

Easy Altivar ATV610

Variable Speed Drives

Modbus Serial Link Manual (Embedded)

EAV64395.03
10/2024



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Safety information and About the Book

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Safety Information

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Important Information

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 intended for industrial use according to this manual.

The product may only be used in compliance with all applicable safety standard and local regulations and directives, the specified requirements and the technical data. The product must be installed outside the hazardous ATEX zone. 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.

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 fully understand the contents of the present manual and all other pertinent product documentation and who have received all necessary 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.
- Verify compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Only use properly rated, electrically insulated tools and measuring equipment.
- Do not touch unshielded components or terminals with voltage present.
- Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- 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.

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

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Before performing work on the drive system:

- Disconnect all power, including external control power that may be present. Take into account that the circuit breaker or main switch does not de-energize all circuits.
- Place a "Do Not Turn On" label on all power switches related to the drive system.
- Lock all power switches in the open position.
- Wait 15 minutes to allow the DC bus capacitors to discharge.
- Verify the absence of voltage. (1)

Before applying voltage to the drive system:

- Verify that the work has been completed and that the entire installation cannot cause hazards.
- If the mains input terminals and the motor output terminals have been grounded and short-circuited, remove the ground and the short circuits on the mains input terminals and the motor output terminals.
- Verify proper grounding of all equipment.
- Verify that all protective equipment such as covers, doors, grids is installed and/or closed.

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

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. This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER**POTENTIAL FOR EXPLOSION**

Install and use this equipment in non-hazardous locations only.

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

Product may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.

⚠ WARNING**UNANTICIPATED EQUIPMENT OPERATION**

- 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.

⚠ 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.

The temperature of the products described in this manual may exceed 80 °C (176 °F) during operation.

⚠ WARNING**HOT SURFACES**

- Ensure that any contact with hot surfaces is avoided.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces.
- Verify that the product has sufficiently cooled down before handling it.
- Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions.

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

Machines, controllers, and related equipment are usually integrated into networks. Unauthorized persons and malware may gain access to the machine as well as to other devices on the network/fieldbus of the machine and connected networks via insufficiently secure access to software and networks.

⚠ WARNING**UNAUTHORIZED ACCESS TO THE MACHINE VIA SOFTWARE AND NETWORKS**

- In your hazard and risk analysis, consider all hazards that result from access to and operation on the network/fieldbus and develop an appropriate cyber security concept.
- Verify that the hardware infrastructure and the software infrastructure into which the machine is integrated as well as all organizational measures and rules covering access to this infrastructure consider the results of the hazard and risk analysis and are implemented according to best practices and standards covering IT security and cyber security (such as: ISO/IEC 27000 series, Common Criteria for Information Technology Security Evaluation, ISO/ IEC 15408, IEC 62351, ISA/IEC 62443, NIST Cybersecurity Framework, Information Security Forum - Standard of Good Practice for Information Security, SE recommended Cybersecurity Best Practices*).
- Verify the effectiveness of your IT security and cyber security systems using appropriate, proven methods.

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

(*) : SE Recommended Cybersecurity Best Practices can be downloaded on [SE.com](https://www.se.com).

⚠ WARNING**LOSS OF CONTROL**

Perform a comprehensive commissioning test to verify that communication monitoring properly detects communication interruptions.

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

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

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Validity note

Original instructions and information given in the present document have been written in English (before optional translation).

This documentation is valid for the Altivar Easy ATV610 drives.

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

Step	Action
1	Go to the Schneider Electric home page www.se.com .
2	In the Search box type the reference of the product or the name of a product range. <ul style="list-style-type: none"> • Do not include blank spaces in the reference or 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.

Document Scope

The purpose of this document is to:

- Show you how to connect the Modbus Serial Link fieldbus on your drive.
- Show you how to configure the drive to use the Modbus Serial Link embedded for monitoring and control.
- Provide examples of setup using Modbus Serial Link communication.

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

ATV610 Related Documents

Use your tablet or your PC to quickly access detailed and comprehensive information on all our products on www.se.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:

(Other option manuals and Instruction sheets are available on www.se.com)

Title of Documentation	Reference number
Easy Altivar ATV610 Catalog	DIA2ED2140702EN (English)
Easy Altivar ATV610 Getting Started	EAV64374 (English) EAV64379 (Chinese)
Easy Altivar ATV610 Installation Manual	EAV64381 (English) EAV64386 (Chinese)
Easy Altivar ATV610 Programming Manual	EAV64387 (English) EAV64393 (Chinese)
Easy Altivar ATV610 Communication Parameters File	EAV64394 (English)
Easy Altivar ATV610 Modbus Manual	EAV64395 (English) EAV64395CN (Chinese)
Easy Altivar ATV610 PROFIBUS DP manual	EAV64396 (English)
Recommended Cybersecurity Best Practices	CS-Best-Practices-2019-340 (English)

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

Electronic product data sheet

Scan the QR code in front of the drive to get the product data sheet.



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
- 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
- IEC 62443: Security for industrial automation and control systems

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.

Contact us

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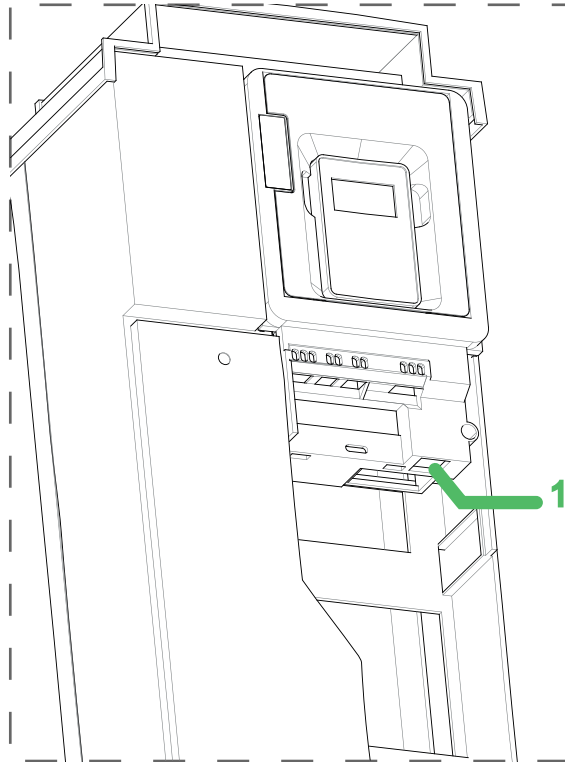
Presentation

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Hardware Overview

General



1 Modbus serial communication port

Software Overview

Supported Modbus Functions

The device supports the following Modbus functions:

Function Name	Code		Description	Remarks
	Dec.	Hex		
<i>Read Holding Registers</i>	03	03 hex	Read N output words	Maximum PDU length: 63 words
<i>Write One Output Word</i>	06	06 hex	Write 1 output word	–
<i>Diagnostics</i>	08	08 hex	Diagnostics	–
<i>Write Multiple Registers</i>	16	10 hex	Write N output word	Maximum PDU length: 61 words
<i>Read/write Multiple Registers</i>	23	17 hex	Read/write multiple registers	Maximum PDU length: 20 words (R), 20 words (W)
(Subfunction) <i>Read Device Identification</i>	43/14	2B hex/ 0E hex	Encapsulated interface transport/ Read device identification	–

Basics

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Profile

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Profile

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 Altivar 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 fieldbus module control word

The I/O profile is supported by the drive itself and therefore in turn by all the communication ports.

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.

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:

- **Separated channel mode [Separate]** `SEP`
- **Combined channel mode [Not separ.]** `SIM`,

Functional Description

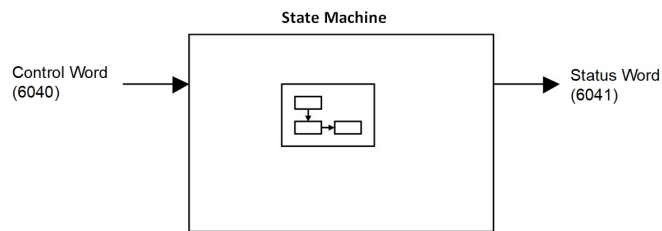
Introduction

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

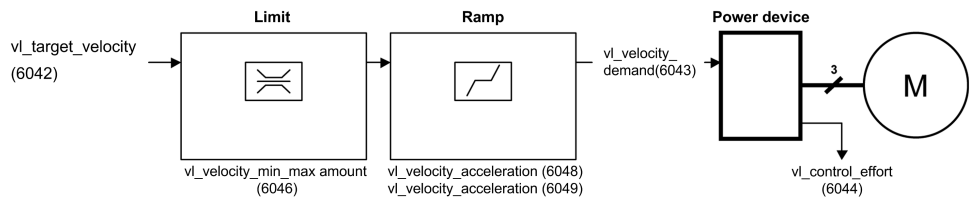
CiA402

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:



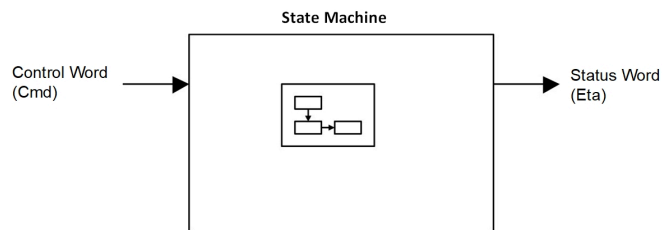
Simplified diagram for speed control in *Velocity* mode:



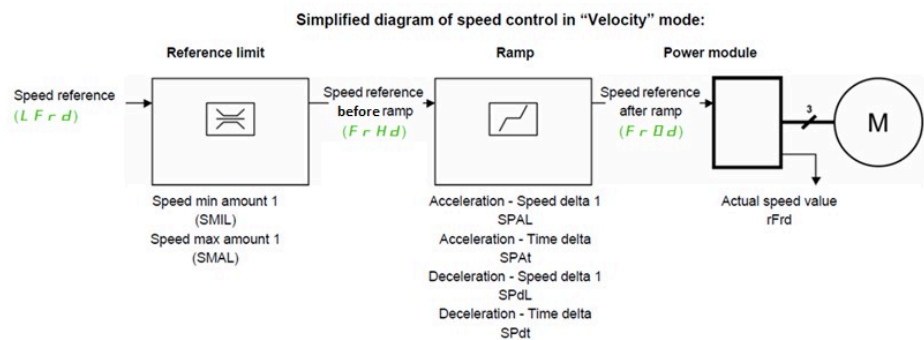
Altivar Drive

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:



Description of Operating States

Each state represents an internal reaction by the drive.

