

# Altivar Process 900

## CANopen Manual - VW3A3608, 618, 628

01/2016



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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.

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# Safety Information



## Important Information

### NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **DANGER**

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

### **WARNING**

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

### **CAUTION**

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

### **NOTICE**

**NOTICE** is used to address practices not related to physical injury.

### PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

### 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.**





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# About the Book

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## At a Glance

### Document Scope

The purpose of this document is to:

- Show you how to install the CANopen fieldbus on your drive.
- Show you how to configure drive to use CANopen for monitoring and control.
- Provide examples of setup using Unity

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

### Validity Note

This documentation is valid for the drive 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 <a href="http://www.schneider-electric.com">www.schneider-electric.com</a> .
2	In the <b>Search</b> box type the reference of a product or the name of a product range. <ul style="list-style-type: none"><li>• Do not include blank spaces in the reference or product range.</li><li>• To get information on grouping similar modules, use asterisks (*).</li></ul>
3	If you entered a reference, go to the <b>Product Datasheets</b> search results and click on the reference that interests you. If you entered the name of a product range, go to the <b>Product Ranges</b> search results and click on the product range that interests you.
4	If more than one reference appears in the <b>Products</b> 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 <b>Download XXX product datasheet</b> .

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](http://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 ATV900 Getting Started	<a href="#">NHA61578</a> (English), <a href="#">NHA61579</a> (French), <a href="#">NHA61580</a> (German), <a href="#">NHA61581</a> (Spanish), <a href="#">EAV61724</a> (Italian), <a href="#">NHA61583</a> (Chinese)
Altivar Process ATV900 Getting Started Annex (SCCR)	<a href="#">NHA61584</a> (English)
Altivar Process ATV930, ATV950 Installation Manual	<a href="#">NHA80932</a> (English), <a href="#">NHA80933</a> (French), <a href="#">NHA80934</a> (German), <a href="#">NHA80935</a> (Spanish), <a href="#">NHA80936</a> (Italian), <a href="#">NHA80937</a> (Chinese)
Altivar Process ATV930, ATV950, ATV960, ATV980 Programming Manual	<a href="#">NHA80757</a> (English), <a href="#">NHA80758</a> (French), <a href="#">NHA80759</a> (German), <a href="#">NHA80760</a> (Spanish), <a href="#">NHA80761</a> (Italian), <a href="#">NHA80762</a> (Chinese)
Altivar Process ATV900 Modbus SL manual (Embedded)	<a href="#">NHA80939</a> (English)
Altivar Process ATV900 Ethernet manual (Embedded)	<a href="#">NHA80940</a> (English)
Altivar Process ATV900 PROFIBUS DP manual (VW3A3607)	<a href="#">NHA80941</a> (English)
Altivar Process ATV900 DeviceNet manual (VW3A3609)	<a href="#">NHA80942</a> (English)
Altivar Process ATV900 PROFINET manual (VW3A3627)	<a href="#">NHA80943</a> (English)
Altivar Process ATV900 CANopen manual (VW3A3608, 618, 628)	<a href="#">NHA80945</a> (English)
Altivar Process ATV900 EtherCAT manual - (VW3A3601)	<a href="#">NHA80946</a> (English)
Altivar Process ATV900 Communication Parameters	<a href="#">NHA80944</a> (English)
Altivar Process ATV900 Service Instructions	<a href="#">NHA80954</a> (English)
Altivar Process ATV900 Safety Functions manual	<a href="#">NHA80947</a> (English), <a href="#">NHA80948</a> (French), <a href="#">NHA80949</a> (German), <a href="#">NHA80950</a> (Spanish), <a href="#">NHA80951</a> (Italian), <a href="#">NHA80953</a> (Chinese)
Altivar Process Drive Systems – Installation manual	<a href="#">NHA37118</a> (German), <a href="#">NHA37119</a> (English), <a href="#">NHA37121</a> (French), <a href="#">NHA37122</a> (Spanish), <a href="#">NHA37123</a> (Italian), <a href="#">NHA37124</a> (Dutch), <a href="#">NHA37126</a> (Polish), <a href="#">NHA37127</a> (Portuguese), <a href="#">NHA37128</a> (Russian), <a href="#">NHA37129</a> (Turkish), <a href="#">NHA37130</a> (Chinese)
Altivar Process ATV960 Configuration guide	<a href="#">NHA37115</a> (English), <a href="#">NHA37114</a> (German)
Altivar Process ATV980 Configuration guide	<a href="#">NHA37117</a> (English), <a href="#">NHA37116</a> (German)

You can download these technical publications and other technical information from our website at <http://download.schneider-electric.com>

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## 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

In addition, the term **zone of operation** is used in conjunction with the description of specific hazards, and is defined as it is for a **hazard zone** or **danger zone** in the EC Machinery Directive (2006/42/EC) and in ISO 12100-1.

Also see the glossary at the end of this manual.



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# Chapter 1

## Presentation

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### What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Hardware Overview	14
Software Overview	15

## Hardware Overview

### General

The VW3A3608, VW3A3618, VW3A3628 are CANopen modules that can be used in a CANopen industrial fieldbus.

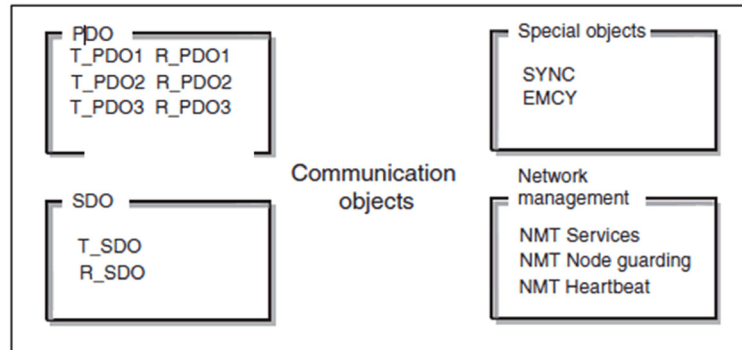
The following figure shows the hardware presentation of these three CANopen modules.



## Software Overview

### General

CANopen manages communication between the network devices with object dictionaries and objects. A network device can use process data objects (PDO) and service data objects (SDO) to request the object data from the object dictionary of another device and, if permissible, write back modified values.



- PDOs (process data objects) for real-time transmission of process data.
- SDOs (service data object) for read and write access to the object dictionary.
- Objects for controlling CAN messages:
  - SYNC object (synchronization object) for synchronization of network devices.
  - EMCY object (emergency object), for signaling errors of a device or its peripherals.
- Network management services:
  - NMT services for initialization and network control (NMT: network management).
  - NMT node guarding for monitoring the network devices.
  - NMT heartbeat for monitoring the network devices.





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## Chapter 2

### Basics

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#### What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Object Dictionary	18
Communication Object Identifier	19
Service Data Communication	20
Process Data Communication	21
Network Management Services	22

## Object Dictionary

### Description

Each CANopen device manages an object dictionary which contains the objects for communication.

### Index and Subindex

The objects are addressed in the object dictionary via a 16 bit index.

One or more 8 bit subindex entries for each object specify individual data fields in the object. Index and subindex are shown in hexadecimal notation.

The following table provides the index and subindex entries using the example of the object ramps (203C hex):

Index	Subindex	Name	Meaning
203C hex	00 hex	–	Number of entries
203C hex	01 hex	ACC	Acceleration time
203C hex	02 hex	DEC	Deceleration time

### Description Object Dictionary

The description object dictionary is made of separate chapters:

- Communication profile area
- RPDO
- TPDO
- Manufacturer specific
- Application profile (CiA402)

Index (hex)	Object
0000	Unused
0001...001F	Static data types
0020...003F	Complex data types
0040...005F	Unused (Manufacturer-specific complex data types)
0060...007F	Device profile-specific static data types
0080...009F	Device profile-specific complex data types
00A0...0FFF	Reserved for further use
1000...1FFF	Communication profile area
2000...5FFF	ATV9xx specific profile area
6000...9FFF	Standardized device profile area
A000...FFFF	Reserved for further use

# Communication Object Identifier

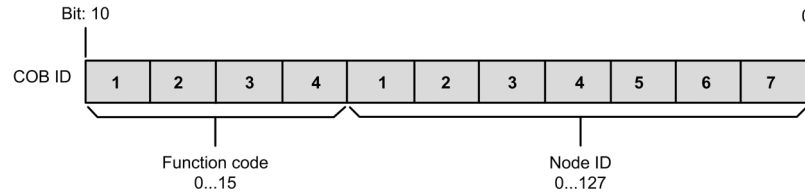
## Description

The COB ID (communication object identifier) has 2 tasks as far as controlling communication object is concerned:

- Bus arbitration: Specification of transmission priorities
- Identification of communication objects

An 11-bit COB identifier as per the CAN 3.0 A specification is defined for CAN communication; it comprises two parts:

- Function code, 4 bits
- Node address (node ID), 7 bits



## Function Code

The function code classifies the communication objects. Since the bits of the function code if the COB ID is more significant, the function code also controls the transmission priorities: Objects with a lower function code are transmitted with higher priority. For example, an object with function code **A** is transmitted prior to an object with function code **3** in the case of simultaneous bus access.

## Node Address

Each network device is configured before it can be operated on the network. The device is assigned a unique 7-bit node address (node ID) between 1 (01 hex) and 127 (7F hex). The device address **0** is reserved for broadcast transmissions which are used to send messages to all reachable devices simultaneously.

## COB IDs of the Communication Objects

The following table provides the COB IDs of the communication objects with the factory settings.

Communication object	Function code	Node address, node ID [1...127]	COB ID decimal (hexadecimal)
Service Network Management (NMT)	0 0 0 0	0 0 0 0 0 0 0	0 (0 hex)
Synchronization service (SYNC)	0 0 0 1	0 0 0 0 0 0 0	128 (80 hex)
Emergency service (EMCY)	0 0 0 1	x x x x x x x	128 (80 hex) + node ID
Transmit PDO1 (TPDO1)	0 0 1 1	x x x x x x x	384 (180 hex) + node ID
Receive PDO1 (RPDO1)	0 1 0 0	x x x x x x x	512 (200 hex) + node ID
Transmit PDO2 (TPDO2)	0 1 0 1	x x x x x x x	640 (280 hex) + node ID
Receive PDO2 (RPDO2)	0 1 1 0	x x x x x x x	768 (300 hex) + node ID
Transmit PDO3 (TPDO3)	0 1 1 1	x x x x x x x	896 (380 hex) + node ID
Receive PDO3 (RPDO3)	1 0 0 0	x x x x x x x	1024 (400 hex) + node ID
Transmit SDO (TSDO)	1 0 1 1	x x x x x x x	1408 (580 hex) + node ID
Receive SDO (RSDO)	1 1 0 0	x x x x x x x	1536 (600 hex) + node ID
NMT error control (Node Guarding, Heartbeat)	1 1 1 0	x x x x x x x	1792 (700 hex) + node ID

## Service Data Communication

### Description

Service Data Objects (SDO) can be used to access the entries of an object dictionary using index and subindex. The values of the objects can be read and, if permissible, also written.

