4 - Enable operation` command.
- The motor can be controlled (send a reference value not equal to zero).
- If the power stage supply is still not present in the operating state `4 - Switched on` after a time delay **[Mains V. time out]** (*LCt*), the drive triggers an error **[Input Contactor]** (*LCF*).
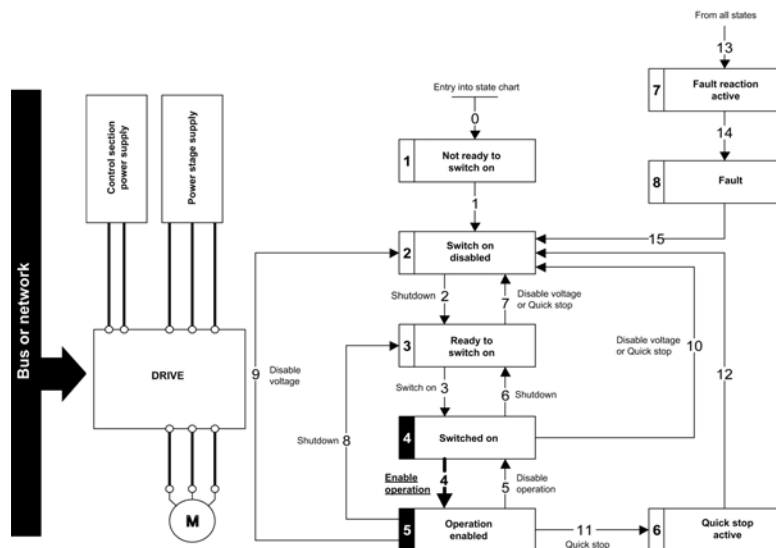
## Sequence for a Drive with Mains Contactor Control

Description

Power is supplied separately to the power and control stages.

If power is supplied to the control stage, it does not have to be supplied to the power stage as well. The drive controls the mains contactor.

The following sequence must be applied:

Step 1

- The power stage supply is not present as the mains contactor is not being controlled.
- Apply the `2 - Shutdown` command.
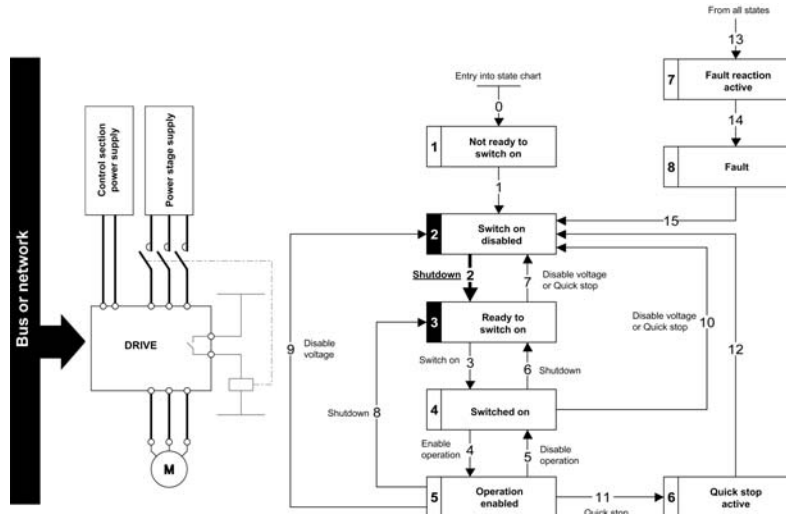
Step 2

- Check that the drive is in the operating state `3 - Ready to switch on`.
- Apply the `3 - Switch on` command, which closes the mains contactor and switch on the power stage supply.
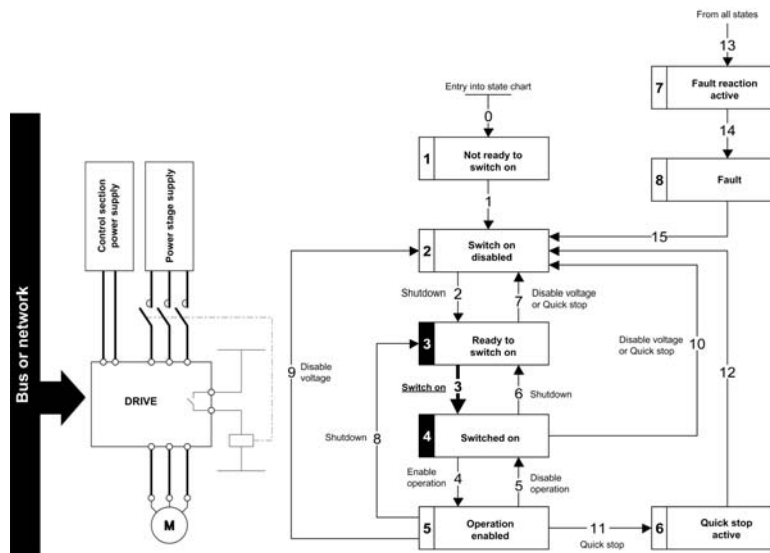
Telegram 100, 101, 102, 106, 107

Overview

The following diagram shows the native modes for telegram 100:
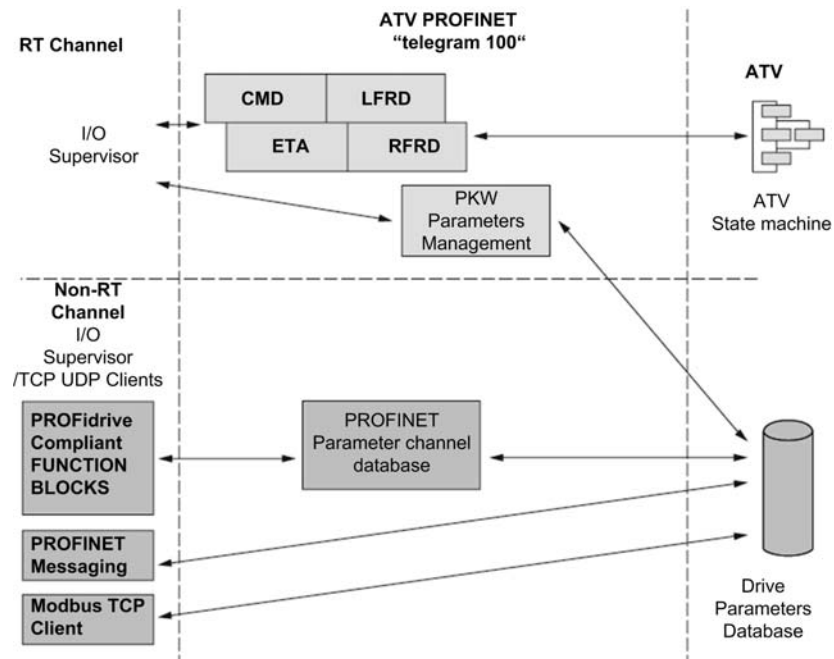
The native mode of the PROFINET VW3A3627 is used when telegram 100 is used.

The PKW area of telegram 100, which is used for a simple parameter management, is compliant with the PKW mechanism used with the PROFINET option module of the Altivar 32, 61, 71.

NOTE: After switching from one telegram to another, the drive shall be restarted to validate the new configuration.

The following diagram shows the native modes for telegram 101, 106, 107:
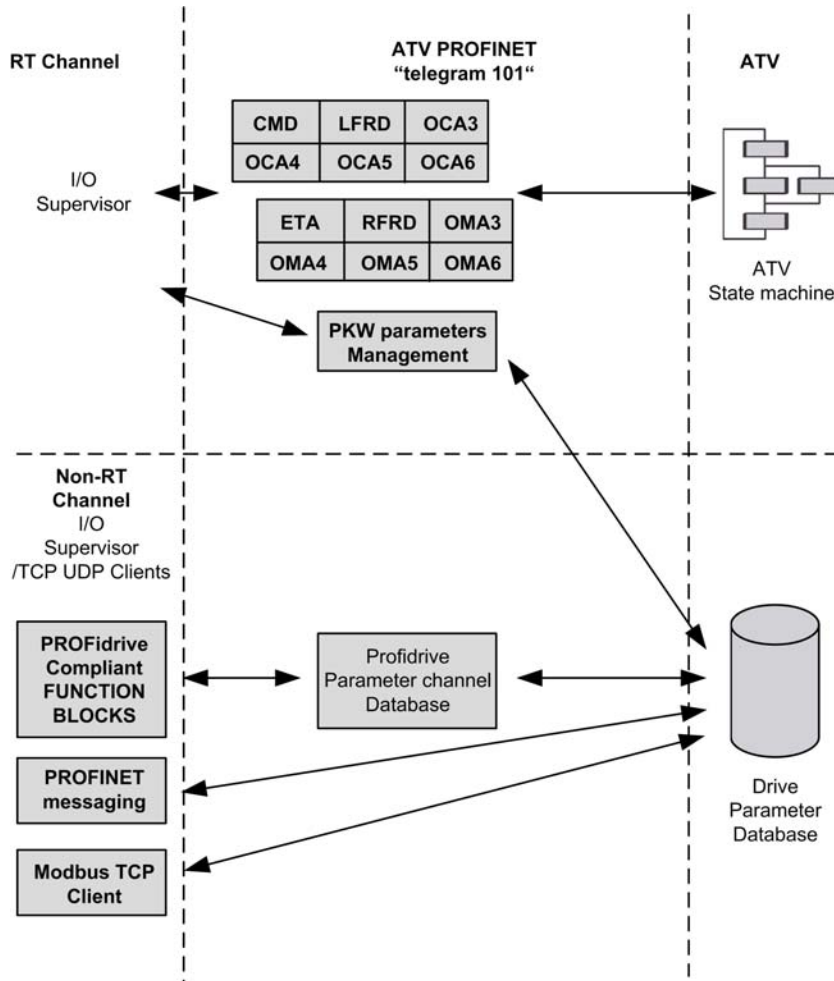
The following diagram shows the native modes for telegram 102:
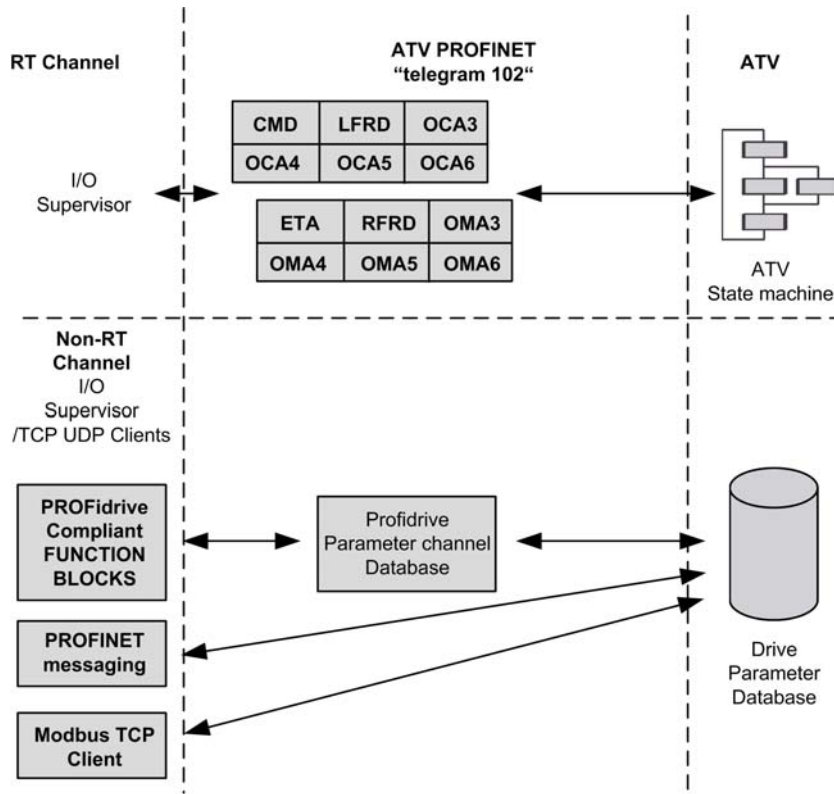
Periodic Exchanges