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

The drive operating state can be identified by the value of the status word **[Status Register] ETA**.

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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 <code>Halt</code> command is applied, no power is supplied to the motor and no torque is applied. To perform [Autotuning] TUN, the drive must be in state 5 - Operation enabled. The adjustment parameters can be modified. The configuration parameters cannot be modified. <p>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.</p> <ul style="list-style-type: none"> The reaction of the drive to a <code>Disable operation</code> command depends on the value of the [SwitchOnDisable Stp] DOTD parameter: <ul style="list-style-type: none"> If the [SwitchOnDisable Stp] DOTD parameter is set to 0, the drive changes to operating state 4 - Switched on and stops in freewheel stop. If the [SwitchOnDisable Stp] DOTD 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	<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. During fast stop, the drive is unlocked and power is supplied to the motor.</p> <p>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 [Fast stop then stay in quick stop state] 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 [Fast stop then disable voltage] FST6, the drive stops according to the fast stop ramp and then remains in state 6 - Quick stop active until:</p>
7 - Fault reaction active	Transient state during which the drive performs an action corresponding to the selected error response.
8 - Fault	<ul style="list-style-type: none"> • Error response terminated. Power stage is disabled. • The drive is locked, no power is supplied to the motor.

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

NOTE:

- Configuration parameters are described in communication parameter file as R/WS access type parameters. Other parameters can be accessed whatever the operating state.
- An adjustment parameter can be accessed in all operating state of the drive.

Command Register CMD

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 assignable 0 = Forward direction asked 1 = Reverse direction asked	Reserved (=0)	Reserved (=0)	Halt
							Halt

Command	State Transition	Final Operating State	Bit 7	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]** `STT` parameter.

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

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 operating state `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	Modbus Serial
Bit 11	C111
Bit 12	C112
Bit 13	C113
Bit 14	C114
Bit 15	C115

For example, to assign the DC injection braking to bit13 of Modbus serial, simply configure the **[DC injection]** `DCI` parameter with the **[C113]** `0113` value.

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

[CIA402 State Reg] ETA

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	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	ETA Masked by 006F H ⁽¹⁾
	Switch On Disabled	Quick Stop	Voltage Enabled	Fault	Operation Enabled	Switched On	Ready to Switch On	
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	1	0	1	1	1	0027 hex
6 -Quick stop active	0	0	1	0	1	1	1	0007 hex
7 -Fault reaction active	0	X	X	1	1	1	1	002F hex
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.

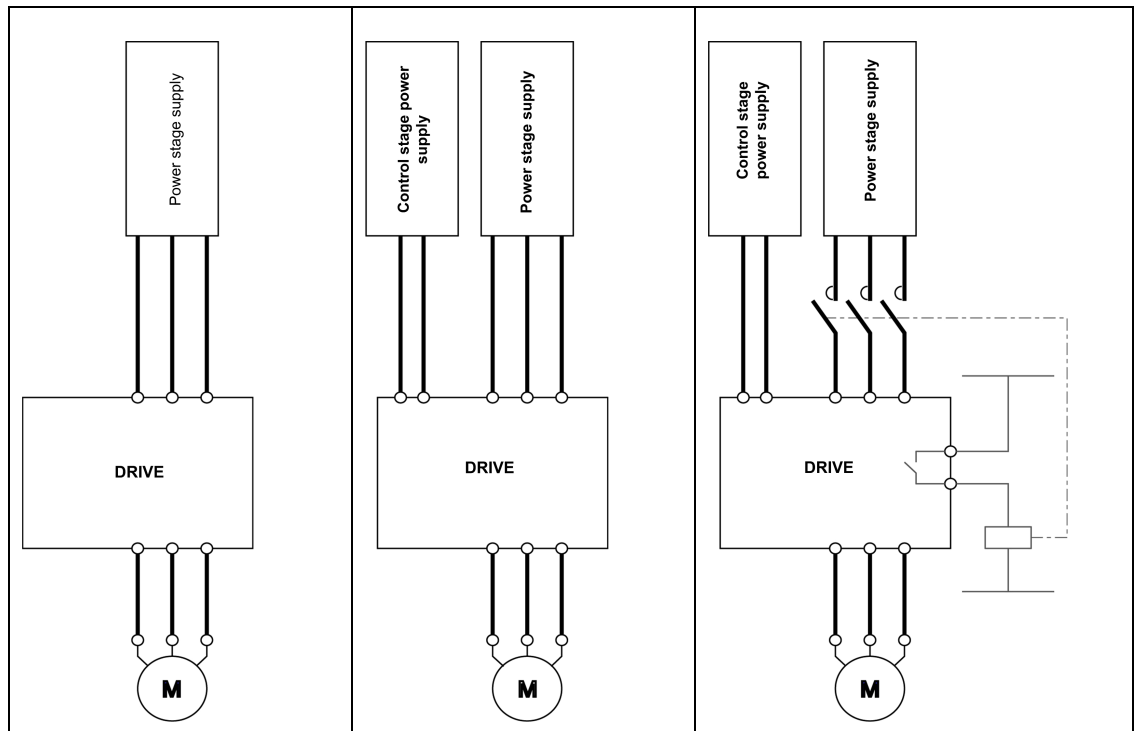
X: In this state, the value of the bit can be 0 or 1.

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.			

Starting Sequence for a Drive Powered by the Power Stage Supply

Description

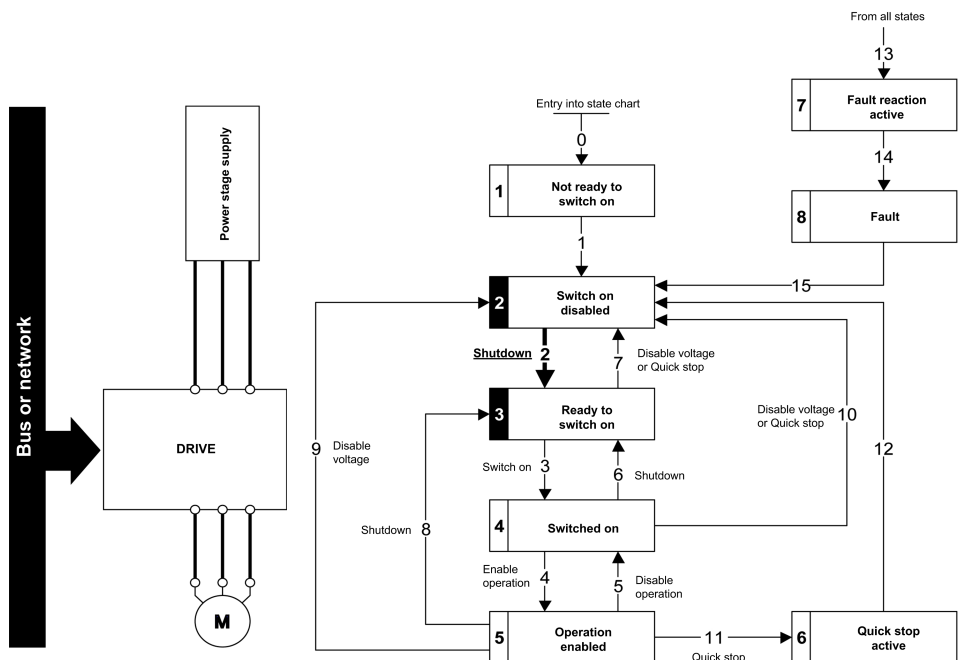
Both the power and control stages are powered by the power stage supply.

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:

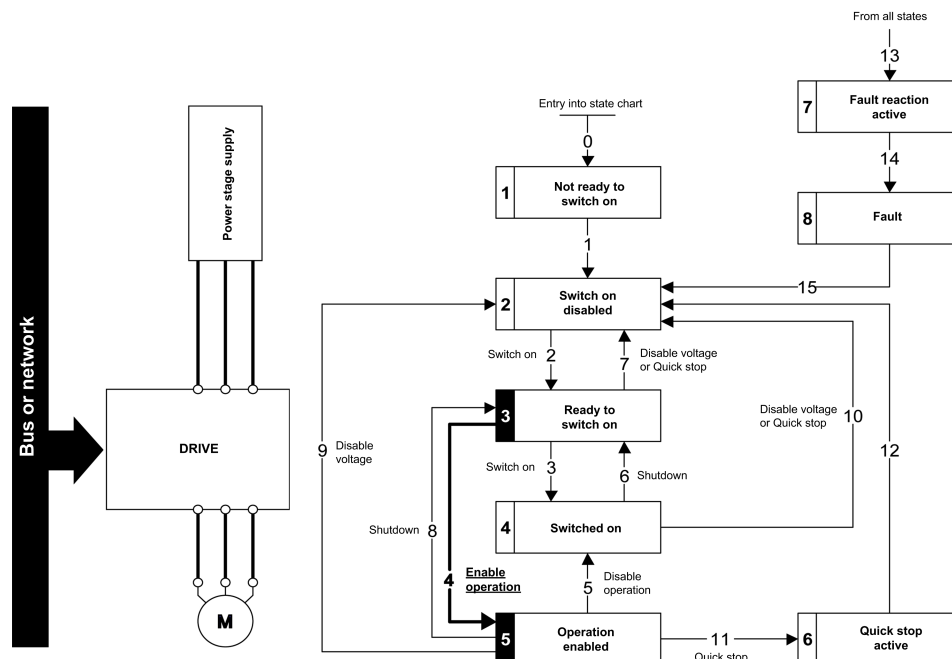
Step 1

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.