Every network device has at least one SDO server to be able to respond to read and write requests from a different device.

The TSDO of a SDO client is used to send the request for data exchange; the RSDO is used to receive.

The data frame of a SDO consists of 8 bytes.

SDOs have a higher COB ID than PDOS, therefore they are transmitted over the can bus at a low priority.

### Example of Read Request

This example explains how to read the acceleration (ACC) parameter on an Altivar located at CANopen address 4 (COB ID = 580 hex + Node ID or 600 hex + Node ID). The index / subindex value of this parameter is 203C/02 hex. Values are given in hexadecimal.

Read request: **Master** → **Drive**

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 6
COB ID	Request code	Object index		Subindex	Request data			
604	40	3C	20	02	00	00	00	00

Read response: **Master** ← **Drive**

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 6
COB ID	Request code	Object index		Subindex	Request data			
584	4B	3C	20	02	E8	03	00	00

The value of parameter read is equal to 1000 (03E8 hex), equivalent to an acceleration (ACC) of 100 s, as the unit of this parameter is 0.1 s.

### Example of Write Request

This example explains how to write the value 100 s to the acceleration (ACC) parameter on an Altivar located at CANopen address 4 (COB ID = 580 hex + NodeID or 600 hex + Node ID). The index / subindex value of this parameter is 203C/02 hex. Values are give in hexadecimal.

The request code is 2B hex for an item of 2 bytes data length.

Write request: **Master** → **Drive**

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 6
COB ID	Request code	Object index		Subindex	Request data			
604	2B	3C	20	02	E8	03	00	00

The request data field indicates the value 03E8 hex as value written is 1000, equivalent to an acceleration (ACC) of 100 s, as the unit of this parameter is 0.1 s.

Write response: **Master** ← **Drive**

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 6
COB ID	Request code	Object index		Subindex	Request data			
584	60	3C	20	02	00	00	00	00

## Process Data Communication

### Description

Process Data Objects (PDO) are used for real-time data exchange of process data such as actual and reference values or the operating state of the device. Transmission is fast because the data is sent without administration data and data transmission acknowledgment from the recipient is not required. Each PDO can be enabled or disabled independently using the bit 31 (valid bit) in subindex 01 hex of the respective communication object.

### PDO1 Details

The first PDO is by default compliant with the PDO1 of the Velocity mode of the CiA402. It is asynchronous and contains two data: the control word (6040 hex, CMD) and the target velocity (6042 hex, LFRD) for the output (from Master to Device) and the status word (6041 hex, ETA) and the control effort (6044 hex, RFRD) for the input (from Device to Master).

### PDO2 Details

The second PDO set (PDO2) is deactivated by default and can be fully configurable (1 to 4 words of the user choice). It is reserved for adjustments and for additional control and monitoring functions.

### PDO3 Details

The third PDO set (PDO3) is reserved. Deactivated by default, it cannot be configured and comprises:

- RPDO3 (receive), containing four output (from Master to Device) words of the communication scanner NC1 to NC4
- TPDO3 (transmit), containing four input (from Device to Master) words of the communication scanner NM1 to NM4

### Transmission Mode

By default, the three PDOs are asynchronous, although the transmission mode of each PDO can be reconfigured by the user in accordance with requirements:

- Asynchronous mode (255): The transmit PDO is only sent when the value of its data changes. In this mode, the `inhibit time` and `event timer` can be modified in order to adjust the PDO transmission frequency on the bus.
- Cyclic synchronous mode (1...240): The transmit PDO is sent each time a synchronization object (SYNC) is received or when a preconfigured number of synchronization objects (from 1 to 240) is received.
- Acyclic synchronous mode (0): The transmit PDO is sent each time the value of its data changes, but only during the synchronous window authorized by the next synchronization object (SYNC).

### Synchronization Object

The synchronization object (SYNC) is sent cyclically by the CANopen master. It does not contain data and its frame is limited to its unique COB ID identifier. The purpose of this object is essentially to authorize synchronous communication modes for CANopen slaves.

## Network Management Services

### Description

Network management (NMT) is part of the CANopen communication profile; it is used to initialize the network and the network devices and to start, stop, and monitor the network devices during operation on the network.

NMT services can be divided into two groups:

- Services for device control, to initialize devices for CANopen communication and to control the behavior of devices during operation on the network.
- Services for connection monitoring to check the status of network devices.

### Network Management State Machine

The CANopen NMT slave device implements a state machine, which brings automatically after power-on and internal initialization every device in pre-Operational state. In this state the node may be configured and parameterized using SDO, no PDO communication is allowed.

The NMT master device may switch all nodes or a single node to operational state and conversely. In operational state PDO transfer is allowed. By switching a device into the stopped state, it is forced to stop PDO and SDO communication. Furthermore, this state can be used to achieve certain application behavior.

In the operational state, all communication objects are active. Object Dictionary access through SDO is possible.

### NMT Message Description

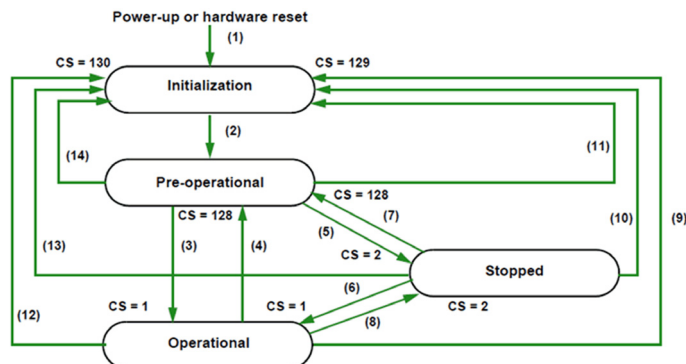
The NMT services for device control are transmitted as unconfirmed messages with COB ID 0. By default, they have the highest priority on the CAN bus.

COB ID	Byte 0	Byte 1
0 (000 hex)	Command specifier (CS)	Node ID <sup>(1)</sup>
<sup>(1)</sup> If Node ID is 0, the command specifier is broadcast to all CANopen slaves.		

The following table provides the of command specifier used to manage the NMT state machine.

Command specifier (CS)	Meaning
1 (01 hex)	Start_Remote_Node
2 (02 hex)	Stop_Remote_Node
128 (80 hex)	Enter_Pre-Operational_State
129 (81 hex)	Reset_Node
130 (82 hex)	Reset_Communication

## NMT State Chart



Transition	Description
(1)	On power-up, the node automatically changes to the initialization state
(2)	Once initialization is complete, the pre-operational state is activated automatically
(3), (6)	Start_Remote_Node
(4), (7)	Enter_Pre-Operational_State
(5), (8)	Stop_Remote_Node
(9), (10), (11)	Reset_Node
(12), (13), (14)	Reset_Communication

Depending on the communication status of the drive, the following services are available:

	Initialization	Pre-Operational	Operational	Stopped
PDO			X	
SDO		X	X	
Synchronization (SYNC)		X	X	
Emergency (EMCY)		X	X	
Bootup Service	X		X	
Network Management (NMT)		X	X	X

In Pre-Operational mode, the master can only perform SDO.

In operation mode, the master can perform SDO and PDO. The device can be controlled only if the user has selected CANopen as the command channel.

In Stop mode, the master cannot perform SDO and PDO.

In the event of a resettable detected error, the drive must be in the Operational NMT state in order that the PDO carrying the control word CMD can reset the drive using the CMD `Fault reset` bit.

## Node Guarding Service

Either the Node Guarding service described here or the Heartbeat service described below can be used for communication monitoring. Only one of these two services can be active at any one time. The Node guarding service is deactivated by default on the Altivar.

The master scans the drive at regular intervals (`Life Time`) by sending "Remote Transmit Requests" (RTR). The "Life Time" is calculated by multiplying the `Guard Time` by the `Life Time Factor`.

If, once the `Life Time` has expired, the drive has not received the RTR:

- It triggers a `Life Guarding error`
- Sends an emergency telegram (`EMCY`)

## Node Guarding Frame Description

COB ID	Byte 0	Byte 1
1792 (700 hex) + Node ID	Bit 7	Bit 6 - 0
	Toggle bit	Node State

The drive indicates its NMT state via the "NMT information field, described here:

Bit 6-0 (node state): Current NMT state of the drive:

- Initialization (00 hex)
- Stopped (04 hex)
- Operational (05 hex)
- Pre-Operational (7 F hex)

Bit 7 (toggle bit): The value of this bit must alternate from one drive response to the other. The value of the toggle bit for the first response following activation of the node Guarding service is 0. This bit can only be reset by sending the `Reset_Communication` command to the drive. If a response is received with the same toggle bit value as the previous one, the new response is treated as if it had not been received.

## Heartbeat Service

If you do not activate the node Guarding service described above, you can use the Heartbeat service to monitor communication with another node that supports this service.

The Heartbeat service is deactivated by default on the Altivar.

Each `Heartbeat Producer` sends Heartbeat messages at regular intervals (`Producer Heartbeat Time`).

All `Heartbeat Consumer` check that they receive these messages in a time less than the `Consumer Heartbeat Time`.

The `Producer Heartbeat Time` must be less than the `Consumer Heartbeat Time`. If the drive has been configured as a consumer and a period equal to the `Consumer Heartbeat Time` elapses without a Heartbeat message being received, the drive triggers a Heartbeat event and send an emergency telegram (EMCY).

## Heartbeat Frame Description

COB ID	Byte 0	
1792 (700 hex) + Node ID	Bit 7	Bit 6 - 0
	Reserved	Heartbeat Producer State

The `Heartbeat` message sent from the drive contains a `Heartbeat Producer state` field (byte 0), described here:

Bit 6-0: Heartbeat Producer state: Current NMT state of the drive:

- Initialization (00 hex)
- Stopped (04 hex)
- Operational (05 hex)
- Pre-Operational (7F hex)

Bit 7 (toggle bit): Reserved: This bit is equal to 0.