The following table provides the details of telegram 100, 101, and 102

	Telegram 100		Telegram 101		Telegram 102	
	PLC>VSD	VSD>PLC	PLC>VSD	VSD>PLC	PLC>VSD	VSD>PLC
PKW 1	**PKE**	**PKE**	**PKE**	**PKE**	–	
PKW 2	**R/W**	**R/W**	**R/W**	**R/W**		
PKW 3	**PWE**	**PWE**	**PWE**	**PWE**		
PKW 4	**PWE**	**PWE**	**PWE**	**PWE**		
Cyclic data 1	OCA1 address of CMD =8501*	OMA1 address of ETA =3201*	OCA1 address of CMD =8501*	OMA1 address of ETA =3201*	OCA1 address of CMD =8501*	OMA1 address of ETA =3201*
Cyclic data 2	OCA2 address of LFRD =8602*	OMA2 address of RFRD =8604*	OCA2 address of LFRD =8602*	OMA2 address of RFRD =8604*	OCA2 address of LFRD =8602*	OMA2 address of RFRD =8604*
Cyclic data 3			OCA3 default =0	OMA3 default =0	OCA3 default =0	OMA3 default =0
Cyclic data 4			OCA4 default =0	OMA4 default =0	OCA4 default =0	OMA4 default =0
Cyclic data 5			OCA5 default =0	OMA5 default =0	OCA5 default =0	OMA5 default =0
Cyclic data 6			OCA6 default =0	OMA6 default =0	OCA6 default =0	OMA6 default =0
*:default Modbus address.						

The following table provides the details of telegram 106 and 107

	Telegram 106		Telegram 107	
	PLC>VSD	VSD>PLC	PLC>VSD	VSD>PLC
PKW 1	**PKE**	**PKE**	**PKE**	**PKE**
PKW 2	**R/W**	**R/W**	**R/W**	**R/W**
PKW 3	**PWE**	**PWE**	**PWE**	**PWE**
PKW 4	**PWE**	**PWE**	**PWE**	**PWE**
Cyclic data 1	OCA1 address of CMD =8501*	OMA1 address of ETA =3201*	OCA1 address of CMD =8501*	OMA1 address of ETA =3201*
Cyclic data 2	OCA2 address of LFRD =8602*	OMA2 address of RFRD =8604*	OCA2 address of LFRD =8602*	OMA2 address of RFRD =8604*
Cyclic data 3	OCA3 default =0	OMA3 default =0	OCA3 default =0	OMA3 default =0
Cyclic data 4	OCA4 default =0	OMA4 default =0	OCA4 default =0	OMA4 default =0
Cyclic data 5	OCA5 default =0	OMA5 default =0	OCA5 default =0	OMA5 default =0
Cyclic data 6	OCA6 default =0	OMA6 default =0	OCA6 default =0	OMA6 default =0
Cyclic data 7	OCA7 default =0	OMA7 default =0	OCA7 default =0	OCA7 default =0
Cyclic data 8	OCA8 default =0	OMA8 default =0	OCA8 default =0	OCA8 default =0
Cyclic data 9			OCA9 default =0	OCA9 default =0
Cyclic data 10			OCA10 default =0	OCA10 default =0
Cyclic data 11			OCA11 default =0	OCA11 default =0
Cyclic data 12			OCA12 default =0	OCA12 default =0
Cyclic data 13			OCA13 default =0	OCA13 default =0
Cyclic data 14			OCA14 default =0	OCA14 default =0
Cyclic data 15			OCA15 default =0	OCA15 default =0
Cyclic data 16			OCA16 default =0	OCA16 default =0
*:default Modbus address.				

The configuration of the cyclic data is made with the PROFINET IO-Controller configuration tool. The Modbus address of the parameter linked to each cyclic data must be defined as in the following example with the HW configuration software:

Input cyclic data 1/2 and output cyclic data 1/2 are already preconfigured to (*C П d*) (8501) and (*L F r d*) (8602); (*E t A*) (3201) and (*r F r d*) (8604).

If a null address Modbus is entered, no link between the related cyclic data and the drive is established. In any case, the 6 cyclic data are not disabled and the 6 cyclic data takes place in the I/O memory image of the controller.
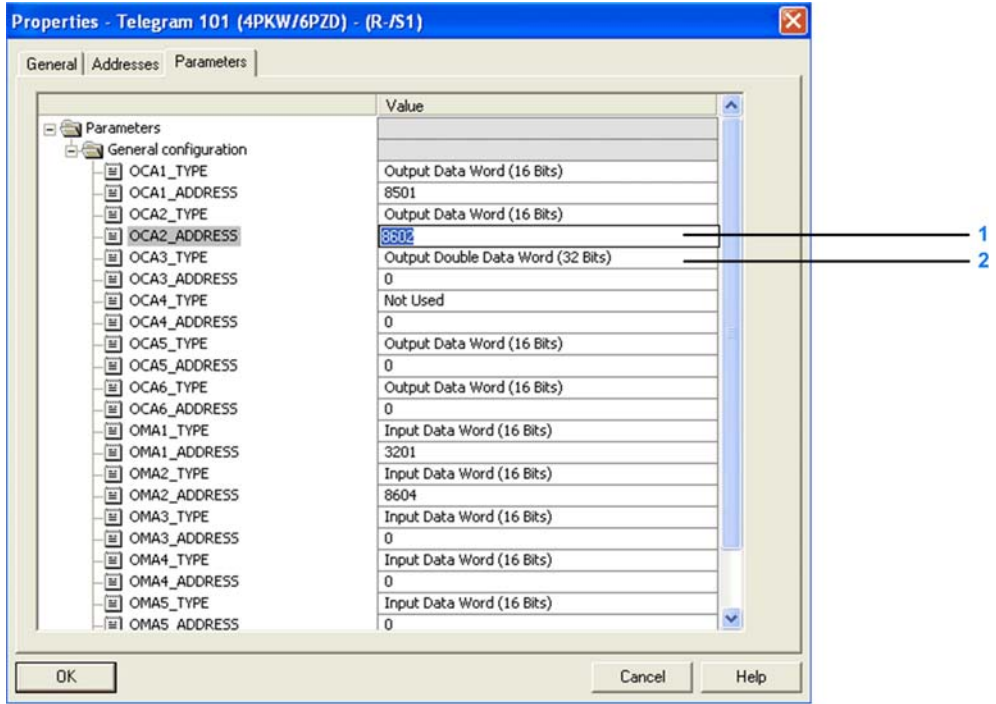
1 Modbus address is entered in this field
2 Data type is entered in this field

Configuring Drive with a Siemens© S7-300

GSDML Installation

First download, and install the GSDML file of the drive in the hardware configuration tool of the SIMATIC STEP7® software.

You can find the GSDML file and its associated picture on www.schneider-electric.com.