Starting Sequence for a Drive with Separate Control Stage

Description

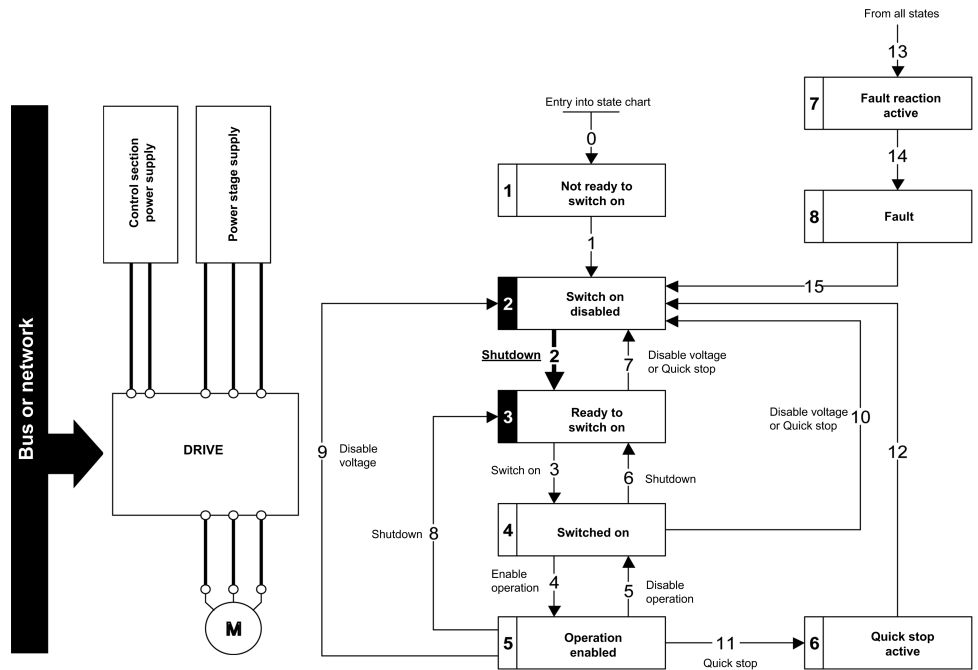
Power is supplied separately to the power and control stages.

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

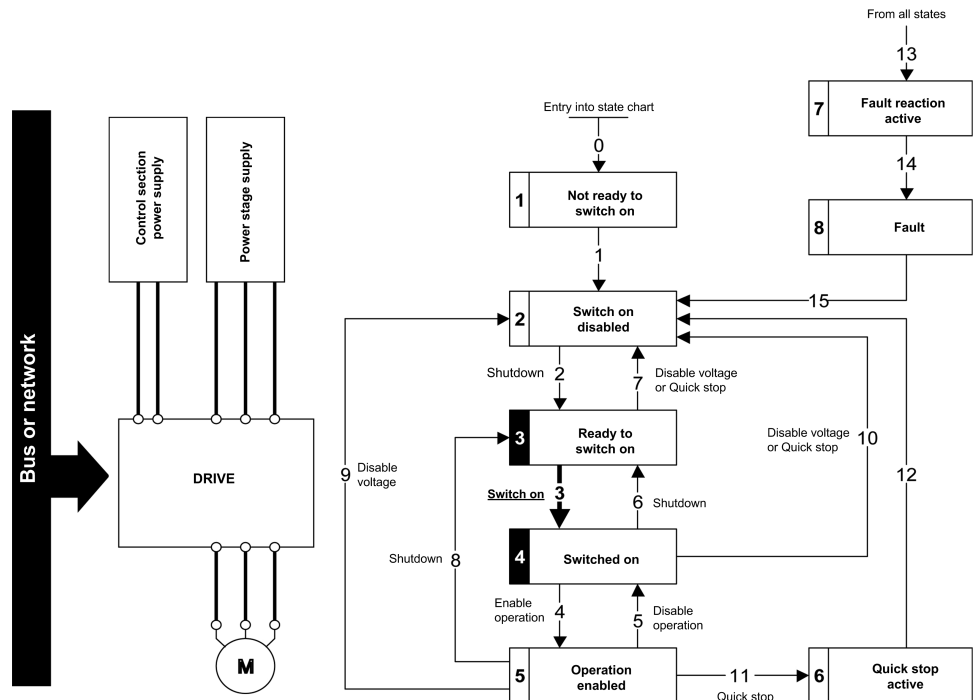


Step 2

- 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).

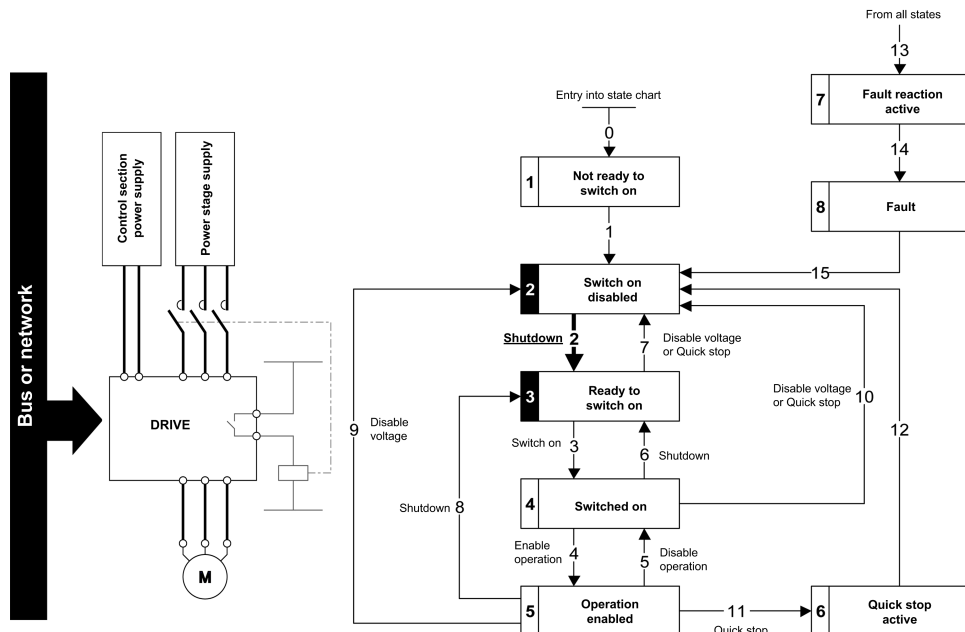
Power Stage Supply	HMI Panel	Status Word
Not present	[No Mains Voltage] NLP	21 hex
Present	[Ready] RDY	31 hex

- Apply the 3 - *Switch on* command



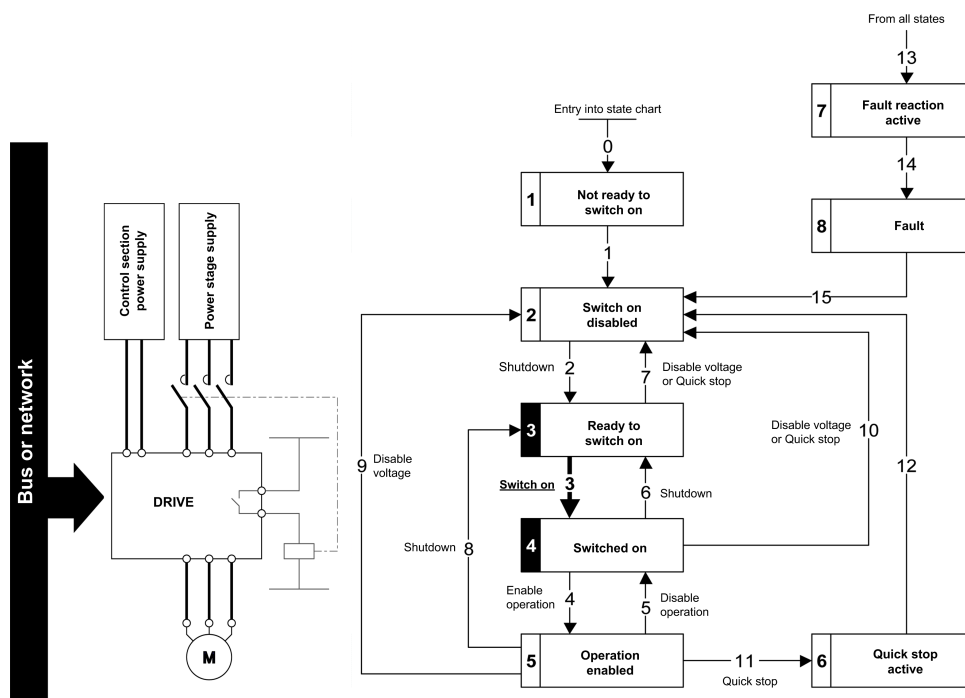
Step 1

- 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.



Modbus Functions

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Modbus Protocol

Introduction

The transmission mode used is RTU. The frame does not contain message header and end of message bytes.

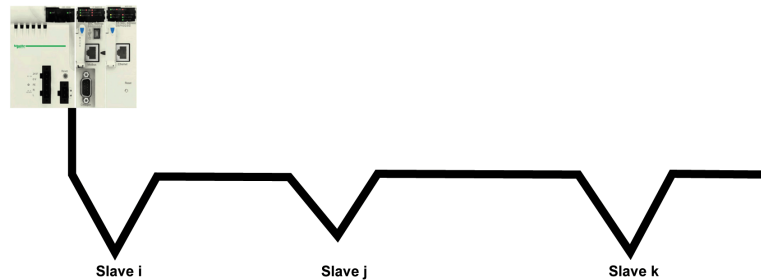
Device address	Request code	Data	CRC16
----------------	--------------	------	-------

The data is transmitted in binary code.

The end of the frame is detected on a silence greater than or equal to three characters.

Principle

The Modbus protocol is a controller/device protocol



Only one device can transmit on the line at any time.

The controller manages the exchanges and only it can take the initiative.

It interrogates each of the devices in succession

No device can send a message unless it is invited to do so.

The controller repeats the question when there is an incorrect exchange, and declares the interrogated device absent if no response is received within a given time period.

If a device does not understand a message, it sends an exception response to the controller. The controller may or may not repeat the request.

Direct device-to-device communications are not possible.

For device-to-device communication, the application software must therefore be designed to interrogate a device and send back data received to the other device.

The 2 types of dialogue are possible between controller and devices:

- The controller sends a request to a device and waits for its response
- The controller sends a request to all devices without waiting for a response (broadcasting principle)

Addresses

Address specification:

- The device Modbus address can be configured from 1 to 247.
- Address 0 coded in a request sent by the controller is reserved for broadcasting. Devices take account of the request, but do not respond to it.