## Emergency Object

An Emergency object (EMCY) is sent by the drive to other CANopen devices, with a high priority, each time an error is detected or cleared. This is the case in particular for `Heartbeat of Life Guard` type detected errors. An Emergency object is never repeated.

COB ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
128 (80 hex) + NodeID	Error code <i>E r r d</i>	Error register		0	0	0	0	0
	LSB	MSB	Bit 0 = 0 (no error) or 1 (error)	–	–	–	–	–

The error code *E r r d*, and its possible values, is described in the communication parameter file available on [www.schneider-electric.com](http://www.schneider-electric.com)



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## Chapter 3

### Hardware Setup

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#### What Is in This Chapter?

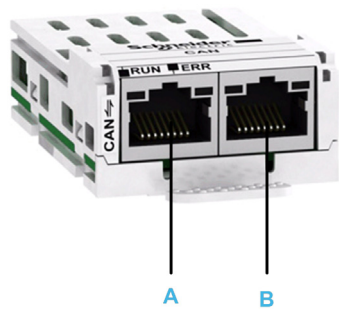
This chapter contains the following topics:

Topic	Page
Hardware Presentation	26
Firmware and Description File	27
Installation of the Module	28
Electrical Installation	29
Cable Routing Practices	32
Accessories Presentation	33

Hardware Presentation

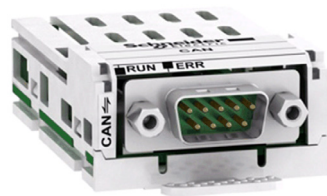
CANopen Fieldbus Modules

The following figure shows the VW3A3608 CANopen module with 2 RJ45 connectors:



Item	Description	Comment
A	Port A	RJ45 connector
B	Port B	RJ45 connector

The following figure shows the VW3A3618 CANopen module with a SubD9 connector:



Item	Description	Comment
-	-	SubD9 connector

The following figure shows the VW3A3628 CANopen module with an open style connector:



Item	Description	Comment
-	-	Open style connector

## Firmware and Description File

### Compatibility

The associated EDS file is named as the following example:

SEATV9x0\_010102E.eds

The files are available on [www.schneider-electric.com](http://www.schneider-electric.com).

## Installation of the Module

### Before Starting

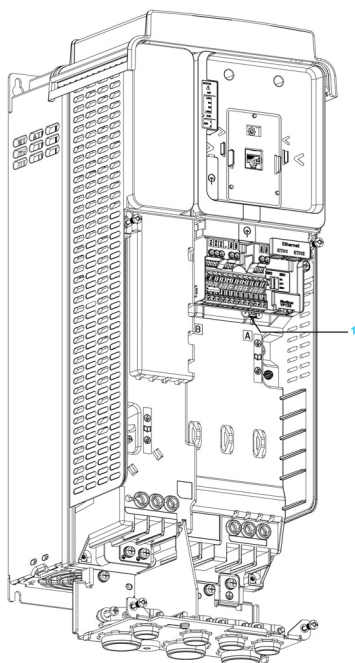
Check that the module catalog number marked on the label is the same as that on the delivery note corresponding to the purchase order.

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 CANopen 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

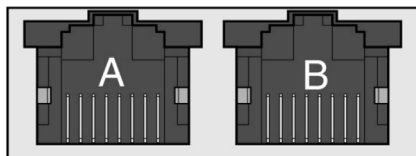
The table provides the procedure for removal of the CANopen option module from the drive:

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 of VW3A3608

The VW3A3608 option module is equipped with 2 RJ45 female sockets for the CANopen connection.

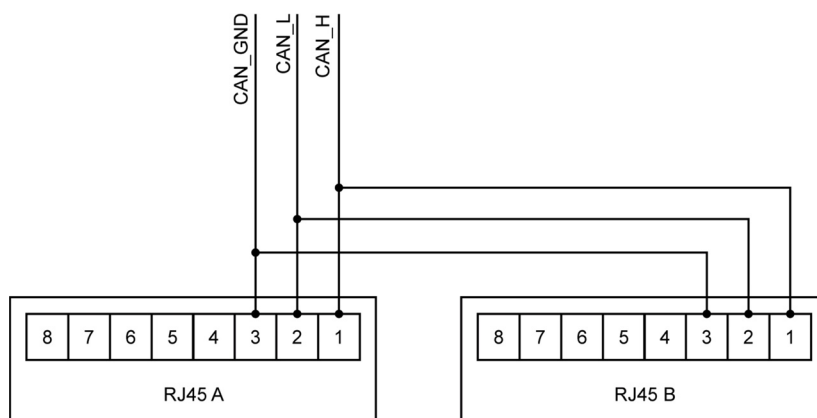


8 7 6 5 4 3 2 1 8 7 6 5 4 3 2 1

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

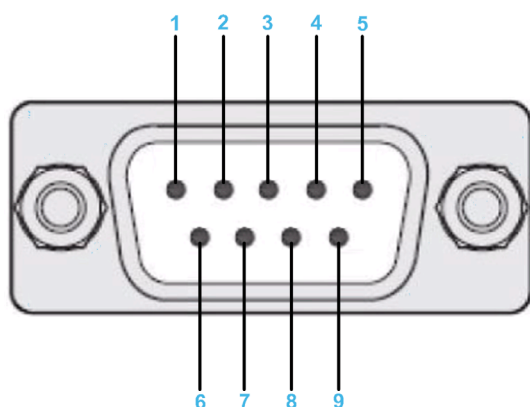
Pin	RJ45 signal
1	CAN_H
2	CAN_L
3	CAN_GND
4	Not connected
5	Not connected
6	Not connected
7	Not connected
8	Not connected

**NOTE:** Both RJ45 are interconnected internally as on the diagram below:



### Pin Layout of VW3A3618

The VW3A3618 option module is equipped with 1 SubD9 male connector for the CANopen connection.

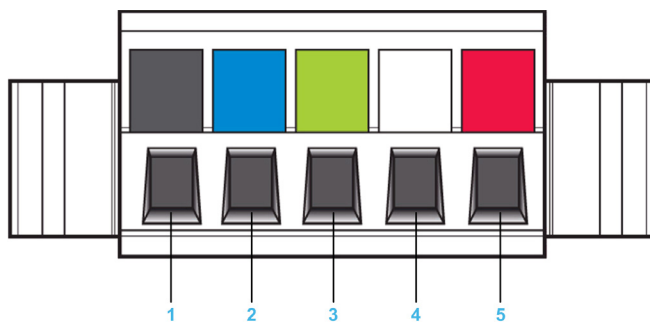


The table provides the pin out details of the SUB-D 9 connector:

Pin	SubD signal
1	Reserved
2	CAN_L
3	CAN_GND
4	Reserved
5	CAN_SHLD
6	CAN_GND
7	CAN_H
8	Reserved
9	Reserved

### Pin Layout of VW3A3628

The VW3A3628 option module is equipped with 1 open style male connector for the CANopen connection.



The table provides the pin out of the open style connector:

Pin	Signal
1	CAN_GND
2	CAN_L
3	CAN_SHLD
4	CAN_H
5	Reserved

### Cable Specification and Maximum Bus Length

The following table describes the maximum length:

Baud rate KBit/s	Maximum bus length m (ft)
50	1000 (3280)
125	500 (1640)
250	250 (820)
500	100 (328)
1000	20 (65)

The reference potential CAN\_GND and the shield connection (connector housing) are galvanically isolated.

- Keep the galvanic isolation in order to avoid ground loops via the CAN bus.
- Use equipotential bonding conductors.
- Use pre-assembled cables to reduce wiring errors.
- Verify that wiring, cables, and connected interfaces meet the PELV requirements.

### Terminating Resistor

Terminating resistors must be placed on both ends of a CAN bus line. A 120 Ohm terminating resistor between CAN\_L and CAN\_H is used for this purpose.

## Cable Routing Practices

### Installation Topology

The following image shows the connection of multiple drives equipped with VW3A3608 CANopen modules.





## Accessories Presentation

### Introduction

Both ends of a CAN bus line must be terminated. A 120 ohm terminating resistor between CAN\_L and CAN\_H is used for this purpose. According to the CANopen several solutions are available (See accessories and wear parts).

The following table describes the CANopen accessories for the different bus termination:

Bus termination	Accessories	
CANopen RJ45 module VW3A3608	CANopen terminating resistor, 120 Ohm, integrated in RJ45 connector	TCSCAR013M120
CANopen open style module VW3A3628	CANopen terminating resistor, 120 ohm, for terminal screw terminal	TCSCAR01NM120
CANopen SubD9 module VW3A3618	CANopen connector, SubD9 (female), with switchable terminating resistor, straight	TSXCANKCDF180T
	CANopen cable, 1 m, SubD9 (female) with integrated terminating resistor to RJ45	VW3M3805R01
	CANopen cable, 3 m, SubD9 (female) with integrated terminating resistor to RJ45	VW3M3805R030



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# Chapter 4

## Software Setup

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### What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
4.1	Basic Settings	36
4.2	Profile	41
4.3	Software Setup with Unity (M340)	58

## Section 4.1

### Basic Settings

---

#### What Is in This Section?

This section contains the following topics:

Topic	Page
Configuring the Communication Parameters	37
[CANopen Address] <i>Address</i>	38
[CANopen Baudrate] <i>Baudrate</i>	39
[CANopen Error] <i>Error</i>	40

---

## Configuring the Communication Parameters

### Overview

The parameters are described according to the graphic display terminal. These settings are also possible from commissioning software.

### Access

The parameters are accessible in the **[Communication]**  $\mathcal{L} \square \Pi$ , **[CANopen]**  $\mathcal{L} \pi \square$  - menu.

## [CANopen Address] *RdC*

### About This Parameter

This parameter defines the address of the drive on the network. This parameter is taken into account after a power cycle.

### Access

This is a read/write parameter.

The parameter number is 6051

### Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[OFF]	<i>0 F F</i>	0	CANopen address is not assigned.
[1 to 127]	<i>1... 1 2 7</i>	1...127	CANopen address is assigned. <b>Factory setting:</b> OFF

## [CANopen Baudrate] *b d C 0*

### About This Parameter

This parameter defines the baud rate at which data is transferred. This parameter is taken into account after a power cycle.

### Access

This is a read/write parameter.

The parameter number is 6053.

### Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[50 kbps]	<i>5 0</i>	38	Baud rate is set to 50 Kbps.
[125 kbps]	<i>1 2 5</i>	52	Baud rate is set to 125 Kbps.
[250 kbps]	<i>2 5 0</i>	60	Baud rate is set to 250 Kbps.
[500 kbps]	<i>5 0 0</i>	68	Baud rate is set to 500 Kbps.
[1 Mbps]	<i>1 0</i>	76	Baud rate is set to 1 Mbps.
			<b>Factory setting:</b> 250 Kbps

## [CANopen Error] $E_r L_a$

### About This Parameter

This parameter indicates the last active CANopen detected error.