From the menu > **Options** > **Install GSD File...**
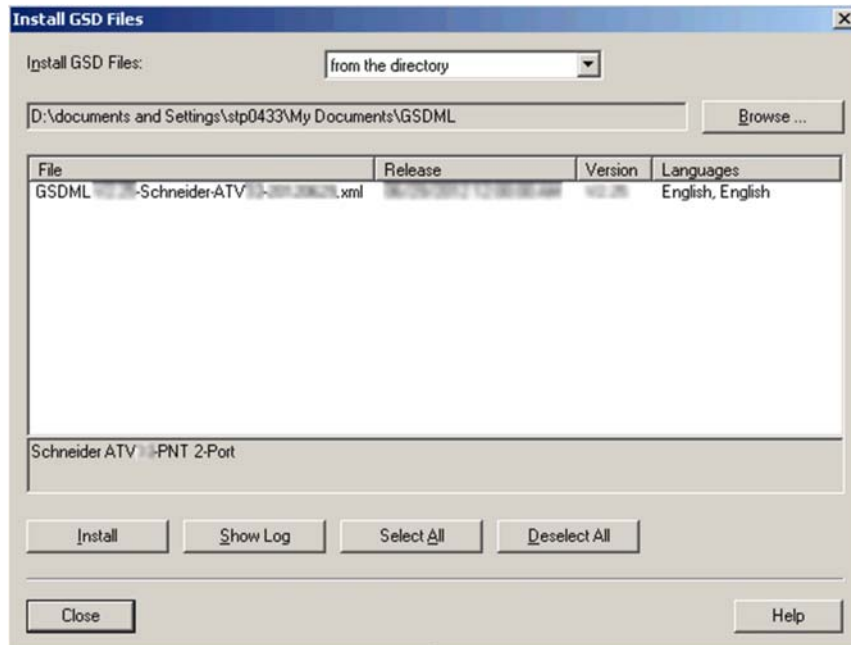
Once installed you can see the drive, in the library, as follow:
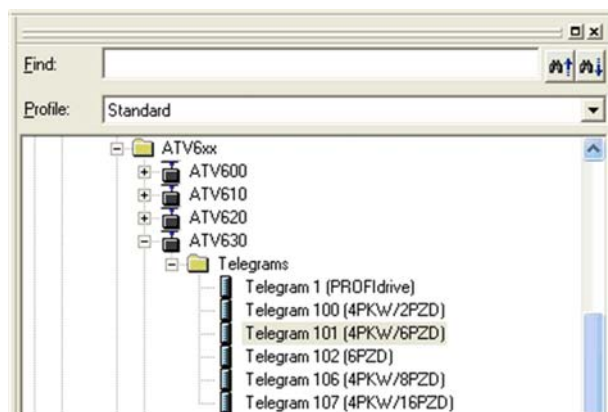
Configuration of Drive with the Telegram 100

Description

With this telegram, the drive is controlled with two process data.

Configure the PLC and its PROFINET network. Then select and place the drive from the library to the bus:
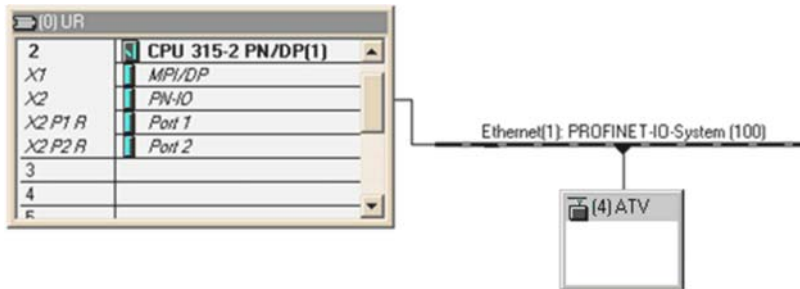
Define the addresses of the cyclic data and PKW data in the PLC periphery:
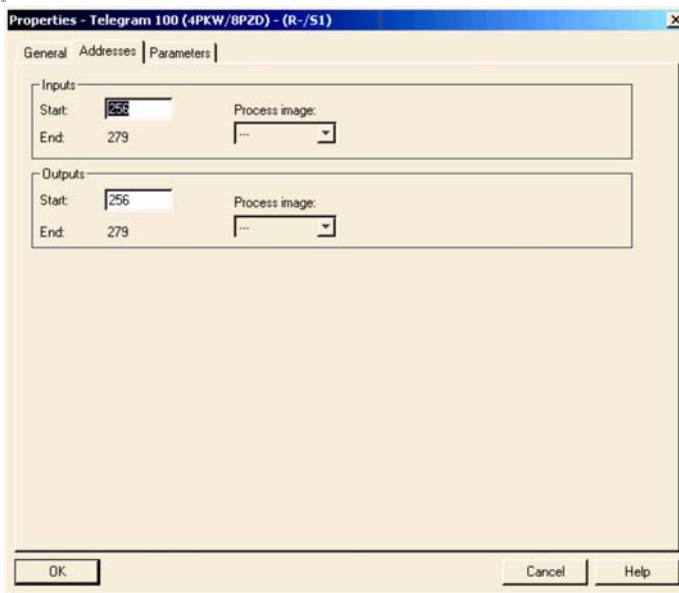
By default, the process data are linked to ($C\,\Pi\,d$), ($L\,F\,r\,d$), ($E\,t\,A$) and ($r\,F\,r\,d$) (native CiA 402 profile of the drive).

You can check that the exchanges are working properly with the **Monitor/Modify** function of the configuration tool:
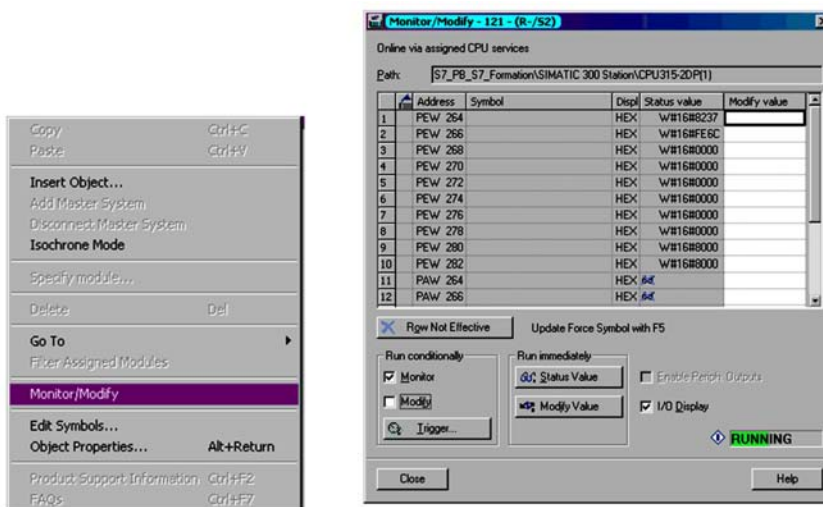
Configuring a Drive with the Telegram 101, 102, 106, or 107

Configuring the Drive Communication Scanner

The configuration of the fieldbus module is defined by the master, by default the 2 first read and write are linked to the default parameters: ($C\,\Pi\,d$), ($L\,F\,r\,d$), ($E\,t\,R$) and ($r\,F\,r\,d$). The 4 next read or write parameters are not configured.

To add new parameters or modify the default configuration of the communication scanner, open the properties dialog box of the slave device and configure the OCA/OMA values in the parameter assignment tab.
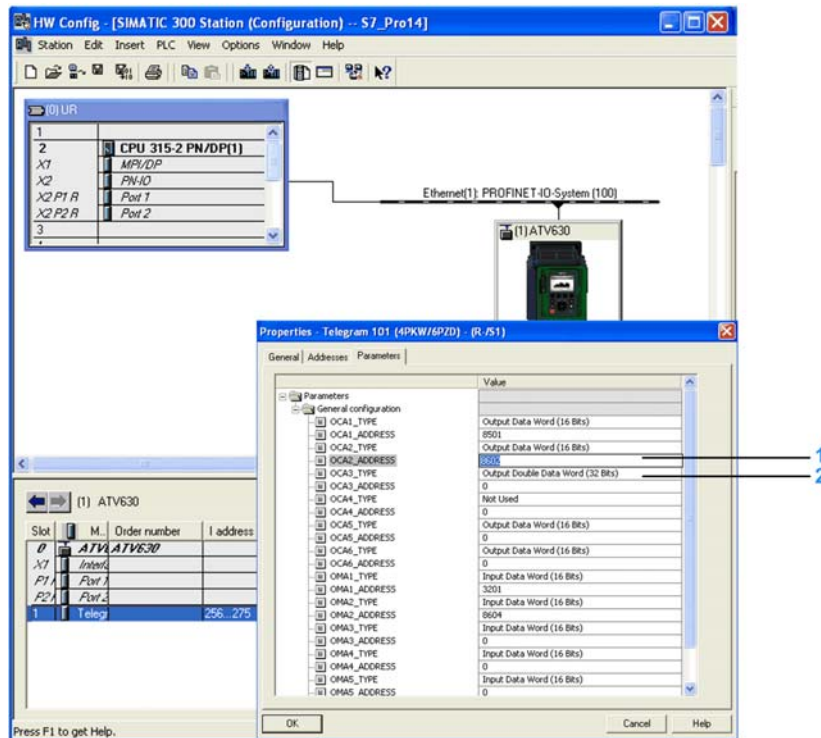
1 Internal Modbus address
2 Data type is entered in this field

New parameters are added or modified by entering the drive Modbus address.

For example: ($o\,\Pi\,R\,\exists$) is configured to read the value of ($R\,C\,C$), which Modbus address is 9001.

Parameters Management with the Telegram 100, 101, 102, 106, 107

Description

In native modes several accesses to the drive parameters are possible:
- The standard acyclic requests from PROFIdrive, for more information see PROFIdrive Parameters Channel .
- PKW mechanisms – consistent with Altivar 32,61, and 71 for 16-bit data.

Parameter Management Through the PKW Area

With telegram 100, 101, 106, 107 you can read or write any drive parameter by using this PKW area. (This addressing format is identical to the PKW mechanism of the Altivar 32,61, and 71).

NOTE: The management of the parameters (compatibility with series 1 product) is Schneider Electric specific. Actually, previous versions of PROFIdrive also specified parameter management thought PKW, are not compatible with Schneider Electric method. In recent versions, parameters are managed with acyclic messages, and the PNO PKW method is obsolete.

The PKW area is made of four input words and four output words.

The table lists the controller-to-drive parameters in the input PKW area:

PKW Number	PKE Name	Description
PKW1	PKE	The Modbus address of the parameter is detailed here.
PKW2	R/W	Request code: 0: no request 1: read 2: write (16 bit) 3: write (32 bit)
PKW3	PWE	Parameter is used when PKW2 = 3
PKW4	PWE	Parameter value in case of write request

The table lists the drive-to-controller parameters in the output PKW area:

PKW Number	PKE Name	Description
PKW1	PKE	Copy of the input PKE
PKW2	R/W	Response code: 0: no request 1: read done (16 bit) 2: write done (16 bit) 3: request in progress 4: read done (32 bit) 5: write done (32 bit) 7: read or write error
PKW3	PWE	Parameter is used when PKW2 = 4 or 5
PKW4	PWE	If the request is successful, the parameter value is copied here.