Supported Modbus Functions

Introduction

The drive supports the following Modbus functions:

Function Name	Code		Description	Remarks
	Dec.	Hex		
<i>Read Holding Registers</i>	03	03 hex	Read N output words	Maximum PDU length: 125 words
<i>Write One Output Word</i>	06	06 hex	Write 1 output word	–
<i>Write Multiple Registers</i>	16	10 hex	Write N output word	Maximum PDU length: 123 words
<i>Read/write Multiple Registers</i>	23	17 hex	Read/write multiple registers	Maximum PDU length: 20 words (W), 20 words (R)
(Subfunction) <i>Read Device Identification</i>	43/14	2B hex/ 0E hex	Encapsulated interface transport/ Read device identification	–
<i>Diagnostics</i>	08	08 hex	Diagnostics	–

Read Holding Registers (03 hex)

This function code is used to read the contents of a contiguous block of holding registers in a remote device.

The Request PDU specifies the starting register address and the number of registers. In the PDU Registers are addressed starting at zero. Therefore registers numbered 1-16 are addressed as 0-15.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Request

Function code	1 byte	03 hex
Starting address	2 bytes	0000 hex...FFFF hex
Quantity of registers	2 bytes	1 to 63 (0x3F)

Response

Function code	1 byte	03 hex
Byte count	1 byte	2 x N ⁽¹⁾
Register value	N ⁽¹⁾ x 2 bytes	-
⁽¹⁾ N: Quantity of registers		

Detected error

Detected error code	1 byte	83 hex
Exception code	1 bytes	01...04

Then, here an example of a request to read registers @3102 to @3105:

Code	Name	Logic Address
SFr	Switching frequency (Hz)	0C1E hex= 3102
tFr	Maximum output frequency (Hz)	0C1F hex= 3103
HSP	High speed (Hz)	0C20 hex= 3104
LSP	Low speed (Hz)	0C21 hex= 3105

Read these 4 words in device address 02 hex, using function 03 hex:

Request

device no.	Function Code	Number of first word	Number of words	CRC16
02	03	0C1E	004	276C

Response

device no.	Function Code	Number of bytes read	First word value	Second word value	Third word value	Last word value	CRC16
02	03	08	0028	0258	01F4	0000	52B0
	Value of:	-	@3102	@3103	@3104	@3105	-
	Parameters:	-	IN	LCS	BST	TBS	-

Analyzed:

Code	Read		Result
	hex	dec.	
SFr	0028 hex	40	Switching frequency at 40 Hz.
tFr	0258 hex	600	Maximum output frequency at 600 Hz.
HSP	01F4 hex	500	High speed at 500 Hz.
LSP	0000 hex	0	Low speed at 0 Hz.

Write 1 Output Word (06 hex)

This function code is used to write a single holding register in a remote device.

The Request PDU specifies the address of the register to be written. Registers are addressed starting at zero. Therefore register numbered 1 is addressed as 0.

The normal response is an echo of the request, returned after the register contents have been written.

Request

Function code	1 byte	06 hex
Register address	2 bytes	0000 hex...FFFF hex
Register value	2 bytes	0000 hex...FFFF hex

Response

Function code	1 byte	06 hex
Register address	2 bytes	0000 hex...FFFF hex
Register value	2 bytes	0000 hex...FFFF hex

Detected error

Detected error code	1 byte	86 hex
Exception code	1 bytes	01...04

Then, here an example of a request to write register @9001:

Write on:

Code	Name	Logic Address
ACC	Acceleration ramp time (s)	2329 hex= 9001

Write value 000D hex in device address 02 hex:

Code	Write	
	hex	dec.
ACC	000D hex	13

Request:

device no.	Function Code	Word number	Value of word	CRC16
02	06	2329	000D	9270

Response:

device no.	Function Code	Word number	Value of word	CRC16
02	06	2329	000D	9270

Analyzed:

Code	Read		Result
	hex	dec.	
ACC	000D hex	13	ACC = 13 s

Write Multiple Register (10 hex)

This function code is used to write a block of contiguous registers (1 to 123 registers) in a remote device.

The requested written values are specified in the request data field. Data is packed as two bytes per register.

The normal response returns the function code, starting address, and quantity of registers written.

Request

Function code	1 byte	10hex
Register address	2 bytes	0000 hex...FFFF hex
Register value	2 bytes	0000 hex...FFFF hex

Response

Function code	1 byte	10 hex
Register address	2 bytes	0000 hex...FFFF hex
Register value	2 bytes	0000 hex...FFFF hex

Detected error

Detected error code	1 byte	90 hex
Exception code	1 bytes	01...04

Then, here an example of a request to write registers @9001 and @9002:

Write on:

Code	Name	Logic Address
ACC	Acceleration ramp time (s)	2329 hex= 9001
DEC	Deceleration ramp time (s)	2330 hex= 9002

Write values on device address 02 hex:

Code	Write	
	hex	dec.
ACC	0014 hex	20
DEC	001E hex	30

Request

device no.	Request code	No. of first word	Number of words	Number of bytes	Value of first word	Value of Second word	CRC16
02 hex	10 hex	2329 hex	0002 hex	04 hex	0014 hex	001E hex	B60D hex

Response

device no.	Response code	No. of first word	No. of words	CRC16
02 hex	10 hex	2329 hex	0002 hex	0BA0 hex

Analyzed:

Code	Read		Result
	hex	dec.	
ACC	0014 hex	20	ACC = 20 s
DEC	001E hex	30	DEC = 30 s

Read/Write Multiple Registers (17 hex)

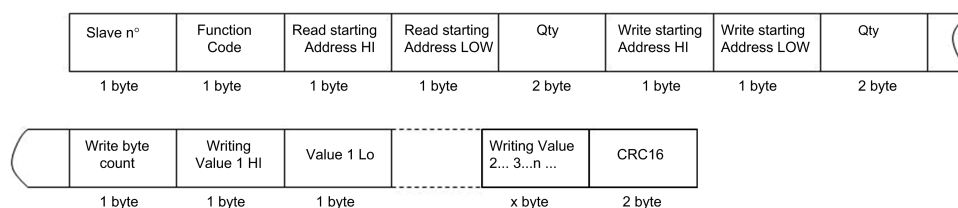
This function code performs a combination of one read operation and one write operation in a single MODBUS transaction. The write operation is performed before the read. Holding registers are addressed starting at zero. Therefore holding registers 1-16 are addressed in the PDU as 0-15.

The request specifies the starting address and number of holding registers to be read as well as the starting address, number of holding registers, and the data to be written. The byte count specifies the number of bytes to follow in the write data field.

The normal response contains the data from the group of registers that were read. The byte count field specifies the quantity of bytes to follow in the read data field.

For example

Description	Length in Byte	Value	Comment
Function code	1	17 hex	-
Read starting address	2	XXXX hex	Modbus address
Quantity	2	03 hex	Contain number of holding registers to be read
Write starting address	2	XXXX hex	Modbus address
Quantity	2	03 hex	Contain number of holding registers to be written
Write byte count	1	06 hex	The byte count specifies the number of bytes to follow in the field write register value
Write registers value	6	XXXXXX XXXXXX hex	Address to be written respectively in NCA1 to NCA3. For example: CMD, LFRD, CMI



Read Device Identification (2B hex/0E hex)

This function code allows reading the identification and additional information relative to the physical and functional description of a remote device, only.

The Read Device Identification interface is modeled as an address space composed of a set of addressable data elements. The data elements are called objects and an object Id identifies them.

The interface consists of 3 categories of objects :

- **Basic Device Identification:**
All objects of this category are mandatory : VendorName, Product code, and revision number.
- **Regular Device Identification:**
In addition to Basic data objects, the device provides additional and optional identification and description data objects. All of the objects of this category are defined in the standard but their implementation is optional.
- **Extended Device Identification:**
In addition to regular data objects, the device provides additional and optional identification and description private data about the physical device itself. All of these data are device dependent.

The table provides the device identification details:

ID	Name / Description	Type
00 hex	VendorName	ASCII String
01 hex	ProductCode	ASCII String
02 hex	MajorMinorRevision	ASCII String
06 hex	ProductName	ASCII String

Request

device no.	Function Code (2B)	Type of MEI	Read Device Id	Object Id	CRC16	
					Lo	Hi
1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes	

Response

device no.	2B	Type of MEI	Read Device Id	Degree of conformity
1 byte	1 byte	1 byte	1 byte	1 byte

Example

Number of additional frames	Next object Id	Number of objects
00	00	03
1 byte	1 byte	1 byte

Id of object number 1	Length of object number 1	Value of object number 1
00	12	Schneider Electric
1 byte	1 byte	18 bytes

Id of object number 2	Length of object number 2	Value of object number 2
01	0B	ATV6xxxxxxxxATV9xxxxxxxx
1 byte	1 byte	11 bytes

Id of object number 3	Length of object number 3	Value of object number 3
02	04	0201
1 byte	1 byte	4 bytes

CRC16	
Lo	Hi
1 byte	1 byte

The total response size equals 49 bytes

The three objects contained in the response correspond to the following objects:

- Object number 1: Manufacturer name (always **Schneider Electric**, that is. 18 bytes).
- Object number 2: Device reference (ASCII string; for example, **ATV6xxxxxxxxATV9xxxxxxxx**, that is. 11 bytes).
- Object number 3: Device version, in **MMmm** format where **MM** represents the determinant and **mm** the subdeterminant (4-bytes ASCII string; for example, : **0201** for version 2.1).

NOTE: The response to function 43 may be negative; in this case, the response located at the top of the next page is sent by the Drive rather than the response described above.

Diagnostics (08 hex)

The function (08 hex) provides a series of tests for checking the communication system between a controller device and a device, or for checking various internal error conditions within a device.

The function uses a two-byte sub-function code field in the query to define the type of test to be performed. The device echoes both the function code and sub-function code in a normal response. Some of the diagnostics cause data to be returned from the remote device in the data field of a normal response.

In general, issuing a diagnostic function to a remote device does not affect the running of the user program in the remote device. User logic, like discrete and registers, is not accessed by the diagnostics. Certain functions can optionally reset error counters in the remote device.

A device can, however, be forced into 'Listen Only Mode' in which it will monitor the messages on the communications system but not respond to them. This can affect the outcome of your application program if it depends upon any further exchange of data with the remote device. Generally, the mode is forced to remove a malfunctioning remote device from the communications system.