### Access

This is a read-only Parameter.

The parameter number is 6056.

### Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0]	0	0	No errors detected since the last start of CANopen communication.
[1]	1	1	Bus off
[2]	2	2	Node guarding error requiring a return to the NMT initialization state.
[3]	3	3	CAN overrun
[4]	4	4	Heartbeat error requiring a return to the NMT initialization state.
[5]	5	5	NMT states chart error.
<b>NOTE:</b> If the motor is running, a [CANopen Error] $L_a F$ is triggered in case of change of NMT state.			



## Section 4.2

### Profile

#### What Is in This Section?

This section contains the following topics:

Topic	Page
Definition of a Profile	42
Functional Profiles Supported by the Drive	43
Functional Description	44
CIA402 Operating State Diagram	45
Description of Operating States	46
Summary	48
Cmd Register <i>C P d</i>	49
Stop Commands	50
Assigning Control Word Bits	51
[CIA402 State Reg] <i>E L R</i>	52
Starting Sequence	53
Sequence for a Drive Powered by the Power Stage Supply	54
Sequence for a Drive with Separate Control Stage	55
Sequence for a Drive with Mains Contactor Control	57

## 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 AC Drive

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.

### 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, EtherCAT, 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, and PROFIBUS DP, PROFINET, EtherCAT, 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] S E P**
- Not separate **[Not separ.] S I P**,

Functional Description

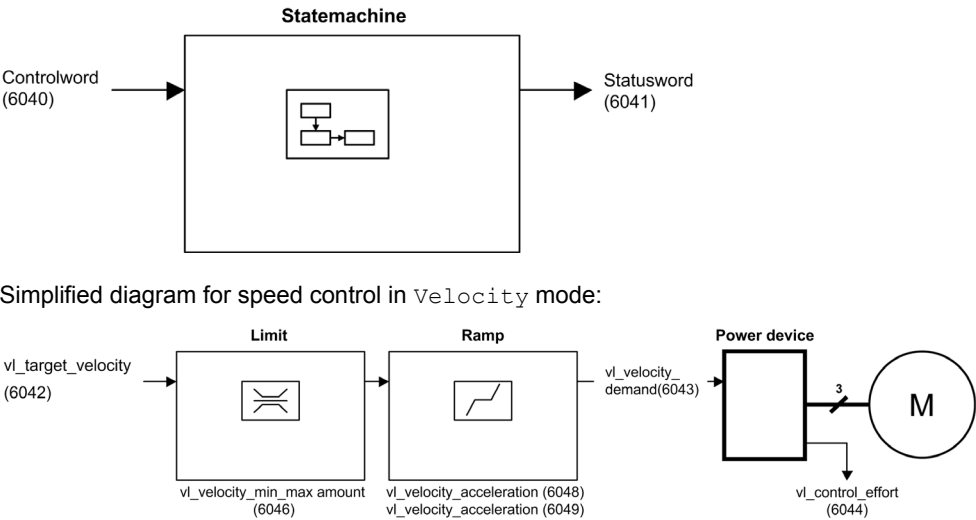
Introduction

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).

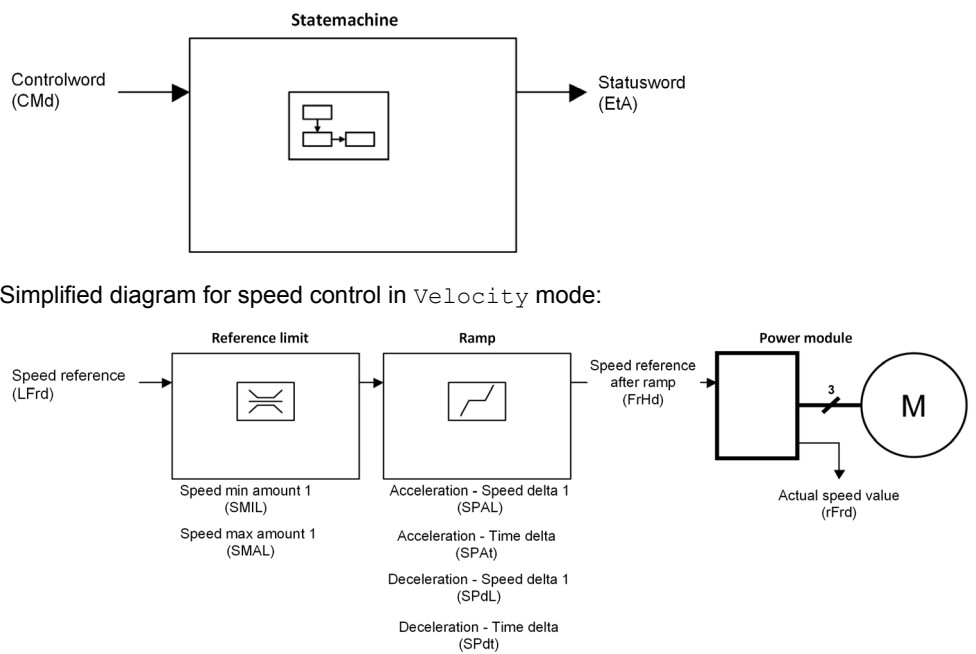
The following figure shows the control diagram for drive operation:



Altivar Drive

These diagrams translate as follows for the Altivar drive.

The following figure shows the control diagram for drive operation:



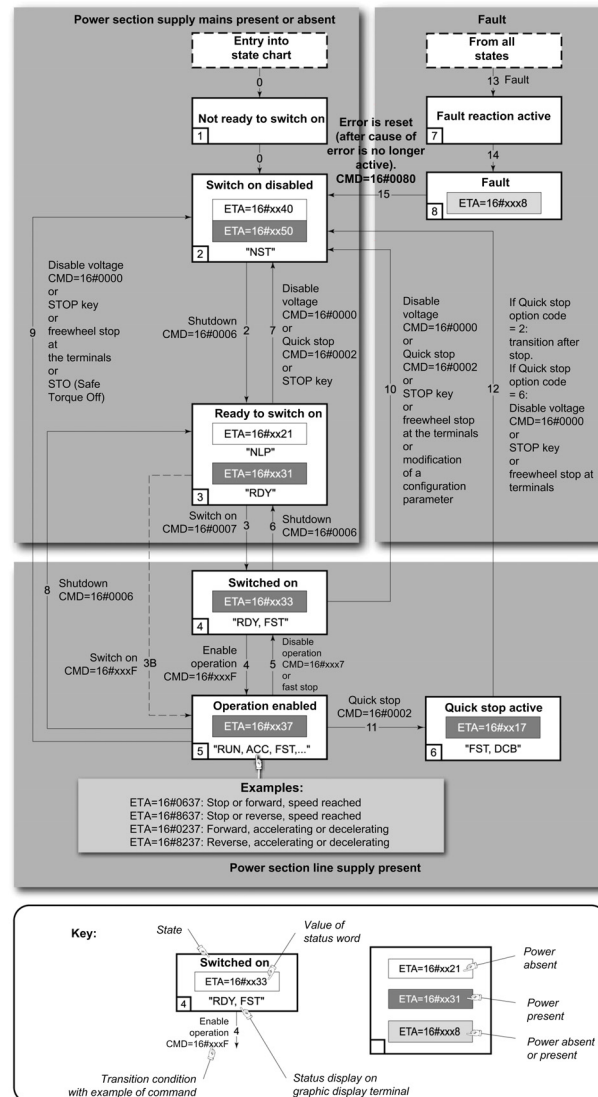
## CIA402 Operating State Diagram

## 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 P 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 E R**.

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 <b>Halt</b> command is applied, no power is supplied to the motor and no torque is applied. To perform <b>[Auto tuning] E u n</b> , the drive must be in state 5 - Operation enabled. The adjustment parameters can be modified. The configuration parameters cannot be modified.  <b>NOTE:</b> 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 <b>Disable operation</b> command depends on the value of the <b>[SwitchOnDisable Stp] d o E d</b> parameter: <ul style="list-style-type: none"> <li>• If the <b>[SwitchOnDisable Stp] d o E d</b> parameter is set to 0, the drive changes to operating state 4 - Switched on and stops in freewheel stop.</li> <li>• If the <b>[SwitchOnDisable Stp] d o E d</b> parameter is set to 1, the drive stops on ramp and then changes to operating state 4 - Switched on.</li> </ul>

Operating State	Description
6 - Quick stop active	<p>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.</p> <p>During fast stop, the drive is unlocked and power is supplied to the motor. The configuration parameters cannot be modified.</p> <p>The condition for transition 12 to state 2 - Switch on disabled depends on the value of the parameter</p> <p>Quick stop mode (QStd):</p> <p>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.</p> <p>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:</p> <ul style="list-style-type: none"> <li>• A Disable voltage command is received or</li> <li>• The <b>STOP</b> key is pressed or</li> <li>• A freewheel stop command via the digital input of the terminal.</li> </ul>
7 - Fault reaction active	Transient state during which the drive performs an action corresponding to the selected error response.
8 - Fault	<p>Error response terminated. Power stage is disabled.</p> <p>The drive is locked, no power is supplied to the motor.</p>

## 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 [ 7 ]

### 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	Bit 3	Bit 2	Bit 1	Bit 0	Example Value
			Fault Reset	Enable Operation	Quick Stop	Enable Voltage	Switch On	
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 → 1	X	X	X	X	0080 hex
X: Value is of no significance for this command. 0→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 L L`** 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 L L`** parameter **[Fast stop Assign] `F 5 L`**, **[Ramp stop] `r P P`**, **[Freewheel Stop] `n 5 L`**, or **[DC Injection Assign] `d L L`**, 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	CANopen
Bit 11	C211
Bit 12	C212
Bit 13	C213
Bit 14	C214
Bit 15	C215

For example, to assign the DC injection braking to bit13 of CANopen, simply configure the **[DC Injection Assign]** `dcI` parameter with the **[C213]** `C213` value.

Bit 11 is assigned by default to the operating direction command **[Reverse Assign]** `rr5`.

## [CIA402 State Reg] *E L R*

### 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 <sup>(1)</sup>
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 <sup>(2)</sup> .. .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.