Telegram 1

Overview

The following diagram shows the operating modes:
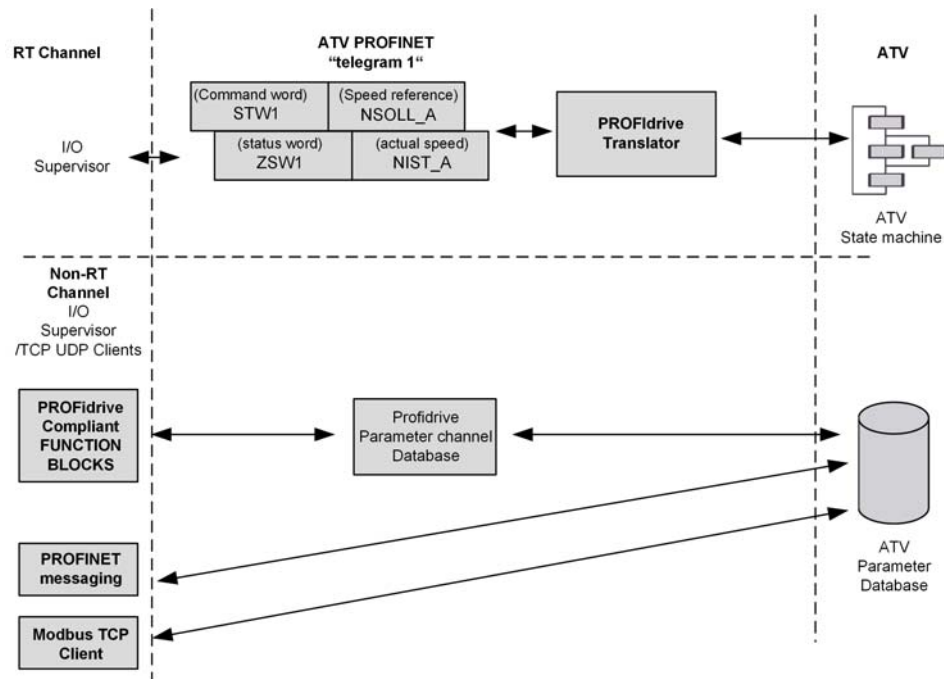
The following section describes how the VW3A3627 is operated when configured in PROFIdrive mode (telegram 1).

The selection of this mode is done while configuring the device with the PROFINET network configuration tool. It is out of the scope of this document to describe how to use such tool. However, you can find in the examples (see Configuring the Drive With a Siemens© S7-300 *(see page 91)*) how to configure the module for the Schneider PLCs and for the SIMATIC® S7 PLCs.

Periodic Exchanges

The periodic exchanges, with PROFIdrive application class 1 profile consists of:
- 16-bit command word (STW1) and 16-bit reference word (NSOLL_A),
- 16-bit operating state word (ZSW1) and 16-bit actual velocity word (NIST_A).

The mapping of these words is automatically done when you select telegram 1 during the configuration of the device.

NOTE: After switching from one telegram to another, restart the controller to validate the new configuration.

State Diagram

Description

The following state diagram shows the PROFIdrive state machine for the application class 1. The diagram also describes the command word and operating state word.
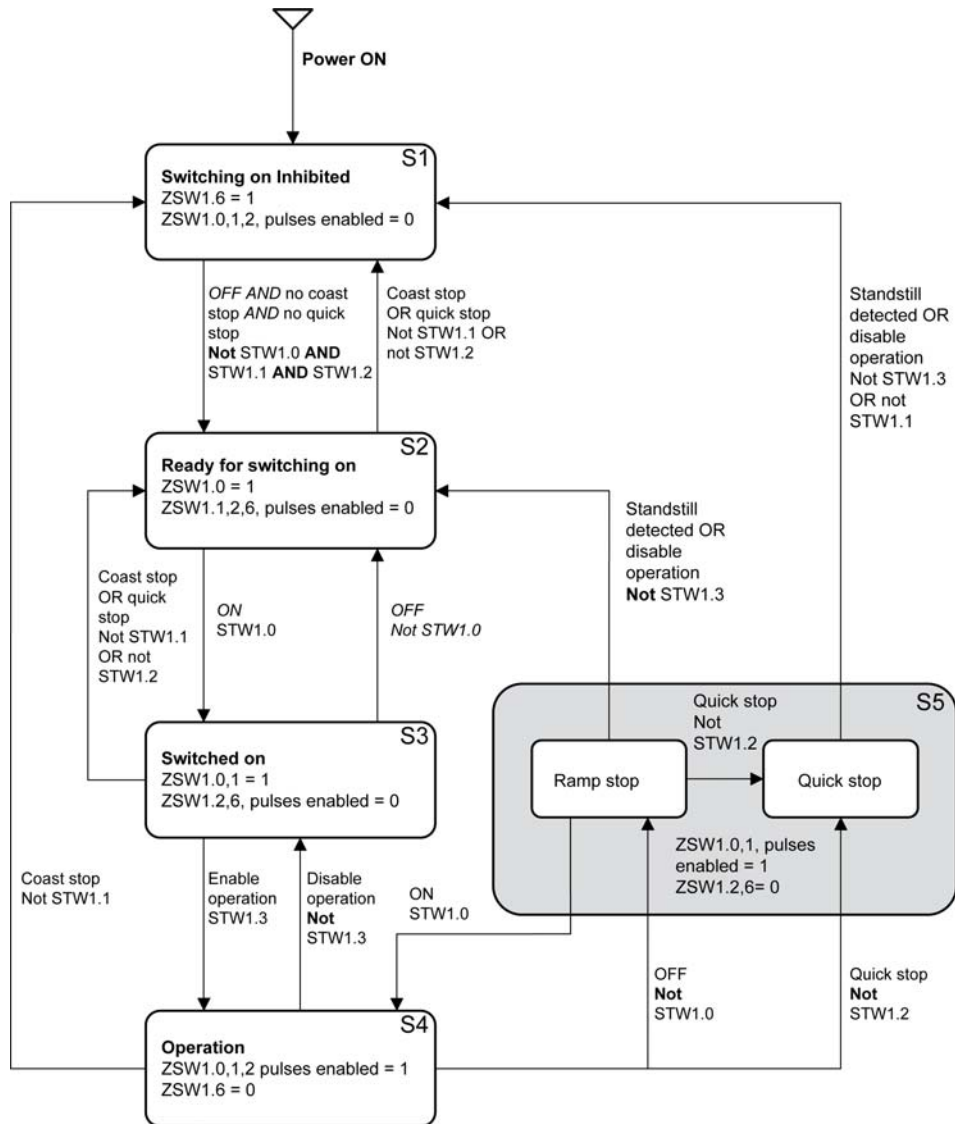
Command Word and Operating State Word

Overview

The table lists the command wording from PROFIdrive application profile class 1:

STW1							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Fault reset	–	–	–	Enable operation	Quick stop	Coast stop	ON/OFF
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
–	–	–	–	–	Control and reference by PLC	–	–

The table lists the status from PROFIdrive application profile class 1:

ZSW1							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Warning	Switching inhibited	Quick stop not activated	Coast stop not activated	Error detected	Operation enabled	Ready to operate	Ready to switch ON
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
–	Reserved	Reserved	Reserved	Reserved	F or n reached or exceeded	Control requested	Speed error found within tolerance range

Command Word Details

STW1			
Bit 0	ON	1	`Switched on` operating state; voltage at the power converters, indicates that the power voltage is enabled.
	OFF (OFF 1)	0	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 and power is disabled when deceleration bit 1 of ZSW1 is still set. An OFF command is interruptible (the drive returns to the `ready for switching on` operating state).
Bit 1	No coast stop	1	`Coast Stop (OFF2)` not active.
	Coast stop (OFF 2)	0	Power voltage disabled.. The drive goes into the `Switching On Inhibited` Power voltage is disabled; the motor coasts down to a standstill.
Bit 2	No quick stop	1	`Quick Stop (OFF3)` not active.
	Quick stop (OFF 3)	0	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 power voltage is disabled (the contact is opened) and the drive goes into the `Switching On Inhibited` operating state. A `Quick Stop` command is not interruptible.
Bit 3	Enable operation	1	Enable electronics and pulses. The drive then runs-up to the reference frequency.
	Disable operation	0	The drive coasts down to a standstill (ramp-function generator to 0 or tracking) and goes into the `Switched on` operating state (refer to control word 1, bit 0).
Bit 4	Reserved		
Bit 5	Reserved		
Bit 6	Not used		
Bit 7	Fault reset	1	The fault reset function is active with a positive edge; the drive error response depends on the type of detected error. If the error response has isolated the voltage, the drive then goes into the `Switching On Inhibited` operating state.
Bit 8	Not used		
Bit 9	Not used		
Bit 10	Control by fieldbus	1	Channel for the reference frequency and the command from the bus are active.
	No control by fieldbus	0	Channel for the reference frequency and the command from the bus are not active.
Bit 11	Reserved		
Bit 12	Reserved		
Bit 13	Reserved		
Bit 14	Reserved		
Bit 15	Reserved		