Subcode 00 hex: Echo

This function asks the device being interrogated to echo (return) the message sent by the controller in its entirety.

Subcode 0A hex: Counter reset

This function resets all the counters responsible for monitoring a device exchanges.

Subcode 0C hex: Read message counter responsible for counting messages received with checksum errors.

Subcode 0E hex: Read message counter responsible for counting messages addressed to device. Read a word indicating the total number of messages addressed to the device, regardless of type (excluding broadcast messages).

Request and response (the frame format is identical)

device no.	Function Code (08)	Subcode		Data		CRC16	
		Hi	Lo	Hi	Lo	Lo	Hi
1 byte	1 byte	2 bytes		N bytes		2 bytes	

Subcode	Request Data	Response Data	Function Executed
00	XX YY	XX YY	Echo
0A	00 00	00 00	Counter reset
0C	00 00	XX YY (= counter value)	Read message counter responsible for counting messages received with checksum errors
0E	00 00	XX YY (= counter value)	Read message counter responsible for counting messages addressed to device

Example

Values 31 hex and 32 hex echoed by device address 04 hex.

Request and response (the frame format is identical)

device no.	Request code or response code	Subcode		Value of first byte	Value of second byte	CRC16	
		Hi	Lo			Lo	Hi
02 hex	08 hex	00 hex	00 hex	31 hex	32 hex	74 hex	1B hex

Hardware Setup

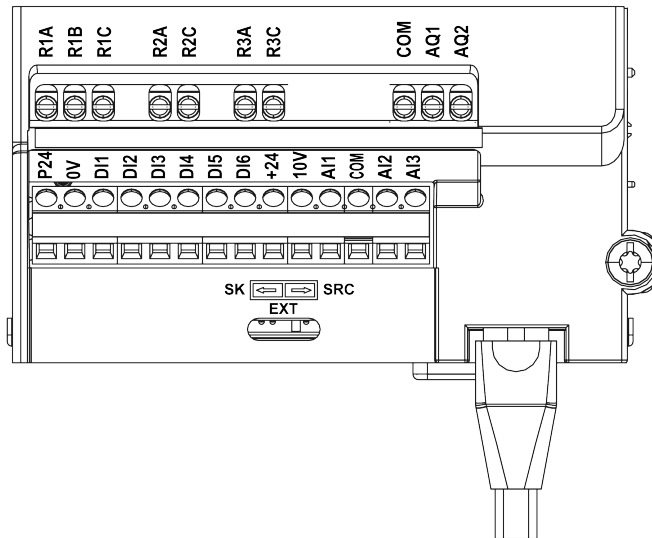
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Cable Routing Practices	55
Accessories Presentation	56

Hardware Presentation

Modbus Serial Communication Port

The following figure shows the terminal view of the drive:



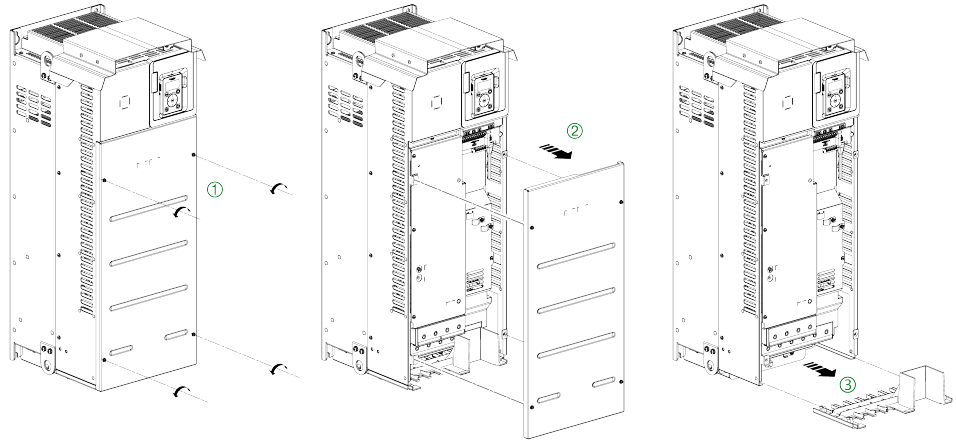
Firmware Version

Compatibility

There is no specific firmware for Modbus serial communication. The drive firmware embeds the Modbus.

Connection to the Adapter

Procedure to Remove the Front Cover of the Drive



Apply the following instructions to remove the front cover of the drive:

Step	Action
1	Unscrew the four screws attaching the front cover
2	Slide down the front cover
3	Remove the front cover
4	<p>On the references ATV610...N4 and ATV610...N4Z, plug the Modbus serial cable in the Modbus serial port</p> <p>On the references ATV610...N4ZC, connect to the Modbus In-Line (A, B, SGND,PE):</p>

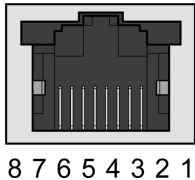
Electrical Installation

Connection to Drive

Connect the RJ45 cable connector to the device connector.

NOTE: Always connect the shield layer of the cable to the ground. For more information about EMC, refer to the product installation manual.

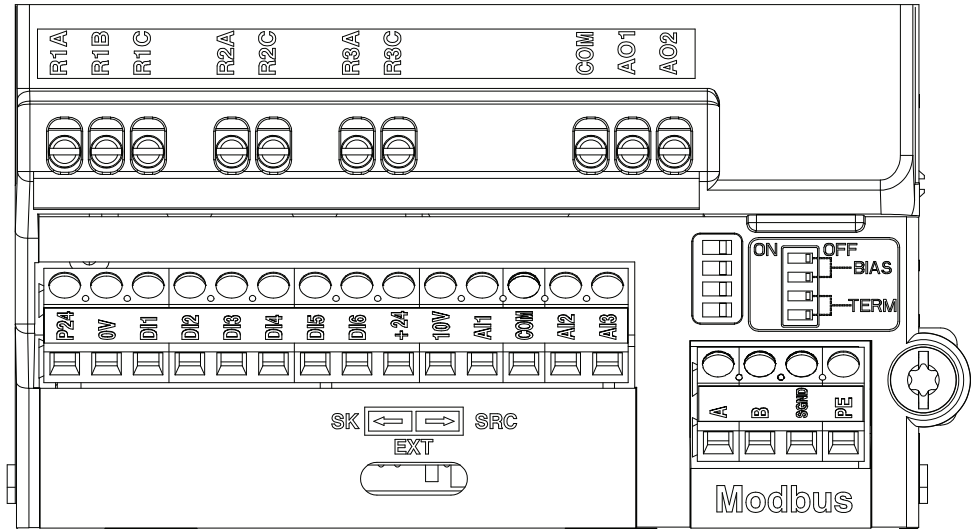
The table describes the pin out of the RJ45 connector of the device:



Pin	Signal
1	Reserved
2	
3	
4	D1 ⁽¹⁾
5	D0 ⁽¹⁾
6	Reserved
7	VP NOTE: Supply for RS232 / RS485 converter or a remote terminal.
8	Common ⁽¹⁾ <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>NOTICE</p> <p>RISK OF SERIAL PORT DAMAGE</p> <p>Do not use shield layer of the cable to connect common.</p> <p>Failure to follow these instructions can result in equipment damage.</p> </div>
⁽¹⁾ Modbus signals	

ATV610...N4ZC Modbus RS485 Terminal

On the references **ATV610...N4ZC**, the Modbus In-Line (A, B, SGND, PE) is available:



Pin	Signal
A	D1 (Modbus signals)
B	D0 (Modbus signals)
SGND	Common (Modbus signals)
PE	Protective Earth ground connection

RS485 Bus Schematic

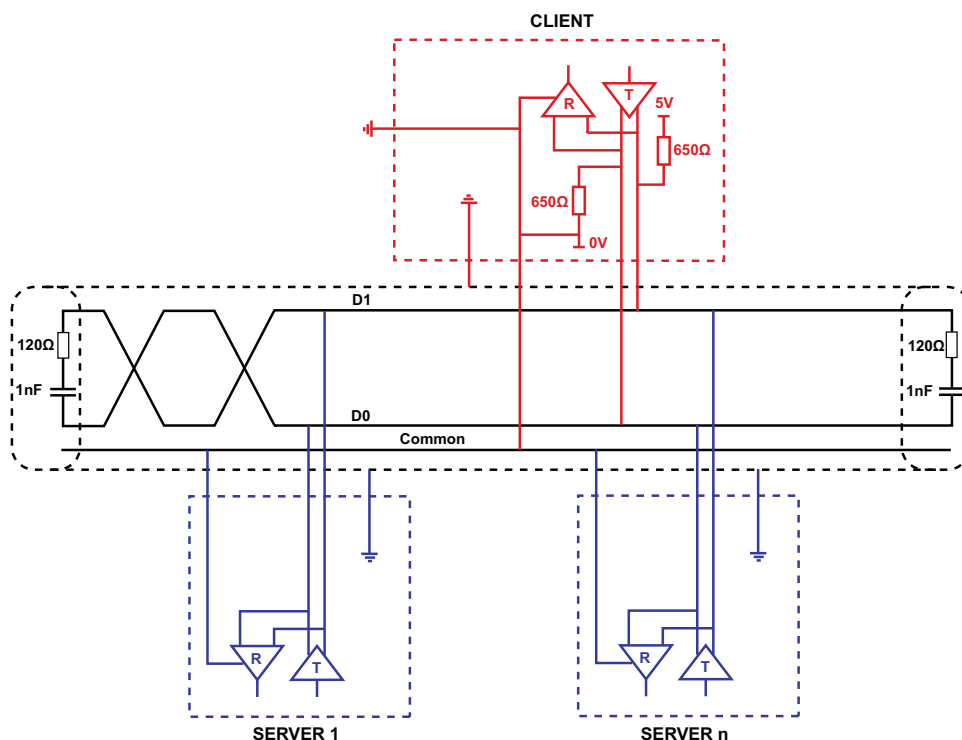
The RS485 standard allows variants of different characteristics:

- Polarization
- Line terminator
- Distribution of a reference potential
- Number of servers
- Length of bus

The Modbus specification published on the Modbus.org site contains precise details of all these characteristics. They are also summarized in standard schematic section. The new Schneider Electric devices conform to this specification.