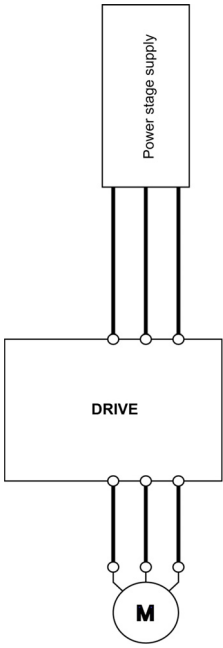
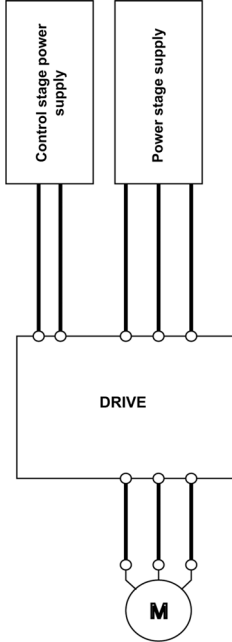
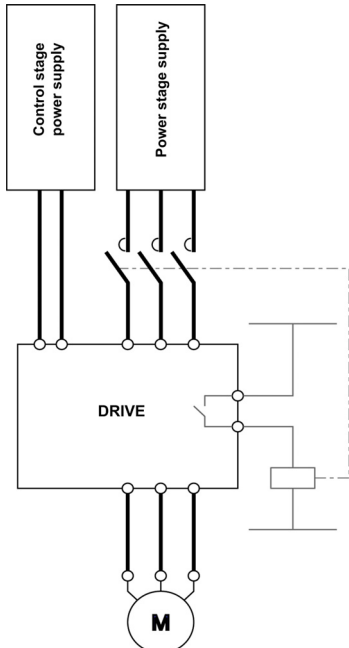
X: In this state, the value of the bit can be 0 or 1.

## 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:

			
<b>Power stage supply</b>	Direct	Direct	Mains contactor controlled by the drive
<b>Control stage supply</b>	Not separate <sup>(1)</sup>	Separate	Separate
<sup>(1)</sup> The power stage supplies the control stage.			

## Sequence for a Drive Powered by the Power Stage Supply

### Description

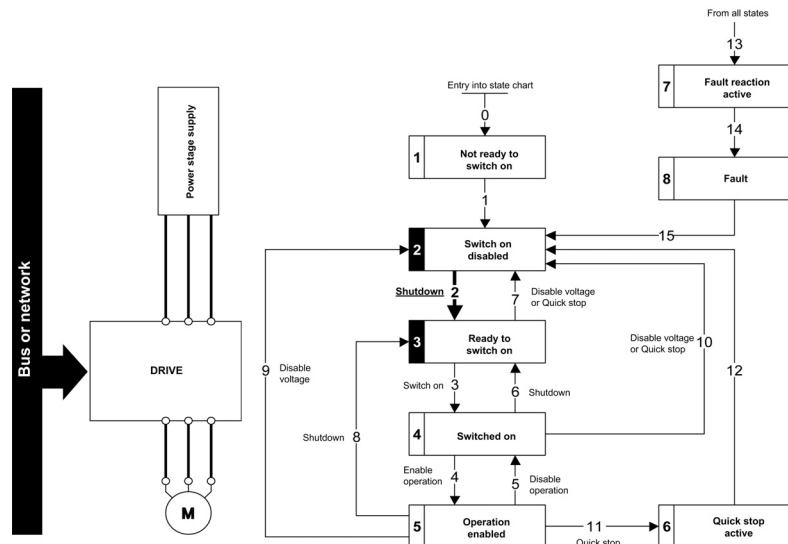
Both the power and control stages are powered by the power stage supply.

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:

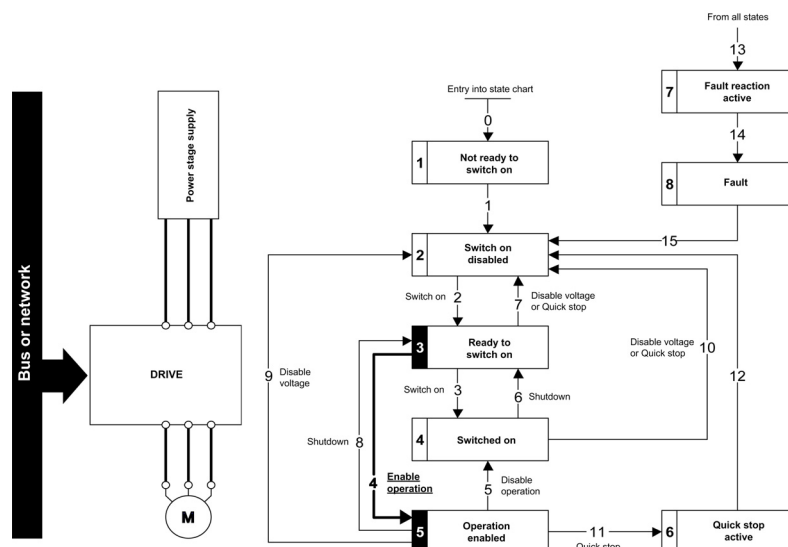
### Step 1

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

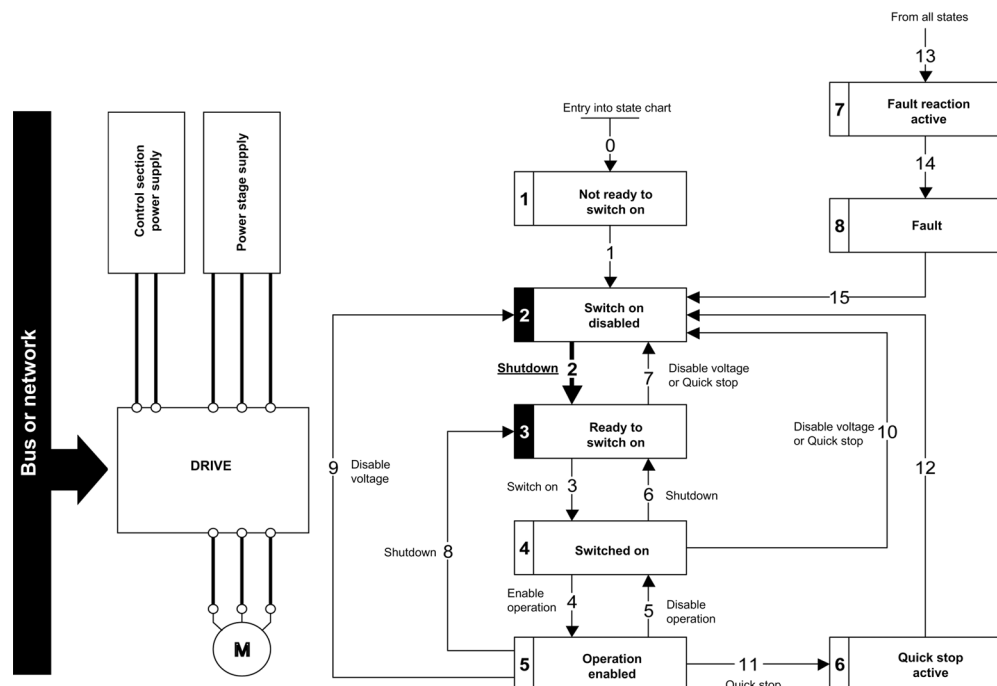
Power is supplied separately to the power and control stages.

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







## Sequence for a Drive with Mains Contactor Control

### Description

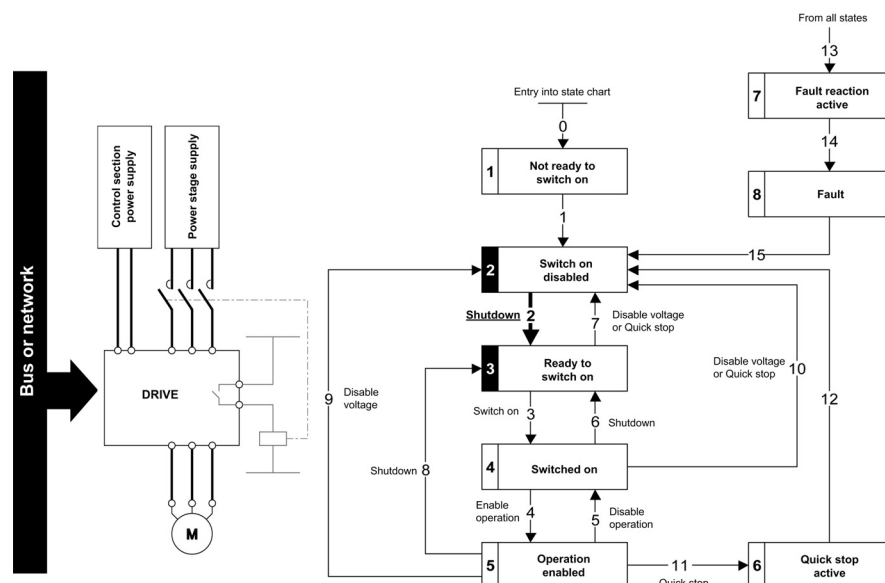
Power is supplied separately to the power and control stages.

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:

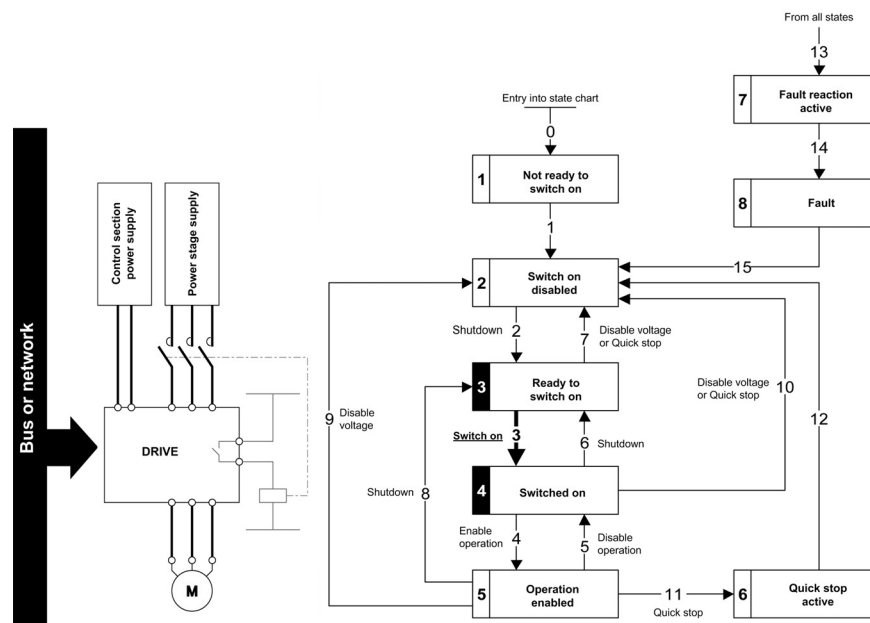
### Step 1

- 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.