Operating State Word

ZSW1			
Bit 0	Ready to switch ON	1	Mains power supply is switched on, electronics are initialized, pulses are inhibited.
	Not ready to switch ON	0	–
Bit 1	Ready to operate	1	Refer to control word 1, bit 0.
	Not ready to operate	0	–
Bit 2	Operation enabled	1	Drive follows a reference frequency. This means that: ● The electronic and the power stage are enabled (Refer to control word 1, bit 3), ● The drive is in running state.
	Operation disabled	0	Either the power stage is disabled or the drive does not follow the reference frequency.
Bit 3	Error detected	1	An error has been detected. The drive error response depends on the type of detected error. The Fault Reset function may only be successfully used if the detected error cause has disappeared or has been removed. If the detected error response has disabled the power stage, the drive goes into the `Switching On Inhibited` operating state, otherwise the drive returns to operation is a state.
	No error detected	0	–
Bit 4	Coast stop not activated	1	–
	Coast stop activated	0	`Coast stop (OFF 2)` command is present.
Bit 5	Quick stop not activated	1	–
	Quick stop activated	0	`Quick Stop (OFF 3)` command is present.
Bit 6	Switching inhibited	1	The drive is in `Switching on inhibited` operating state.
	Switching not inhibited	0	–
Bit 7	Warning present	1	Warning information present in the service/maintenance parameter; acknowledgement required.
	No warning	0	–
Bit 8	Speed feedback within tolerance range	1	Actual value is within a tolerance band; dynamic speed discrepancies are permissible.
	Speed feedback out of tolerance range	0	–
Bit 9	Control requested	1	The automation system controls the drive.
	No control requested	0	Control by the automation system is not possible, only possible at the device level, by another interface or the drive is controlled from a supervisor (Master class 2).
Bit 10	Reference frequency reached or exceeded	1	Actual output frequency ≥ reference frequency which may be set via the parameter number.
	Reference frequency not reached	0	–
Bit 11	Reserved		
Bit 12	Reserved		
Bit 13	Reserved		
Bit 14	Reserved		
Bit 15	Reserved		

Reference Frequency

Channel for Reference Frequency

The reference frequency, written in NSOLL_A is defined by the following formula:

Reference frequency in Hz = (NSOLL_A x **[Max Frequency]** (*ᴴ F ⱼ*)) /4000 HEX

Reference Frequency Range

The table lists the different values for the reference frequency and the correspondence for the drive:

Value	Reference Frequency Used by the Drive
0x0000	0
0x4000	100% of **[Max Frequency]** (*ᴴ F ⱼ*)
0xC000	−100% of **[Max Frequency]** (*ᴴ F ⱼ*)

PROFIdrive / Acyclic Messaging

For more information, see PROFIdrive Parameters Channel .

Section 4.5
Fieldbus Integration Tutorial

Fieldbus Integration Tutorial

Simple LAD Language FC (Controlling the Drive in CiA 402 Mode)

The following example shows a simple LAD language FC for controlling the drive in CiA402 mode
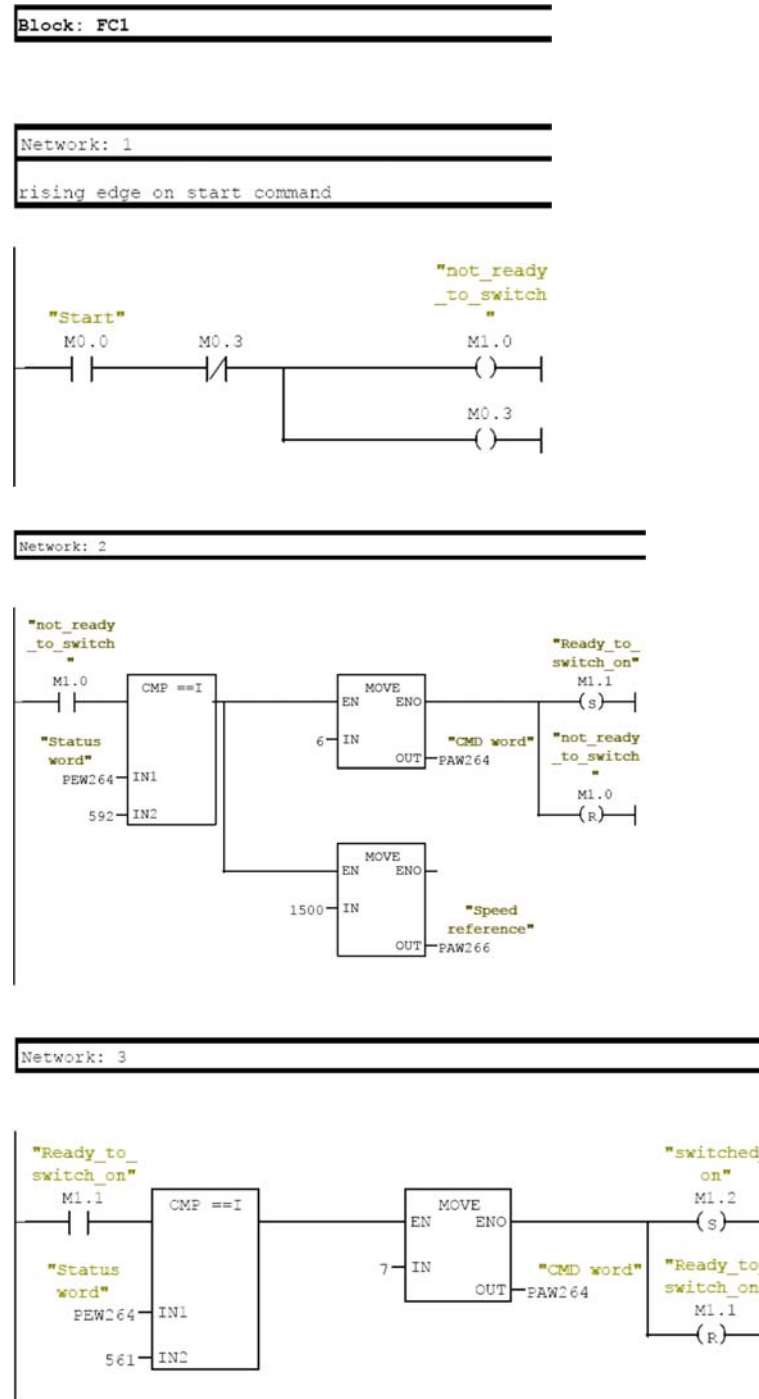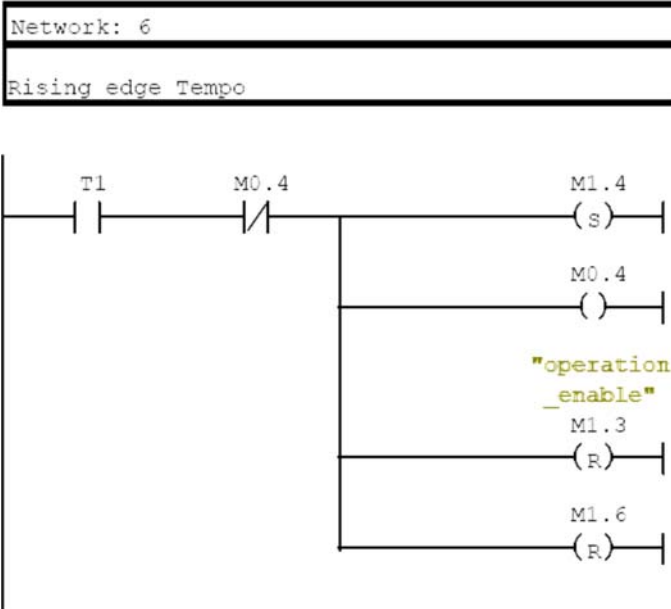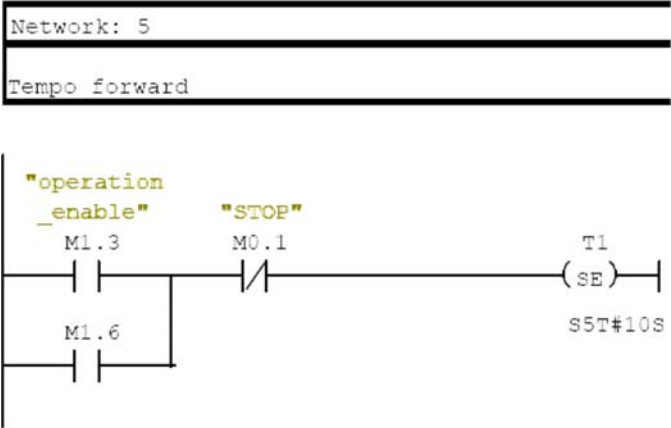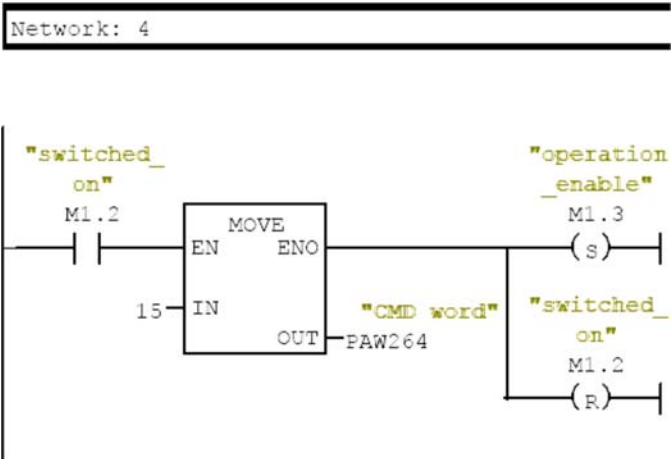
Network: 4

Network: 5

Tempo forward

Network: 6

Rising edge Tempo

Network: 7

RAMP STOP

```
        M1.4              MOVE
       ──┤ ├────────────┤EN    ENO├──────────────────────
                                        "CMD word"
                 271───┤IN         OUT├─PAW264
```

Network: 8

```
        T2        M0.5                        M1.5
      ──┤ ├───────┤/├──────────┬────────────(S)──┤
                               │             M0.5
                               ├────────────( )──┤
                               │             M1.4
                               └────────────(R)──┤
```

Network: 9

```
                    "STOP"
        M1.4        M0.1                        T2
      ──┤ ├─────────┤/├───────────────────────(SE)──┤
                                              S5T#10S
```

Network: 10

```
      "STOP"
       M0.1              MOVE
      ──┤ ├────────────┤EN    ENO├──────────────────────
                                        "CMD word"
                   0───┤IN         OUT├─PAW264
```

Network: 11

```
        M1.5              MOVE
      ──┤ ├──────────┤EN       ENO├─────────────────────
                     │              │
          2063 ──────┤IN            │   "CMD word"
                     │           OUT├─ PAW264
                     └──────────────┘
```

Network: 12

```
                       "STOP"
        M1.5            M0.1                        T3
      ──┤ ├────────────┤/├─────────────────────────(SE)──
                                                   S5T#10S
```