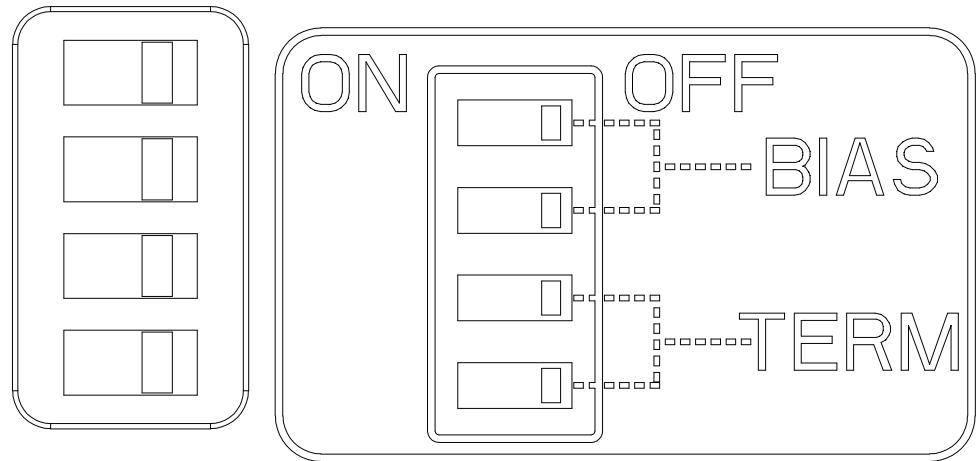
Schematic Diagram

The following is the RS485 bus schematic diagram:



Characteristic	Definition
Type of trunk cable	Shielded cable with 1 twisted pair and at least a third conductor
Maximum length of bus	1000 m at 19200 bps
Maximum number of stations (without repeater)	32 stations that are 31 servers
Maximum length of tap links	<ul style="list-style-type: none"> 20 m for 1 tape link 40 m divided by the number of tape links on a multiple junction box
Bus polarization	<ul style="list-style-type: none"> One 450...650 Ω pull-up resistor at 5 V (650 Ω recommended) One 450...650 Ω pull-down resistor at the common (650 Ω recommended) This polarization is recommended for the client.
Line terminator	One 120 Ω 0.25 W resistor in series with 1 nF 10 V capacitor
Common polarity	The Common circuit (Signal and optional Power Supply Common) must be connected directly to protective ground, at one point only for the entire bus on the client device side.

BIAS & TERM Switch Part



NOTE: ATV610...N4ZC reference have built-in Bus polarization and Line terminator resistor, recommend to switch on when drive meet communication error.

Cable Routing Practices

Immunity Against Interference

Keep the Modbus cable separated from the power cables (30 cm (11.8 in.) minimum).

Accessories Presentation

Information

Connection accessories should be ordered separately (See the catalog).

Software Setup

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Basic Settings

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[Modbus Time Out] (<i>t t o</i>).....	60

Configuring the Communication Parameters

Overview

Configuration of the Modbus communication functions of the drive can be accessed from the **[Communication]** (*C o m -*) menu.

[Modbus Address] (*A d d*)

About This Parameter

This parameter defines the address of the drive on the network.

Access

This is a read/write parameter.

The parameter Modbus address is 6001.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[OFF]	(<i>o f f</i>)	0	Modbus address is not assigned.
[1 to 247]	(<i>1...247</i>)	1...247	Modbus address is assigned. Factory setting: OFF

[Modbus baud rate] (*t b r*)

About This Parameter

This parameter defines the baud rate at which data is transferred.

Access

This is a read/write parameter.

The parameter Modbus address is 6003.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[4K8]	(4 K B)	24	Baud rate is set to 4.8 Kbps.
[9K6]	(9 K B)	28	Baud rate is set to 9.6 Kbps.
[19K2]	(1 9 K 2)	32	Baud rate is set to 19.2 Kbps.
[38K4]	(3 8 K 4)	36	Baud rate is set to 38.4 Kbps.
			Factory setting: 19.2 Kbps

[Modbus format] (Ɨ F □)

About This Parameter

This parameter is used to define the data format.

Access

This is a read/write parameter.

The parameter Modbus address is 6004.

Possible Settings

This table presents the parameter settings:

Settings	Code	Value	Description
[8O1]	(B O 1)	2	8 data bits, odd parity, 1 stop bit
[8E1]	(B E 1)	3	8 data bits, even parity, 1 stop bit
[8N1]	(B n 1)	4	8 data bits, no parity, 1 stop bit
[8N2]	(B n 2)	5	8 data bits, no parity, 2 stop bits
			Factory setting: 8E1

[Modbus Time Out] (Ɨ Ɨ □)

About This Parameter

This parameter defines.

Access

This is a read/write parameter.

The parameter Modbus address is 6005.

Possible Settings

The table presents the parameter settings:

Settings	Code	Value	Description
[0.1...30.0]	(0. 1... 3 0. 0)	1...300	Adjustable from 0.1 to 30 s Factory setting: 10 s

Additional Settings

What's in This Chapter

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Local Configuration of the Communication Scanner

The communication scanner is useful when used in combination by the Modbus client device with the function `Read/Write Multiple registers: 23 (17 hex)`, which provides in a single telegram a read multiple registers and a write multiple registers. The detail of the function 23 is described in the supported Modbus functions.

The communication scanner is accessible via the following menus to the DTM: **[Communication] C 0 P - / Comm parameters (C P P -) / Modbus SL (P 5 L -) / Modbus Fieldbus (P d I -)** and **[COM. scanner input] , C 5 - , [COM. scanner output] 0 C 5 -** submenus.

An nCAx or nMAx parameter with a value of zero is not linked to a parameter in the device.

The following table displays the list of Communication Scanners configuration parameters:

Sub Menu	Parameter description	Default assignment	Modbus address
[COM. scanner input] , C 5 -	[Scan. IN1 address] n P A 1 Source drive address of the 1st input word	Status (ETA)	12701 319D hex
	[Scan. IN2 address] n P A 2 Source drive address of the 2nd input word	Output speed (RFRD)	12702 319E hex
	[Scan. IN3 address] n P A 3 Source drive address of the 3rd input word	0	12703 319F hex
	[Scan. IN4 address] n P A 4 Source drive address of the 4th input word	0	12704 31A0 hex
	[Scan. IN5 address] n P A 5 Source drive address of the 5th input word	0	12705 31A1 hex
	[Scan. IN6 address] n P A 6 Source drive address of the 6th input word	0	12706 31A2 hex
	[Scan. IN7 address] n P A 7 Source drive address of the 7th input word	0	12707 31A3 hex
	[Scan. IN8 address] n P A 8 Source drive address of the 8th input word	0	12708 31A4 hex
[COM. scanner output] 0 C 5 -	[Scan. Out1 address] n C A 1 Destination drive address of the 1st output word	Command (CMD)	12721 31B1 hex
	[Scan. Out2 address] n C A 2 Destination drive address of the 2nd output word	Speed target (LFRD)	12722 31B2 hex
	[Scan. Out3 address] n C A 3 Destination drive address of the 3rd output word	0	12723 31B3 hex
	[Scan. Out4 address] n C A 4 Destination drive address of the 4th output word	0	12724 31B4 hex
	[Scan. Out5 address] n C A 5 Destination drive address of the 5th output word	0	12725 31B5 hex
	[Scan. Out6 address] n C A 6 Destination drive address of the 6th output word	0	12726 31B6 hex
	[Scan. Out7 address] n C A 7 Destination drive address of the 7th output word	0	12727 31B7 hex

Sub Menu	Parameter description	Default assignment	Modbus address
	[Scan. Out8 address] <i>n C B B</i> Destination drive address of the 8th output word	0	12728 31B8 hex

Monitoring the Communication Scanner

It is also possible to monitor the value of the parameters which has been configured in the communication scanner. This monitored values (**[Com. scanner input map]** and **[Com scan output map]**) are accessible via the following menus: **[Communication] → [Communication map] → [Modbus network diag]**.

The 8 output variable values and the 8 input variable values are located into parameters **[Com Scan Out1 val.] n C 1** to **[Com Scan Out8 val.] n C B** and **[Com Scan In1 val.] n B 1** to **[Com Scan In8 val.] n B B**.

The following table displays the list of Communication Scanner monitoring parameters:

Sub Menu	Parameter description	Default assignment	Modbus address
[COM. scanner input map] <i>i S B -</i>	[COM Scan. In1 val.] n B 1 Source drive value of the 1st input word	ETA value	12741 31C5 hex
	[COM Scan. In2 val.] n B 2 Source drive value of the 2nd input word	RFRD value	12742 31C6 hex
	[COM Scan. In3 val.] n B 3 Source drive value of the 3rd input word	0	12743 31C7 hex
	[COM Scan. In4 val.] n B 4 Source drive value of the 4th input word	0	12744 31C8 hex
	[COM Scan. In5 val.] n B 5 Source drive value of the 5th input word	0	12745 31C9 hex
	[COM Scan. In6 val.] n B 6 Source drive value of the 6th input word	0	12746 31CA hex
	[COM Scan. In7 val.] n B 7 Source drive value of the 7th input word	0	12747 31CB hex
	[COM Scan. In8 val.] n B B Source drive value of the 8th input word	0	12748 31CC hex
[COM. scanner output map] <i>o S B -</i>	[COM Scan. Out1 val.] n C 1 Destination drive address of the 1st output word	CMD value	12761 31D9 hex
	[COM Scan. Out2 val.] n C 2 Destination drive address of the 2nd output word	LFRD value	12762 31DA hex
	[COM Scan. Out3 val.] n C 3 Destination drive address of the 3rd output word	0	12763 31DB hex
	[COM Scan. Out4 val.] n C 4 Destination drive address of the 4th output word	0	12764 31DC hex
	[COM Scan. Out5 val.] n C 5 Destination drive address of the 5th output word	0	12765 31DD hex
	[COM Scan. Out6 val.] n C B	0	12766

Sub Menu	Parameter description	Default assignment	Modbus address
	Destination drive address of the 6th output word		31DE hex
	[COM Scan. Out7 val.] n L 7 Destination drive address of the 7th output word	0	12767 31DF hex
	[COM Scan. Out8 val.] n L 8 Destination drive address of the 8th output word	0	12768 31E0 hex

Fieldbus Integration Using Unity

What's in This Chapter

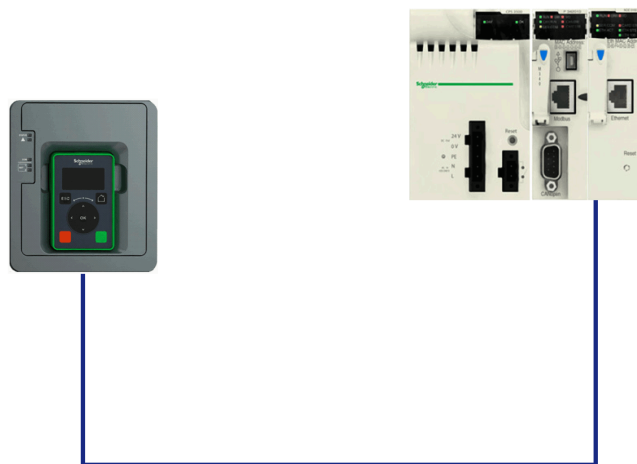
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Introduction

Overview

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

In the example, the communication scanner of the drive is used. The PLC sends the command and the reference speed to the drive and read the status word and the actual speed of the drive.