## Section 4.3

### Software Setup with Unity (M340)

---

#### What Is in This Section?

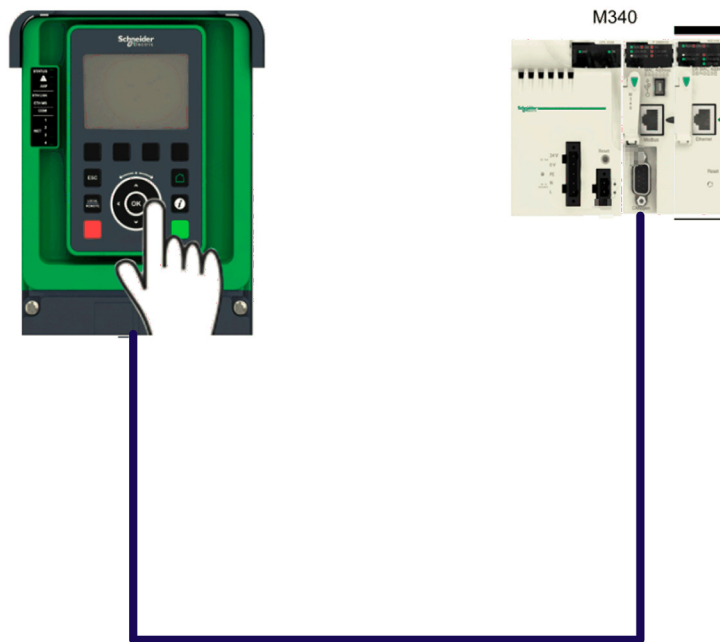
This section contains the following topics:

Topic	Page
Introduction	59
Drive Configuration	60

## Introduction

### Overview

Here is an example of an application that shows how to control a drive with a M340 PLC equipped with a CANopen port. The operator can control the drive directly from Unity. The version of Unity used here is Unity Pro XL



## Drive Configuration

### Factory Setting

Before configuring the drive, it is advised to make a factory setting. Go to:

- **[File management]** *F P L* - menu
- **[Factory settings]** *F L S* - submenu

Then configure **[Go to Factory Settings]** *L F S* parameter to **OK**

### Command Configuration

To control the drive with a CANopen fieldbus, it is necessary to select CANopen as command channel active.

Go to:

- **[Complete Settings]** *L S L* -
- **[Command and Reference]** *L r P* - menu

Then configure **[Ref.1 channel]** *F r l* parameter to **[Ref. Freq-CANopen]** *L R n* value

### Communication Configuration

Select the CANopen address and the Baud rate in the menu:

- **[Communication]** *L o P* -
- **[Comm parameters]** *L P P* -
- **[CANopen]** *L n o* -

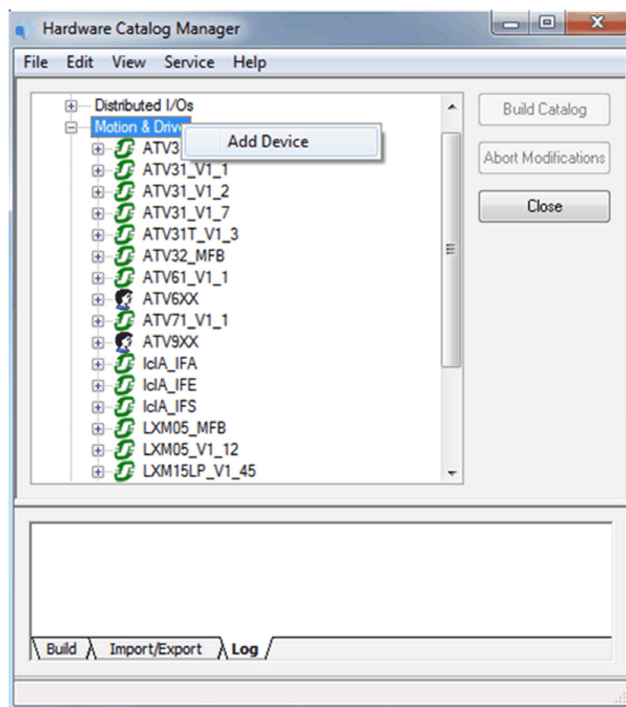
Then configure

- **[CANopen Address]** *R d L o* parameter to **[2] 2**.
- **[CANopen Baudrate]** *b d L o* parameter to **[125 kbps] 1 2 5**

The drive must be restarted in order to take into account the CANopen address

### EDS Integration

If your Unity software does not contain the drive in the CANopen catalog. You must add the EDS file to the hardware catalog manager installed with Unity.



Once imported, you should see the drive in the **Motion & Drive** section. The two topics **default** and **PDOonly** are used in the CANopen device configuration screen of Unity to select which objects are mapped and linked to an application variable.

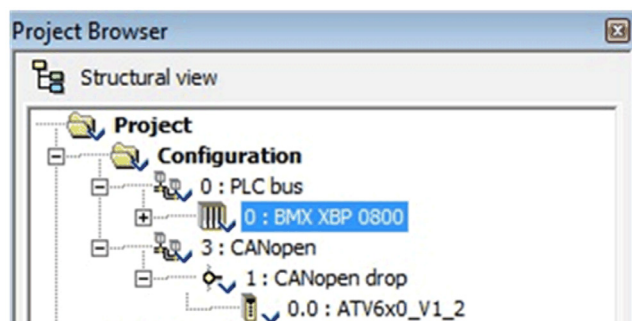
- Default: all the objects described in the EDS have reserved memory in the PLC application.
- PDOs only: Only the TPDO and RPDO objects are mapped in PLC memory. (The current example uses this function).

Your hardware catalog manager is now updated and contains the drive. If you import only the EDS file you have only the default choice. You must create new functions in the hardware catalog manager if you need several choices.

**NOTE:** You cannot reopen the project, if the device which is used in an existing unity project is removed from the hardware catalog manager.

### Configuring the Drive in the CANopen Master Project

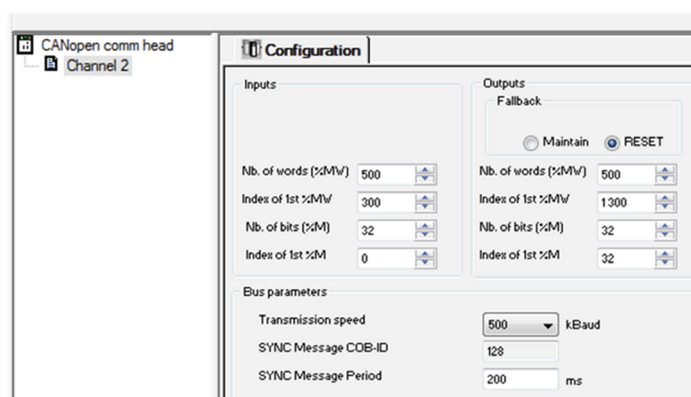
From the project browser opens the CANopen configuration tool by double-clicking the CANopen drop:



### Configuration of the Master

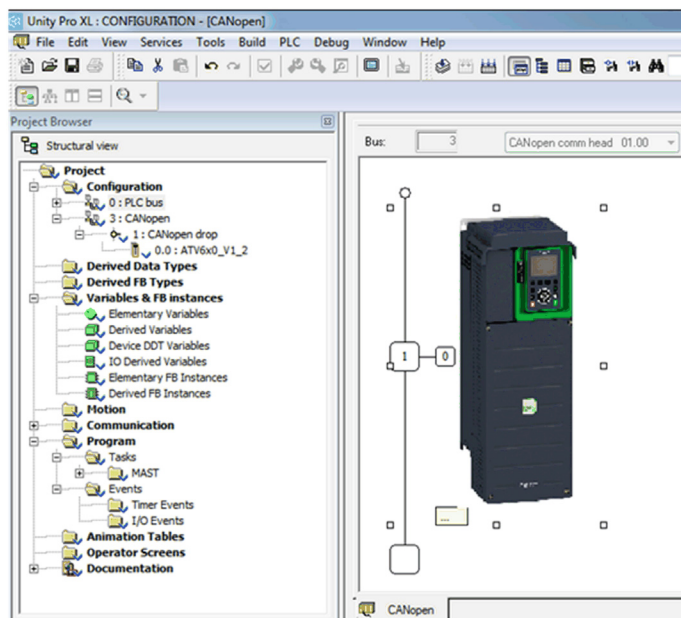
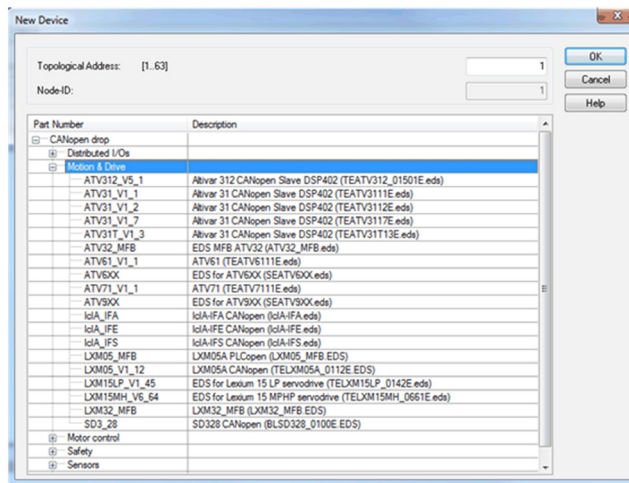
The master configuration consists of:

- Setting the baud rate
- Setting the SYNC message period
- Configuring the memory area which is the image of the whole PDOs handled by the PLC.

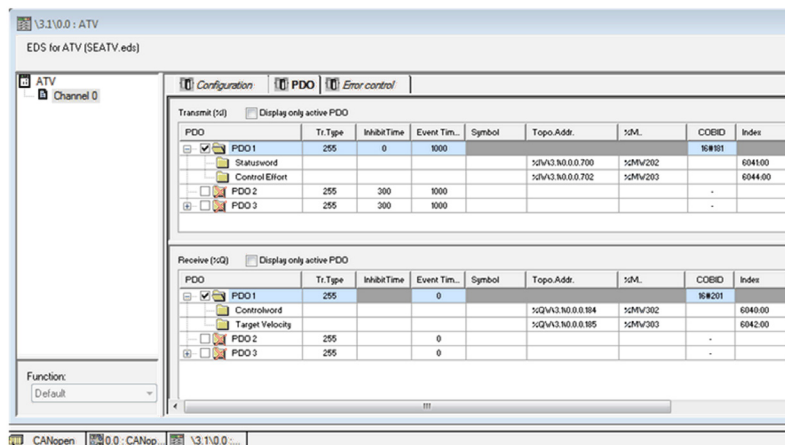


## Configuration of the Slave

Add a new device and select the drive in the catalog. The drive was previously added to the catalog by importing the EDS file of the drive.