Network: 13

```
        T3              M0.6                        M0.6
      ──┤ ├────────────┤/├──────────┬──────────────( )──
                                    │
                                    │               M1.5
                                    ├──────────────(R)──
                                    │
                                    │               M1.6
                                    └──────────────(S)──
```
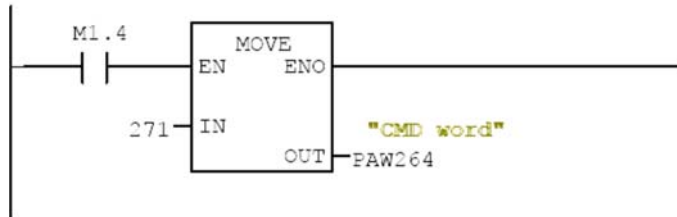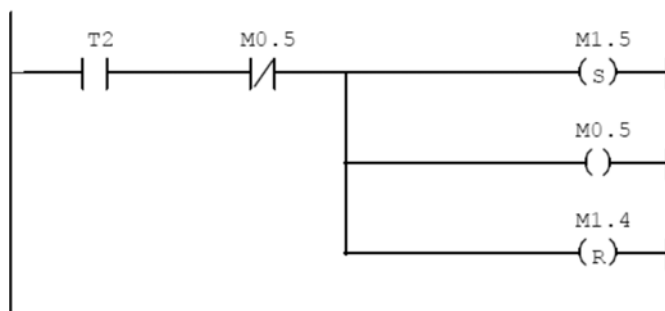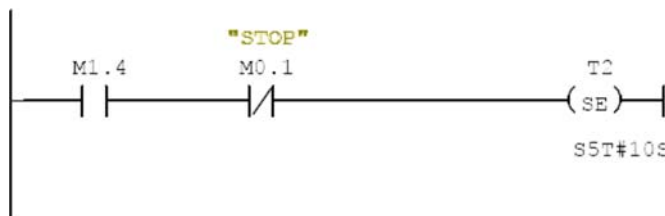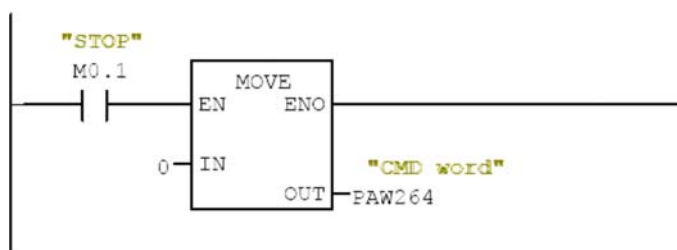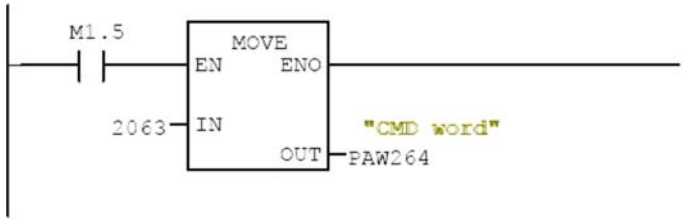
Network: 14
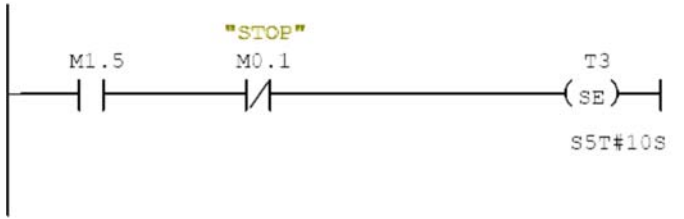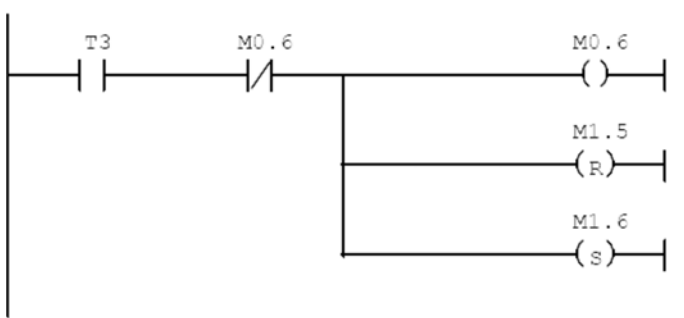
```
        M1.6              MOVE
      ──┤ ├──────────┤EN       ENO├─────────────────────
                     │              │
            15 ──────┤IN            │   "CMD word"
                     │           OUT├─ PAW264
                     └──────────────┘
```
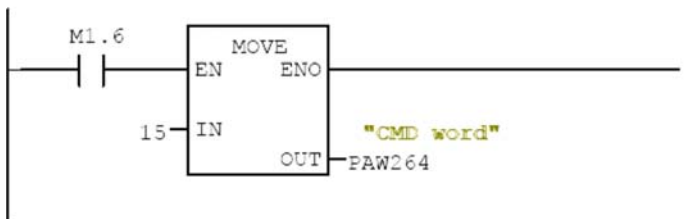
Chapter 5
Operation

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
5.1	Operating States	106
5.2	Operating Modes	107

Section 5.1
Operating States

Configuring Communication Error Response

Description

The response of the drive in the event of communication interruption can be configured. Configuration can be performed using the display terminal from the **[Complete settings]** (*C S t -*), **[Error/Warning handling]** (*C S W N -*) menu, **[Communication Module]** (*C o N o -*) submenu, via the **[Fieldbus Interrupt Resp]** (*C L L*) parameter.

The values of the parameter, which triggers a transition to the operating state faults are:

Value	Meaning
[Freewheel Stop] (*Y E S*)	Freewheel stop (factory setting)
[Ramp stop] (*r N P*)	Stop on ramp
[Fast stop] (*F S t*)	Fast stop
[DC injection] (*d C i*)	DC injection stop

The values of the parameter, which does not trigger a transition to the operating state faults are:

Value	Meaning
[Ignore] (*n o*)	Detected error ignored
[Per STT] (*S t t*)	Stop according to configuration of **[Type of stop]** (*S t t*)
[Fallback Speed] (*L F F*)	Change to fallback speed, maintained as long as the detected error persists and the run command has not been removed
[Speed maintained] (*r L S*)	The drive maintains the speed at the time the detected error occurred, as long as the detected error persists, and the run command has not been removed

The fallback speed can be configured in the **[Complete settings]** (*C S t -*), **[Error/Warning handling]** (*C S W N -*) menu, **[Fallback speed]** (*L F F -*) submenu, using the **[FallbackSpeed]** (*L F F*) parameter.

> ## ⚠ WARNING
>
> **LOSS OF CONTROL**
>
> If this parameter is set to *n o*, Modbus communication monitoring is disabled.
> - Only use this setting after a thorough risk assessment in compliance with all regulations and standards that apply to the device and to the application.
> - Only use this setting for tests during commissioning.
> - Verify that communication monitoring has been re-enabled before completing the commissioning procedure and performing the final commissioning test.
>
> **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Section 5.2
Operating Modes

What Is in This Section?

This section contains the following topics:

Configuring the Control Channel

Overview

This chapter explains how to configure the drive for operation from the communication network through three following examples.

- I/O mode - a simple command word (based on forward, reverse, and reset binary commands).
- Combined mode (with native profile CiA 402) - Both reference value and command word come from the communication network.
- Separate (with native profile CiA 402) - reference value and command word come from separate sources: for example, the command word (in CiA 402) comes from the communication network and the reference value from the HMI.

Configuration of the Drive for Operation in I/O Profile

Description

For the I/O profile, here is a simple example, which can be extended with additional features. The command word is made of run forward (bit 0 of CMd), run reverse (bit 1 of CMd), and the function fault reset (bit 7 of CMd).
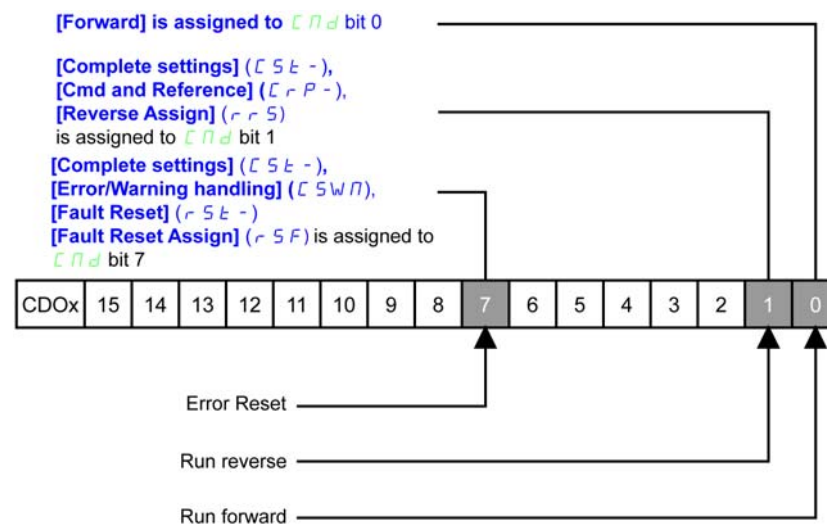
The settings are the following:

[Ref Freq 1 Config] (*F r 1*)	**[HMI]** (*H N i*)
[Control Mode] (*C H C F*)	**[I/O profile]** *i o*
[Command switching] (*C C S*)	Default
[Cmd channel 1] (*C d 1*)	**[Com. Module]** (*n E t*)

The bits of the command word can now be configured.

In the **[Command and Reference]** (*C r P -*) menu configure:

[Reverse Assign] (*r r S*)	**[CD01]** (*C d 0 1*)

In the **[Error/Warning handling]** (*C S W N -*) menu, **[Fault reset]** (*r S t -*) submenu, configure:

[Fault Reset Assign] (*r S F*)	**[CD07]** (*C d 0 7*)

Configuration of the Drive for Operation with CiA 402 Profile in Combined Mode

Description

This section describes how to configure the settings of the drive if it is controlled in CiA 402 mode. The example focuses on the not separate mode. Additional modes combined mode are detailed in the drive programming manual.