Drive Configuration

Factory Setting

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

- **[File management]** (*F P E -*) menu,
- **[Factory settings]** (*F L S -*) submenu.

Then configure the following parameters:

- **[Parameter group list]** (*F r Y -*) = **[All]** (*R L L*)
- **[Go to Factory Settings]** (*L F S*) = OK

Command Configuration

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

Goto to:

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

Then configure:

- **[Ref.1 channel]** (*F r l*) parameter to **[Ref. Freq-Modbus]** (*P d b*) value.

Communication Configuration

Select the Modbus address in the menu:

- **[Communication]** (C o n -)
- **[Comm parameters]** (C n P -)
- **[Modbus SL]** (n S L -)
- **[Modbus Fieldbus]** (n d l -)
- **[Modbus Address]** (R d d)

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

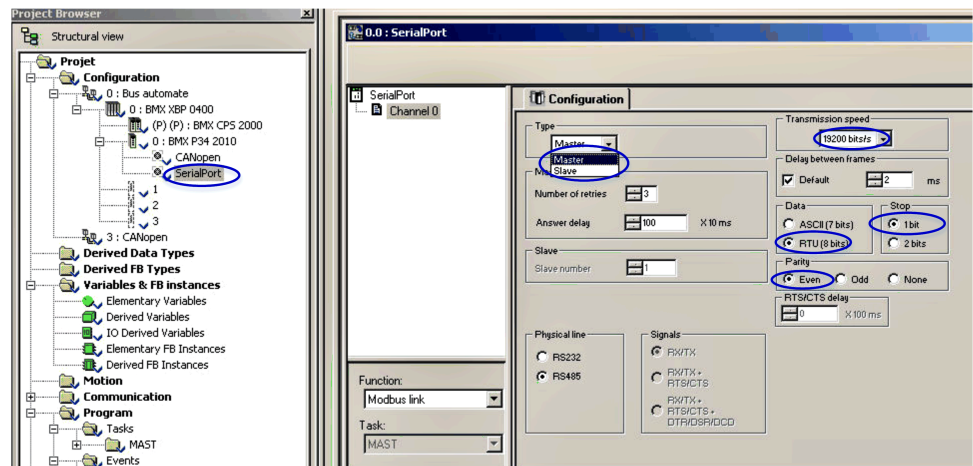
Modbus Client Configuration

Overview

In this example, Modbus client configuration is done with unity.

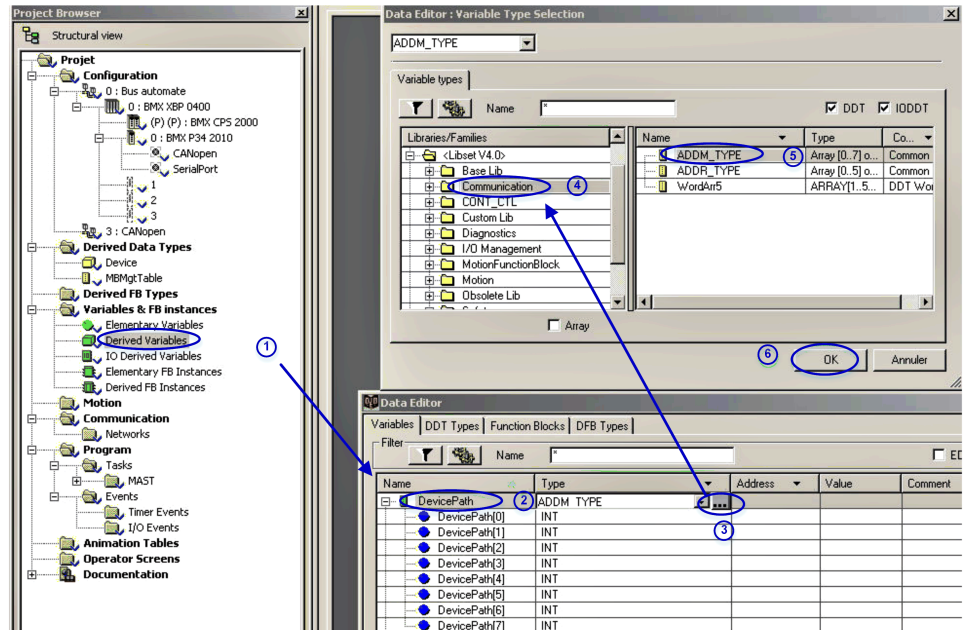
Serial Port Configuration

Configure the serial port as client. The other default settings are compliant with the default settings of the drive.

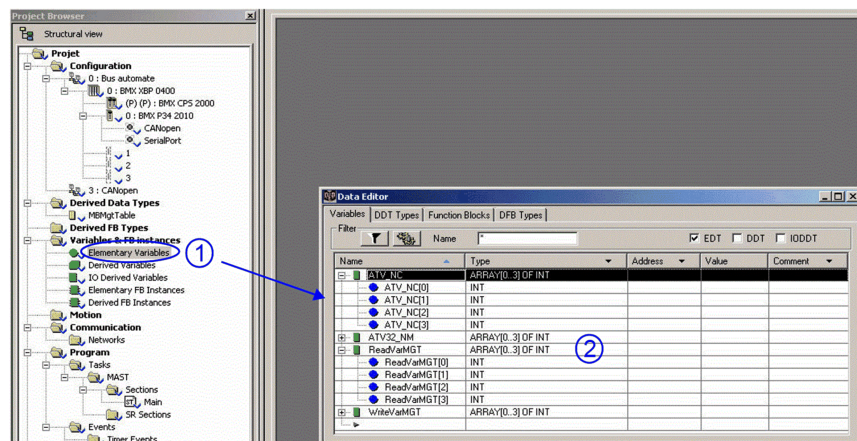


Data Structure Declaration

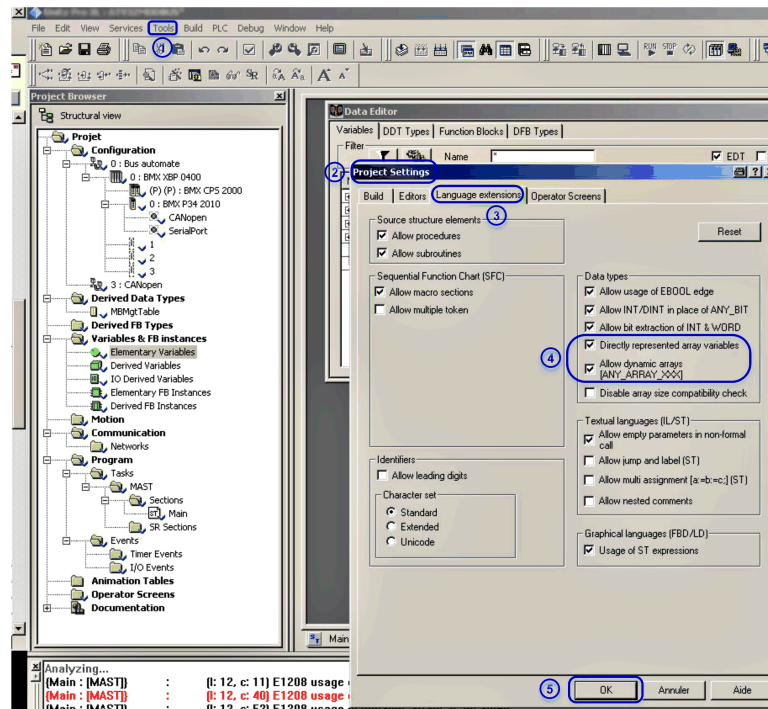
Create the following table (DevicePath). DevicePath describes the path to the device including its server address.



Then create the four other tables as arrays from 0 to 3 of integer.

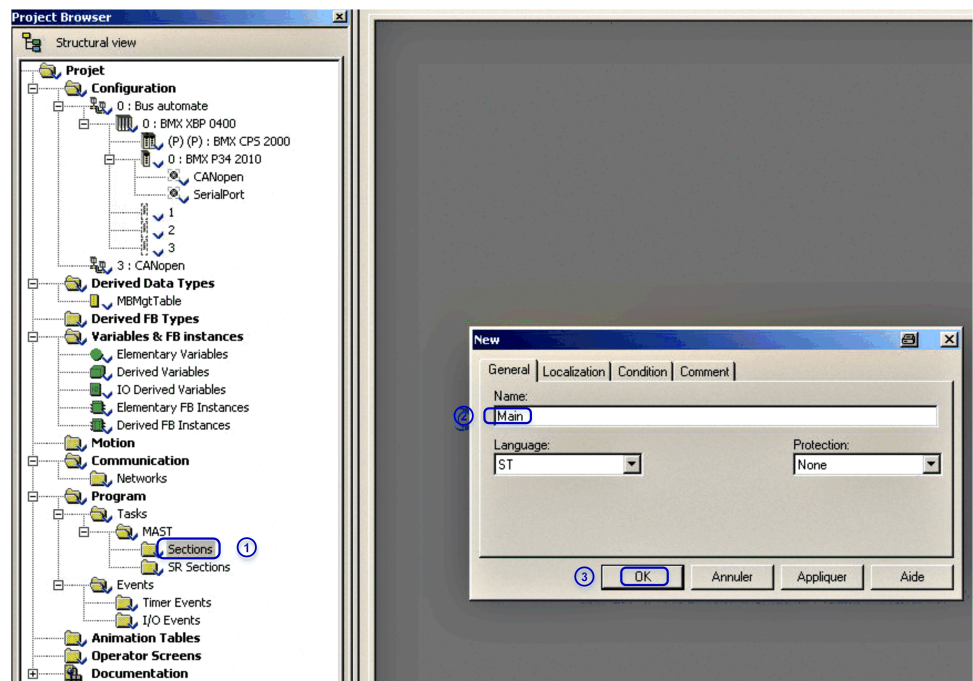


As all the tables declared are dynamic (no fixed address), it is necessary in the project setting to «Allows dynamic array» and to «Directly represented array variables». The parameterization must be done in the menu «Tool», «Project settings», «Language extensions» window.