In the example below, TPDO1 and RPDO1 are selected which provides the basic control command of the drive with the CiA402 velocity mode profile.



PDOs are linked to the %Mw variables, the mapping is automatically generated by Unity according to the index defined in the master configuration panel and to the PDOs and to the slave Node ID.

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# Chapter 5

## Operations

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### What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
5.1	Operating States	64
5.2	Operating Modes	65

## Section 5.1

### Operating States

#### Configuring Communication Error Response

##### Description

The response of the drive in the event of a CANopen communication interruption can be configured. Configuration can be performed using the display terminal from the **[Complete settings]**  $\text{C 5 E -}$ , **[Error/Warning handling]**  $\text{C 5 W \Pi -}$ , **[Communication Module]**  $\text{C 6 \Pi 6 -}$  menu via the **[CANopen Error Resp]**  $\text{C 6 L}$  submenu.

The values of the **[CANopen Error Resp]**  $\text{C 6 L}$  parameter, which triggers a drive detected error **[CANopen Com Interrupt]**  $\text{C 6 F}$  are:

Value	Meaning
<b>[Freewheel Stop]</b> $\text{y E 5}$	Freewheel stop (factory setting)
<b>[Ramp stop]</b> $\text{r \Pi P}$	Stop on ramp
<b>[Fast stop]</b> $\text{? F 5 E}$	Fast stop
<b>[DC injection]</b> $\text{d C ,}$	DC injection stop

The values of the **[CANopen Error Resp]**  $\text{C 6 L}$  parameter, which does not trigger a transition to the operating state faults are:

Value	Meaning
<b>[Ignore]</b> $\text{n 6}$	Detected error ignored
<b>[Per STT]</b> $\text{5 E E}$	Stop according to configuration of <b>[Type of stop]</b> $\text{5 E E}$
<b>[Fallback Speed]</b> $\text{L F F}$	Change to fallback speed, maintained as long as the detected error persists and the run command has not been removed
<b>[Speed maintained]</b> $\text{r L 5}$	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]**  $\text{C 5 E -}$ , **[Error/Warning handling]**  $\text{C 5 W \Pi -}$  menu, **[Fallback speed]**  $\text{L F F -}$  submenu, using the **[FallbackSpeed]**  $\text{L F F}$  parameter.

#### WARNING

##### LOSS OF CONTROL

If this parameter is set to  $\text{n 6}$ , CANopen 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.**



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## Section 5.2

### Operating Modes

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#### What Is in This Section?

This section contains the following topics:

Topic	Page
Configuring the Control Channel	66
Configuration of the Drive for Operation in I/O Profile	67
Configuration of the Drive for Operation with CiA 402 Profile in Combined Mode	68
Configuration of the Drive for Operation with CiA 402 Profile in Separate Mode	69

## Configuring the Control Channel

### Overview

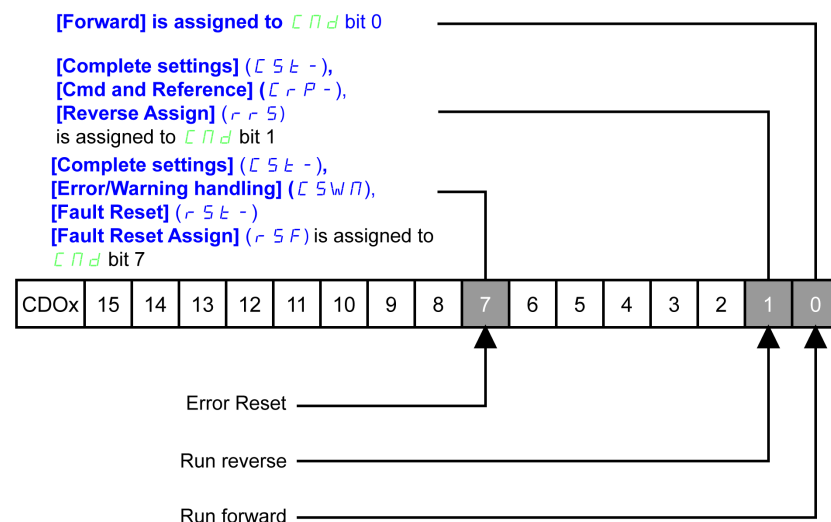
This chapter explains how to configure the drive for operation from communication network through three following examples.

- 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 come from separate sources: for example, the command (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] FR1	[HMI] HMI
[Control Mode] CLCF	[I/O profile] IO
[Command switching] CLCS	Default
[Cmd channel 1] CLC1	[CANopen] CLCN

The bits of the command word can now be configured.

In the [Command and Reference] CRP- menu configure:

[Reverse Assign] RRS	[CD01] CLD01
----------------------	--------------

In the [Error/Warning handling] CSWN- menu, [Fault reset] RSK-?submenu, configure:

[Fault Reset Assign] RSF	[CD07] CLD07
--------------------------	--------------

## 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 are detailed in the drive programming manual.

In the **[Complete settings] CSE-?** menu, **[Command and reference] C r P -** submenu:

- **[Ref Freq Channel 1] 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
CANopen	<b>[CANopen] C R n</b>

- **[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).

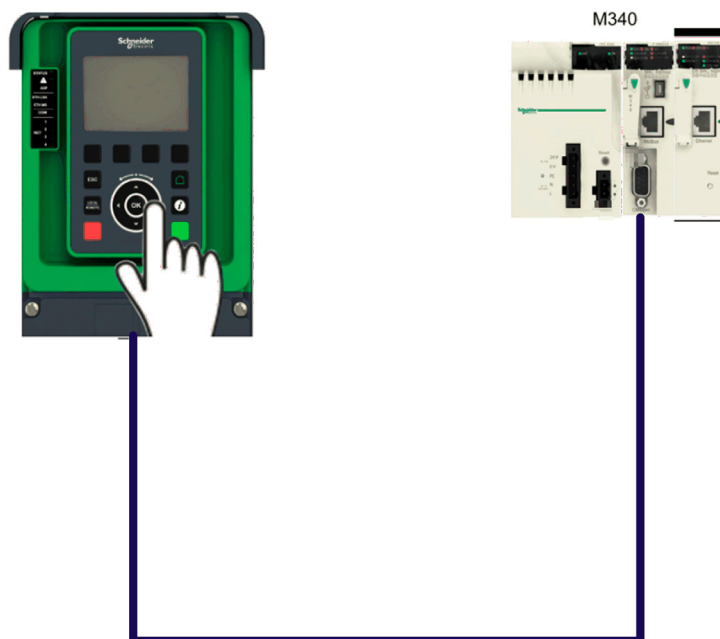
For the current example, **[Control Mode] C H C F** is adjusted to **[Not separ.] S , n** as reference and control are originated from the communication network:

Profile	Ref1 Channel setting
CiA 402 combined mode	<b>[Not separ.] S , n</b>
CiA 402 separate mode	<b>[Separate] S E P</b>
I/O profile	<b>[I/O profile] , o</b>

## 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 communication (CANopen) but the reference value is adjusted on the display 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] <i>F r I</i>	[AI1] <i>R i I</i>
[Control Mode] <i>C H C F</i>	[Separate] <i>S E P</i>
[Cmd channel 1] <i>C d I</i>	[CANopen] <i>C R n</i>
[Freq Switch Assign] <i>r F C</i>	Factory setting



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# Chapter 6

## Diagnostics and Troubleshooting

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### What Is in This Chapter?

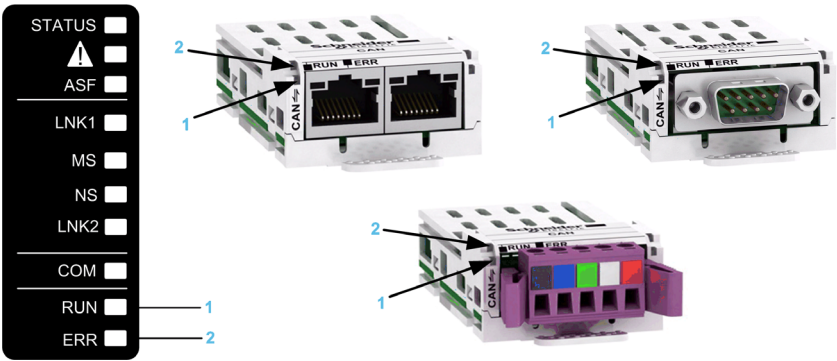
This chapter contains the following topics:

Topic	Page
Fieldbus Status LEDs	72
Connection for Fieldbus Mode	75
Monitoring of Communication Channel	76
Control-Signal Diagnostics	78

Fieldbus Status LEDs

LED Indicators

The following figure describes the LEDs status for the module::



LED Description

Item	LED	Description
1	CAN_RUN	CANopen status
2	CAN_ERR	CANopen error

CANopen Status

This LED indicates the CANopen status:

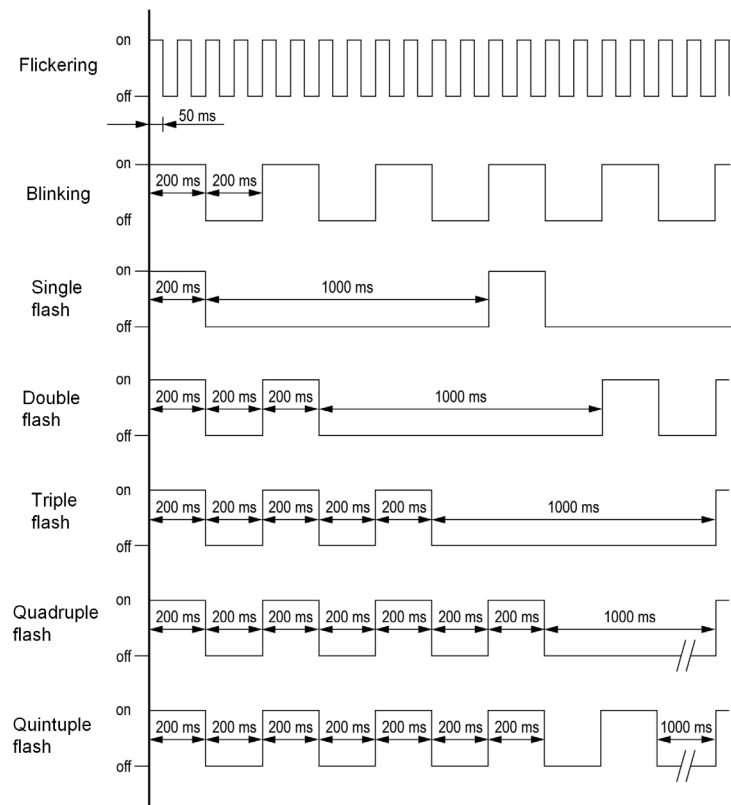
Color & Status	Description
OFF	The CANopen controller is in OFF state
Green single flash	The Altivar 9xx is in STOPPED state
Green blinking	The Altivar 9xx is in PRE-OPERATIONAL state
Green ON	The Altivar 9xx is in OPERATIONAL state