In the **[Complete settings]** (*C S t -*) menu, **[Command and Reference]** (*C r P -*) submenu:
- **[Ref Freq 1 Config]** (*F r 1*): is set on according to the communication source you can choose in the following table:

Origin of the Control	Ref1 Channel Setting
PROFINET	**[Ref. Freq-Com. Module]** (*n E t*)

- **[Freq Switch Assign]** (*r F C*) is set to default value (**[Ref Freq 1 Config]** (*F r 1*)).
- **[Control Mode]** (*C H C F*): defines if the drive operates in combined mode (reference and command from the same channel).

For the current example, **[Control Mode]** (*C H C F*) is adjusted to **[Not separ.]** (*S i M*) as reference and control are originated from the communication network:

Profile	Ref1 Channel setting
CiA 402 combined mode	**[Not separ.]** (*S i M*)
CiA 402 separate mode	**[Separate]** (*S E P*)
I/O profile	**[I/O profile]** (*i o*)

Configuration of the Drive for Operation with CiA 402 Profile in Separate Mode

Description

Alternate combinations are possible, see the drive programming manual for the list of possible settings.

For example:

The drive is controlled from the fieldbus (PROFINET) but the reference is adjusted on the controller terminal. The control word comes from the controller and is written according to CiA 402 profile.

The settings are as shown in the table:

[Ref Freq 1 Config] (F r 1)	[AI1] (A i 1)
[Control Mode] (C H C F)	[Separate] (S E P)
[Cmd channel 1] (C d 1)	[Com. Module] (n E t)
[Freq Switch Assign] (r F C)	Factory setting

Chapter 6
Diagnostic and Troubleshooting

What Is in This Chapter?

This chapter contains the following topics:

Fieldbus Status LEDs

LED Indicators

The following figure describes the LEDs status module:
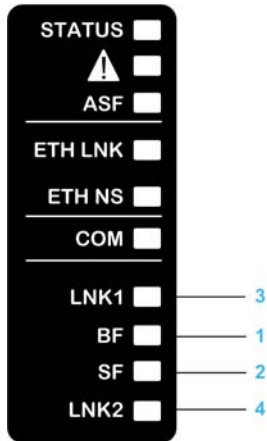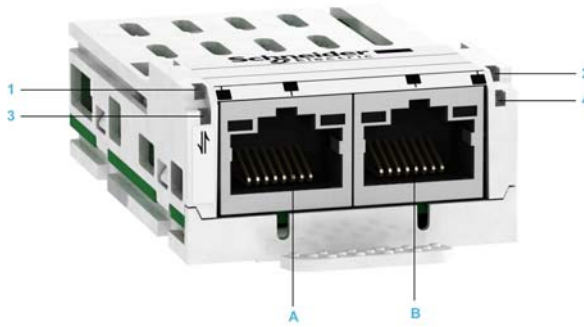
LED Description

Item	LED	Description
1	RUN/BF	Module status
2	STS/SF	Network status
3	LNK1	Port A activity
4	LNK2	Port B activity

LED 2: Module Status

This LED indicates the module status:

Color & Status	Description
OFF	The device is powered off
Red ON	The device has detected an ILF error
Green ON	The device is ready and operational
Red flickering	The device has detected a communication interruption / wrong configuration or a PROFINET controller at `Stop` state.
Green flickering	In combination with other LEDs: DCP manual identification phase / DCP flash mode
Green/Red blinking	Power up testing
Red single flash	No connection to the PROFINET controller

LED 3: Network Error Status

Color & Status	Description
OFF	The device does not have an IP address or is powered off
RED ON	Error detected on the module
Green ON	At least a port is connected and has a valid IP address.
Green flickering	In combination with other LEDs: DCP manual identification phase / DCP flash mode or as long as the iPar-Client did not accomplish transfer (backup or restore) its parameters
Green/Red blinking	Power-up testing
Green flashing 3 times	All ports are unplugged, but the module has an IP address
Green flashing 4 times	Error detected: duplicate IP address
Green flashing 5 times	The module is performing a DHCP sequence

NOTE: If the fieldbus module operates as a Modbus TCP server only, LED 1 and 2 have another behavior.

LED 1 and 4

These LEDs indicate the status of the Ethernet port A (1) and Ethernet port B (4):

Color & Status	Description
OFF	No link
Green ON	Link established at 100 Mbit/s
Green Blinking	Network activity at 100 Mbit/s
Yellow ON	Link established at 10 Mbit/s
Yellow blinking	Network activity at 10 Mbit/s

LED behavior
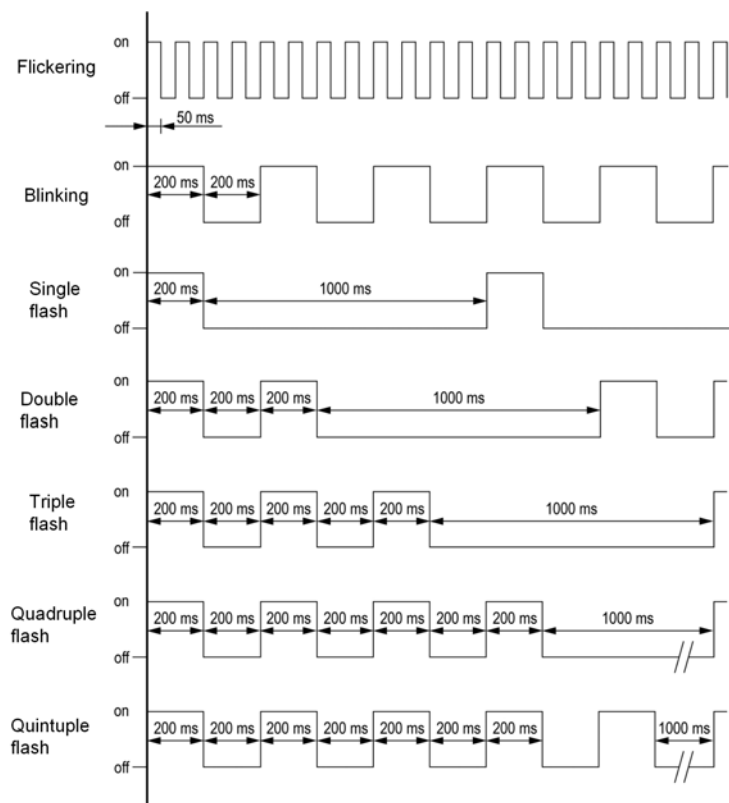
Connection for Fieldbus Mode

Description

If the product cannot be addressed via the fieldbus, first check the connections. The product manual contains the technical data of the device and information on network and device installation. Check the following:

● Power connections to the device
● Fieldbus cable and fieldbus wiring
● Network connection to the device

Fieldbus Function Test

Description

If the connections are correct, check the settings for the fieldbus addresses. After correct configuration of the transmission data, test the fieldbus mode.

In addition to the controller that knows the device via the data in the GSDML file and its address, a bus monitor should be installed. As a passive device, it can display messages.
● Switch off or on the supply voltage of the drive system.
● Observe the network messages shortly after switching on the drive system. A bus monitor can be used to record the elapsed time between telegrams and the relevant information in the telegram.

Possible Errors: Addressing, Parameterization, Configuration

If it is impossible to connect to a device, check the following:
● Addressing: The address of the network device must be a valid IP address. Each network device must have a unique address.
● Parameterization: The parameterized Ident number and the user parameters must match the values stored in the GSDML file.

Communication Interruption

Description

The drive triggers an error **[Internal Link Error]** (*ɪL F*) when the following events occur:
- Hardware error is detected on the PROFINET module
- Communication interruption between the PROFINET module and the drive

The response of the drive in the event of an **[Internal Link Error]** (*ɪL F*) error cannot be configured, and the drive stops in freewheel. This detected error requires a power reset.

The diagnostic parameter can be used to obtain more detailed information about the origin of the **[Internal Link Error]** (*ɪL F*) (**[InterCom Error1]** (*ɪL F I*) if the detected error has occurred on option module in slot A).

The **[InterCom Error1]** (*ɪL F I*) parameter can be accessed on the graphic display terminal in the **[Communication map]** (*C П П -*) menu, **[PROFINET DIAG]** (*P r n -*) submenu.

Value	Description of the values of the [InterCom Error1] (*ɪL F I*) parameter
0	No error detected
1	Internal communication interruption with the drive
2	Hardware error detected
3	Error found in the EEPROM checksum
4	EEPROM
5	Flash memory
6	RAM memory
7	NVRAM memory
101	Unknown module
102	Communication interruption on the drive internal bus
103	Time out on the drive internal bus (500 ms)

Diagnostic (PROFINET Service)

PROFINET diagnostic is associated with specific data which can be helpful during maintenance:
- The error code, if a detected error is present,
- The value of ETA operating state word,
- The value of the output frequency.

This data report and gives an indication on the drive status when the diagnostic event was triggered

Byte	Description	
1...28	Header information	Header information with interrupts from PROFINET IO in case of manufacturer-specific diagnostic.
29	Ext_Diag_Data	External diagnostic data length = 6
30		IF ETA.bit 3 = 1: ADL LFT LSB Otherwise: 0
31		ADL ETA LSB
32		ADL ETA MSB
33		LSB of the last value of the output speed
34		MSB of the last value of the output speed

Enabling Diagnostics

By default, alarm diagnostics function is enabled. It can be modified during the configuration phase as shown below:
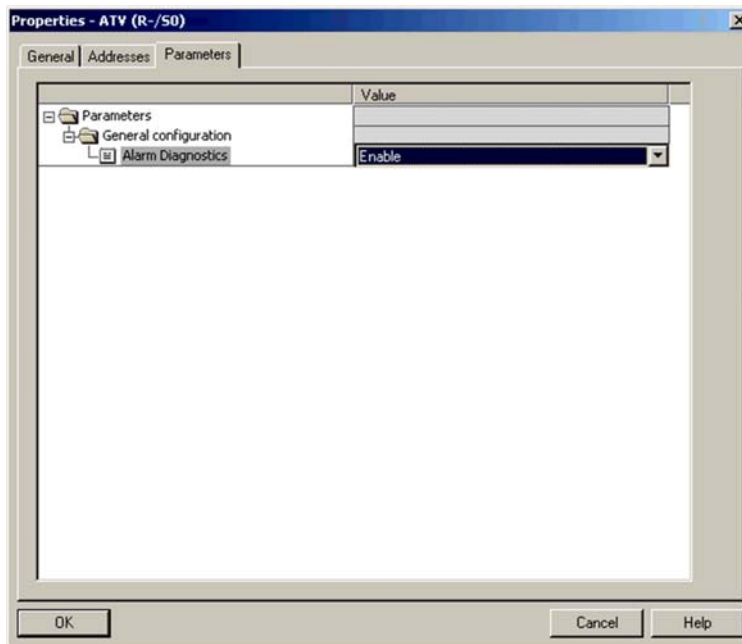
Monitoring of Communication Channel

Channel for Command and Reference Frequency

All the drive commands and reference value parameters are managed on a channel-by-channel basis.

Parameter Name	Parameter Code				
	Taken Into Account by the Drive	Modbus Serial	CANopen	Fieldbus Module	Ethernet Embedded
Control word	(*C N d*)	(*C N d 1*)	(*C N d 2*)	(*C N d 3*)	(*C N d 5*)
Extended control word	(*C N i*)	(*C N i 1*)	(*C N i 2*)	(*C N i 3*)	(*C N i 5*)
Reference speed (rpm)	(*L F d*)	(*L F d 1*)	(*L F d 2*)	(*L F d 3*)	(*L F d 5*)
Reference frequency (0.1 Hz)	(*L F r*)	(*L F r 1*)	(*L F r 2*)	(*L F r 3*)	(*L F r 5*)
Reference value supplied by PI controller	(*P i S P*)	(*P i r 1*)	(*P i r 2*)	(*P i r 3*)	(*P i r 5*)
Reference value supplied by analog multiplier function	(*N F r*)	(*N F r 1*)	(*N F r 2*)	(*N F r 3*)	(*N F r 5*)

Network Monitoring Criteria

The table provides the details of the detected errors

Protocol	Criteria	Error Code
PROFINET module	10: No valid IP	**[Fieldbus Error]** (*E P F 2*)
	9: Duplicated IP address	
	12: iPar unconfigured	
	13: iPar unrecoverable error detected	
	0:No error detected	**[Fieldbus Com Interrupt]** (*C n F*)
	1: Network timeout (configurable timeout) for received requests destined for the drive	
	2: Network overload	
	3: Loss of Ethernet Carrier	
	EEPROM detected error	**[Internal Link Error]** (*i L F*)

Monitoring of Communication Channels

Communication channels are monitored if they are involved in one of the following parameters:
- The control word (**[Cmd Register]** ($C \Pi d$)) from the active command channel
- The control word containing the command switch (bit configured on **[Cmd switching]** ($C C 5$))
- The control word containing the switch for reference value 1'1B (bit configured on **[Ref 1B switching]** ($r C b$))
- The control word containing the switch for reference value 1'2 (bit configured on **[Freq Switch Assign]** ($r F C$))
- The reference frequency or reference speed (**[Ref Frequency]** ($L F r$) or LFRD: Nominal speed value) from the active channel for reference value
- Summing reference frequency or reference speed (**[Ref Frequency]** ($L F r$) or LFRD: Nominal speed value) 2 (assigned to **[Summing Input 2]** ($5 A 2$))
- Summing reference frequency or reference speed (**[Ref Frequency]** ($L F r$) or LFRD: Nominal speed value) 3 (assigned to **[Summing Input 3]** ($5 A 3$))
- Subtracting reference frequency or reference speed (**[Ref Frequency]** ($L F r$) or LFRD: Nominal speed value) 2 (assigned to **[Subtract Ref Freq 2]** ($d A 2$))
- Subtracting reference frequency or reference speed (**[Ref Frequency]** ($L F r$) or LFRD: Nominal speed value) 3 (assigned to **[Subtract Ref Freq 3]** ($d A 3$))
- The reference value given by the PID controller (PISP)
- The PID controller feedback (**[AI Virtual 1]** ($A i u 1$))
- The multiplication coefficient of the reference values (**[Multiplying coeff.]** ($\Pi F r$)) 2 (assigned to **[Ref Freq 2 Multiply]** ($\Pi A 2$))
- The multiplication coefficient of the reference values (**[Multiplying coeff.]** ($\Pi F r$)) 3 (assigned to **[Ref Freq 3 Multiply]** ($\Pi A 3$))

As soon as one of these parameters has been written once to a communication channel, it activates monitoring for that channel.

If a communication warning is sent (in accordance with the protocol criteria) by a monitored port or fieldbus module, the drive triggers a communication interruption.

The drive reacts according to the communication interruption configuration (operating state Fault, maintenance, fallback, and so on)

If a communication warning occurs on a channel that is not being monitored, the drive does not trigger a communication interruption.

Enabling of Communication Channels

A communication channel is enabled once all the parameters involved have been written at least one time.The drive is only able to start if all channels involved in command and reference are enabled.

For example:

A drive in DSP402 profile is connected to an active communication channel.

It is mandatory to write at least 1 time the reference and the command in order to switch from `4-Switched on` to `5-Operation enabled` state.

A communication channel is disabled:
- In the event of a communication alarm.
- In `forced local` mode.
  NOTE: On exiting `forced local` mode:
- The drive copies the `run` commands, the direction, and the forced local reference to the active channel (maintained).
- Monitoring of the active command and reference channels resumes following a time delay **[Time-out forc. local]** ($F L o t$).
- Drive control only takes effect once the drive has received the reference and the command from the active channel.

Control-Signal Diagnostics

Introduction

On the display terminal, the **[Display]** (*N o n -*) , **[Communication map]** (*C N N -*) submenu can be used to display control-signal diagnostic information between the drive and the controller:
- Active command channel **[Command Channel]** (*C N d C*)
- Value of the control word **[Cmd Register]** (*C N d*) from the active command channel **[Command Channel]** (*C N d C*)
- Active reference frequency channel **[Ref Freq Channel]** (*r F C C*)
- Value of the reference frequency **[Pre-Ramp Ref Freq]** (*F r H*) from the active target channel **[Ref Freq Channel]** (*r F C C*)
- Value of the operating state word **[CIA402 State Reg]** (*E t A*)
- Specific data for all available fieldbus are in dedicated submenus.
- In the **[Command word image]** (*C W i -*) submenu: control words from all channels
- In the **[Freq. ref. word map]** (*r W i -*) submenu: reference frequency values produced by all channels

Control Word Display

The **[Command Channel]** (*C N d C*) parameter indicates the active command channel.

The **[Cmd Register]** (*C N d*) parameter indicates the hexadecimal value of the control word (CMD) used to control the drive.

The **[Command word image]** (*C W i -*) submenu (**[COM. Module cmd.]** (*C N d 3*)) parameter is used to display the hexadecimal value of the control word from the fieldbus module.

Reference Frequency Display

The **[Ref Freq Channel]** (*r F C C*) parameter indicates the active channel for reference frequency.

The **[Ref Frequency]** (*L F r*) parameter indicates the value (in 0.1 Hz units) of the reference frequency used to control the drive.

The **[Freq. ref. word map]** (*r W i -*) submenu (**[Com Module Ref Freq]** (*L F r 3*) parameter is used to display the value (in 0.1 Hz units) of the reference frequency from the fieldbus.

Operating State Word Display

The **[CIA402 State Reg]** (*E t A*) parameter gives the value of the operating state word (ETA).

The table provides the bit details of *E t A* parameter:

Bit	Description
DRIVECOM	Status word
Bit0 = 1	Ready to switch on
Bit1 = 1	Switched on
Bit2 = 1	Operation enabled
Bit3 = 1	Operating state fault
Bit4 = 1	Power stage is switched on
Bit5 = 0	Quick stop
Bit6 = 1	Switch on disabled
Bit7 = 1	Warning
Bit8 = 1	Drivecom reserved
Bit9 = 0	Forced local mode in progress
Bit10 = 1	Reference value reached (steady state)
Bit11 = 1	Reference value exceeded (< LSP or > HSP)
Bit12	Reserved
Bit13	Reserved
Bit14 = 1	Stop imposed via **STOP** key
Bit15 = 0	Motor rotation in forward direction (or stopped)

Glossary

A

Abbreviations

Req. = Required

Opt. = Optional

D

Display terminal

The display terminal menus are shown in square brackets.

For example: **[Communication]**

The codes are shown in round brackets.

For example: ($\varepsilon \, o \, \Pi$ -)

Parameter names are displayed on the display terminal in square brackets.

For example: **[Fallback Speed]**

Parameter codes are displayed in round brackets.

For example: ($L \, F \, F$)

E

Error

Discrepancy between a detected (computed, measured, or signaled) value or condition and the specified or theoretically correct value or condition.

F

Factory setting

Factory settings when the product is shipped

Fault

Fault is an operating state. If the monitoring functions detect an error, a transition to this operating state is triggered, depending on the error class. A "Fault reset" is required to exit this operating state after the cause of the detected error has been removed. Further information can be found in the pertinent standards such as IEC 61800-7, ODVA Common Industrial Protocol (CIP).

Fault Reset

A function used to restore the drive to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active.

M

Monitoring function

Monitoring functions acquire a value continuously or cyclically (for example, by measuring) in order to check whether it is within permissible limits. Monitoring functions are used for error detection.

P

Parameter

Device data and values that can be read and set (to a certain extent) by the user.

PELV

Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41

PLC

Programmable logic controller

PNO

PROFIBUS Nutzerorganisation e.V. (PROFIBUS User Organization).

Power stage

The power stage controls the motor. The power stage generates current for controlling the motor.

Q

Quick Stop

The quick Stop function can be used for fast deceleration of a movement as a response to a detected error or via a command.

W

Warning

If the term is used outside the context of safety instructions, a warning alerts to a potential problem that was detected by a monitoring function. A warning does not cause a transition of the operating state.