## Error Status

This LED indicates the CANopen error status:

Color & Status	Description
OFF	No detected error reported
Red single flash	Detected error reported by the CANopen controller of the Altivar 9xx (example: too many detected error frames)
Red double flash	Detected error due to the occurrence of a Node Guarding or a Heartbeat event
Red ON	The CANopen controller is in Bus OFF state



## NMT Chart

The **[CANopen NMT state]**  $n \pi E 5$  parameter (logic address 6057, CANopen index/subindex 201E hex/3A) indicates the NMT chart state. The various possible values are **[Boot]**, **[Stopped]**, **[Operation]** and **[Pre-op]** (Pre-operational).

This parameter is accessible in the **[Display]**  $\pi \alpha n - \rightarrow$  **[Communication map]**  $\mathcal{L} \pi \pi - \rightarrow$  **[CANopen map]**  $\mathcal{L} n \pi -$  menu.

## PDO Counter

**[Number of RX PDO]**  $n b r P$  and **[Number of TX PDO]**  $n b t P$  indicate the number of PDOs received and the number of PDOs transmitted by the drive (all PDO sets - PDO1, PDO2, and PDO3 - combined).

The values of the counters are reset to zero once 65535 is reached.

This parameter is accessible in the **[Display]**  $\pi \alpha n - \rightarrow$  **[Communication map]**  $\mathcal{L} \pi \pi - \rightarrow$  **[CANopen map]**  $\mathcal{L} n \pi -$  menu.

## Last CANopen Detected Error

The **[Error code] E r C o** parameter (index/subindex 201E hex/39) indicates the last active CANopen detected error and maintains its value until the last detected error has been cleared.

This parameter is accessible:

- in the **[Display] n o n** → **[Communication map] C n n** → **[CANopen map] C n n** - menu
- in the **[Communication] C o n** → **[Comm Parameters] C n P** → **[CANopen] C n o** - menu.

The possible values are listed below:

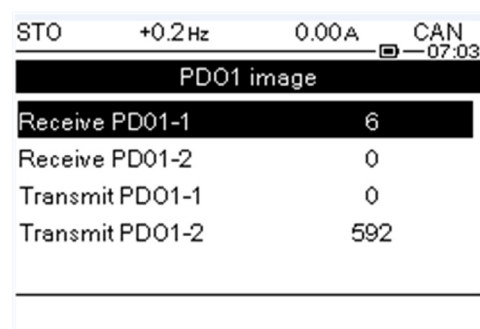
Display	Description
[0]	No errors detected since the start of CANopen communication.
[1]	Bus off.
[2]	Node guarding error requiring a return to the NMT initialization state.
[3]	CAN overrun.
[4]	Heartbeat error requiring a return to the NMT initialization state.
[5]	NMT state chart error

## PDO Value Display

The value of parameters mapped in PDOs can be displayed using **[PDO1 image] P o 1** -, **[PDO2 image] P o 2** - and **[PDO3 image] P o 3** - submenus.

These submenus are available in **[Display] n o n** → **[Communication map] C n n** → **[CANopen map] C n n** - menu.

The following figure shows the content of **[PDO1 image] P o 1** - submenu:



ST0	+0.2Hz	0.00A	CAN	07:03
PDO1 image				
Receive PDO1-1	6			
Receive PDO1-2	0			
Transmit PDO1-1	0			
Transmit PDO1-2	592			

**NOTE:** In each of these screens and for each PDO transmitted or received, only the **[Transmit PDOo-o]** or **[Received PDOo-o]** words transmitted and received on the CANopen bus are displayed. This means, for example, PDO2 containing only 4 data bytes (that is, RP21 and RP22), the fields **[Received PDO2-3]** and **[Received PDO2-4]** are not displayed.

## 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.

## Monitoring of Communication Channel

### Command and Reference Channels

All the drive command and reference 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	<i>C N d</i>	<i>C N d 1</i>	<i>C N d 2</i>	<i>C N d 3</i>	<i>C N d 5</i>
Extended control word	<i>C N ,</i>	<i>C N , 1</i>	<i>C N , 2</i>	<i>C N , 3</i>	<i>C N , 5</i>
Reference speed (rpm)	<i>L F d</i>	<i>L F d 1</i>	<i>L F d 2</i>	<i>L F d 3</i>	<i>L F d 5</i>
Reference frequency (0.1 Hz)	<i>L F r</i>	<i>L F r 1</i>	<i>L F r 2</i>	<i>L F r 3</i>	<i>L F r 5</i>
Reference for torque control mode (0.1% of the normal torque)	<i>L t r</i>	<i>L t r 1</i>	<i>L t r 2</i>	<i>L t r 3</i>	<i>L t r 5</i>
Reference value supplied by PI controller	<i>P , S P</i>	<i>P , r 1</i>	<i>P , r 2</i>	<i>P , r 3</i>	<i>P , r 5</i>
Reference value supplied by analog multiplier function	<i>Π F r</i>	<i>Π F r 1</i>	<i>Π F r 2</i>	<i>Π F r 3</i>	<i>Π F r 5</i>

### Monitoring of Communication Channels

Communication channels are monitored if they are involved in one of the following parameters:

- The control word ([**Cmd Register**] *C N 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**] *S A 2*)
- Summing reference frequency or reference speed ([**Ref Frequency**] *L F r* or LFRD: Nominal speed value) 3 (assigned to [**Summing Input 3**] *S 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 , u 1*)
- The multiplication coefficient of the reference values ([**Multiplying coeff.**] *Π F r*) 2 (assigned to [**Ref Freq 2 Multiply**] *Π A 2*)
- The multiplication coefficient of the reference values ([**Multiplying coeff.**] *Π F r*) 3 (assigned to [**Ref Freq 3 Multiply**] *Π 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 value 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 value 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 warning.
- In forced local mode.
  - NOTE:** On exiting forced local mode:
    - The drive copies the run commands, the direction, and the forced local reference value to the active channel (maintained).
    - Monitoring of the active channels for the command and reference value 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 value and the command from the active channels.

## Control-Signal Diagnostics

## Introduction

On the display terminal, the **[Display]**  $\Pi \alpha \alpha$  -, **[Communication map]**  $\zeta \Pi \Pi$  - submenu can be used to display control-signal diagnostic information between the drive and the controller:

- Active command channel **[Command Channel]**  $\mathcal{L} \mathcal{N} \mathcal{d} \mathcal{L}$
- Value of the control word **[Cmd Register]**  $\mathcal{L} \mathcal{N} \mathcal{d}$  from the active command channel **[Command Channel]**  $\mathcal{L} \mathcal{N} \mathcal{d} \mathcal{L}$
- Active reference frequency channel **[Ref Freq Channel]**  $\mathcal{r} \mathcal{F} \mathcal{L} \mathcal{L}$
- Value of the reference frequency **[Pre-Ramp Ref Freq]**  $\mathcal{F} \mathcal{r} \mathcal{H}$  from the active target channel **[Ref Freq Channel]**  $\mathcal{r} \mathcal{F} \mathcal{L} \mathcal{L}$
- Value of the operating state word **[CIA402 State Reg]**  $\mathcal{E} \mathcal{L} \mathcal{H}$
- Specific data for all available fieldbus are in dedicated submenus.
- In the **[Command word image]**  $\mathcal{L} \mathcal{W} \mathcal{r}$  - submenu: control words from all channels
- In the **[Freq. ref. word map]**  $\mathcal{r} \mathcal{W} \mathcal{r}$  - submenu: reference frequency values produced by all channels

## Control Word Display

The **[Command Channel]**  $\mathbb{C} \cap \mathbb{D} \mathbb{C}$  parameter indicates the active command channel.

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

The **[Command word image]**  $\mathcal{C}W$  , - submenu (**[COM. Module cmd.]**  $\mathcal{C} \Pi d \exists$ ) parameter is used to display the hexadecimal value of the control word from the fieldbus module.

### Reference Frequency Display

The **[Ref Freq Channel]**  $r F [ ]$  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]**  $rW$  - submenu (**[Com Module Ref Freq]**  $LFr\exists$  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 L H* parameter gives the value of the operating state word (ETA).

The table provides the bit details of  $E \leq R$  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 <b>STOP</b> key
Bit15 = 0	Motor rotation in forward direction (or stopped)



## A

### Abbreviations

Req. = Required

Opt. = Optional

## C

### CAN

Controller Area Network is an internally standardized serial bus system

### COB

Communication Object. A unit of transportation in a CAN network. Data must be sent across a CAN Network inside a COB. There are 2048 different COB's in a CAN network. A COB can contain at most 8 bytes of data.

### COB ID

Each COB is uniquely identified in a CAN network by a number called the COB Identifier (COB-ID).

## D

### Display terminal

The display terminal menus are shown in square brackets.

For example: **[Communication]**

The codes are shown in round brackets.

For example: **[ C a n ]** -

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

Default configuration of the product.

### 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.

## L

### LSB

Least Significant Byte

**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.

**MSB**

Most Significant Byte

**N****NMT**

Network Management. One of the service elements of the application layer in the CAN Reference Model. The NMT serves to configure, initialize, and handle detected errors in a CAN network.

**P****Parameter**

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

**PDO**

Process Data Object

**PELV**

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

**PLC**

Programmable logic controller

**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.

**R****RPDO**

Receive PDO

**S****SYNC**

Synchronization Object

**T****TPDO**

Transmit PDO

**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.



**Z****Zone of operation**

This term is used in conjunction with the description of specific hazards, and is defined as it is for a **hazard zone** or **danger zone** in the EC Machinery Directive (2006/42/EC) and in ISO 12100-1.