Program

Create a program in MAST section.



The communication is based on the *READ_VAR*, *WRITE_VAR* functions. During the first execution of the MAST task, you can initialize the data structure used by these two functions.

ReadVarMgt and *WriteVarMgt* are arrays used respectively by *READ_VAR* and *WRITE_VAR*. Only the third element of these arrays is modifiable, you can define the timeout duration of the requests.

In the example, the application manages two requests:

- A read request of four words starting at Modbus address 12741 (31C5 hex). It is the address of the first word of the input scanner of the drive **[Com Scan In1 val.]** (n n I). Modbus function. The information is sent from the PLC to the drive. The table ATV_NM is used. The 2 first words are mapped by default.

Name	Address	Comment
ATV_NM(0)	12741	Default: ETA (status word)
ATV_NM(1)	12742	Default: RFRD (output speed)
ATV_NM(2)	12743	-
ATV_NM(3)	12744	-

- A write request of four words starting at Modbus address 12761 (31D9 hex). It is the address of the first word of the input scanner of the drive **[Com Scan Out1 val.]** (n L I). Modbus function #16. The information is sent from the PLC to the drive. The table ATV_NC is used. The 2 first words are mapped by default.

Name	Address	Comment
ATV_NC(0)	12761	Default: CMD (command word)
ATV_NC(1)	12762	Default: LFRD (speed referenced)
ATV_NC(2)	12763	-
ATV_NC(3)	12764	-

```

Main: [MAST]
IF NOT init THEN
    (* ADDM has to be used to add the slave at address 2*)
    DevicePath := ADDM('0.0.0.2');

    (* Timeout duration *)
    ReadVarMGT[2] := 50;
    WriteVarMGT[2] := 50;

    (* the configuration has to be done only once *)
    init := TRUE;
END_IF;

IF NOT ReadVarMGT[0].0 THEN (* bit 0 is set when READ_VAR is busy *)
    (* read data is stored in ATV_NM array *)
    READ_VAR(DevicePath, '%MW', 12741, 4, ReadVarMGT, ATV_NM);
END_IF;

IF NOT WriteVarMGT[0].0 THEN (* bit 0 is set when WRITE_VAR is busy *)
    (* data to be written is stored in ATV_NC array *)
    WRITE_VAR(DevicePath, '%MW', 12761, 4, ATV_NC, WriteVarMGT);
END_IF;
    
```

Operations

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Operating States

What's in This Chapter

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Configuring Communication Detected Error Response

Description

The response of the drive in the event of a Modbus serial communication interruption can be configured. Configuration can be performed using the display terminal from the **[Complete settings]** (*C S E -*), **[Error/warning handling]** (*C S W Π*) menu, **[Fieldbus monitoring]** (*C L L -*) submenu, via the **[Modbus Error Resp]** (*S L L*) .

The values of the **[Modbus Error Resp]** (*S L L*) parameter, which triggers a drive detected error **[Modbus Com Interruption]** (*S L F I*), are:

Value	Meaning
[Freewheel] (<i>Y E S</i>)	Freewheel stop (factory setting)
[Ramp stop] (<i>r Π P</i>)	Stop on ramp
[Fast stop] (<i>F S E</i>)	Fast stop
[DC injection] (<i>d C i</i>)	DC injection stop

The values of the **[Modbus Error Resp]** (*S L L*) parameter, which does not trigger a drive detected error, are:

Value	Meaning
[Ignore] (<i>n o</i>)	Detected error ignored
[Per STT] (<i>S E E</i>)	Stop according to configuration of [Type of stop] (<i>S E E</i>)
[fallback spd] (<i>L F F</i>)	Change to fallback speed, maintained 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] (<i>C S E -</i>), [Error/warning handling] (<i>C S W Π</i>) menu, [Fallback speed] (<i>L F F -</i>) submenu, using the [Fallback speed] (<i>L F F</i>) parameter.
[Spd maint.] (<i>r L S</i>)	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

⚠ WARNING

LOSS OF CONTROL

If this parameter is set to **[Ignore]**, 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.

Operating Modes

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Configuring the Control Channel

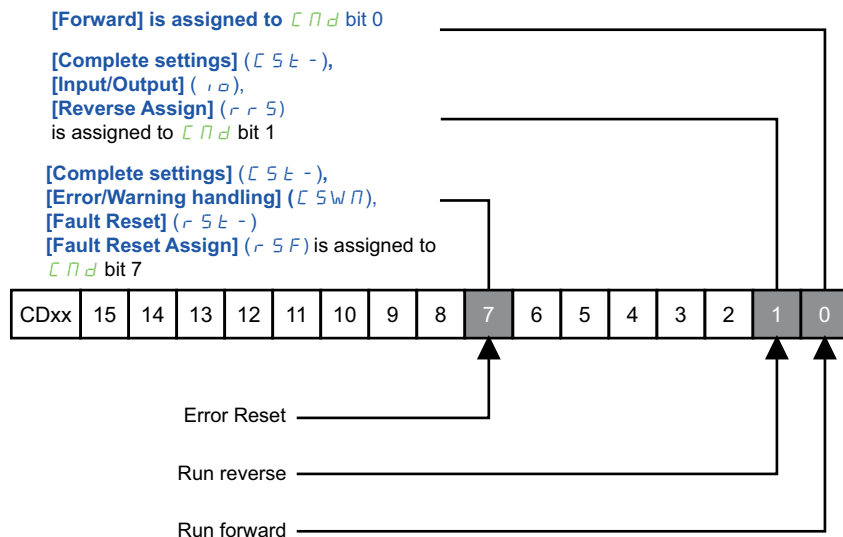
This chapter explains how to configure the drive for operation from the communication network through three following examples.

- 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

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 reference frequency is given by Display Terminal.



The settings are the following:

[Ref Freq 1 Config] <code>FR1</code>	[HMI] <code>LCC</code>
[Reverse Disable] <code>RIN</code>	Default
[Stop Key Enable] <code>PST</code>	Default
[Control Mode] <code>CHCF</code>	[Separate] <code>SEP</code>
[Command Switching] <code>CCS</code>	Default
[Cmd channel 1] <code>CD1</code>	[Modbus] <code>MBD</code>

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

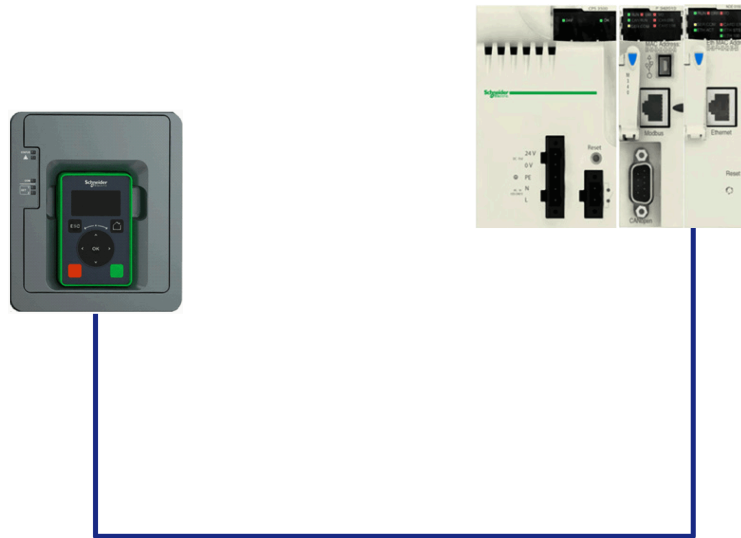
This section describes how to configure the settings of the drive if it is controlled in CiA 402 mode. The example focuses on the not separate mode. Additional modes are detailed in the drive programming manual.

- Check if **[Ref Freq 1 Config] FR1** is set on according to the communication source ().
- **[Control Mode] CHCF**: defines if the drive operates in combined mode (reference and command from the same channel).

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

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

For example:



The drive is controlled from the communication but the frequency 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] FR1	[HMI] LCC
[Reverse Disable] RIN	Default
[Stop Key Enable] PST	Default
[Control Mode] CHCF	[Separate] SEP
[Command Switching] CCS	Default
[Cmd channel 1] CD1	[Modbus] n b d

Diagnostics and Troubleshooting

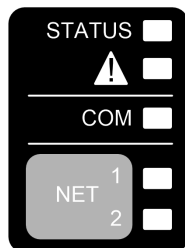
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Fieldbus Status LEDs

LED Indicators

The following figure describes the LEDs status for fieldbus monitoring:



LED Description

Item	LED	Description
1	COM	Indicates the Modbus serial link connection status

LED COM : Link Activity

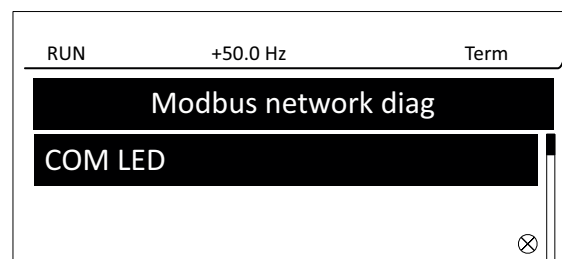
The table provides the LED status for Modbus serial connection

Color & Status	Description
OFF	No link
Yellow flashing	Fieldbus active

Communication Diagnostics

These parameters are visible only with the Display Terminal.

On the terminal, in the **[Display]** (П о н -) menu (**[COMMUNICATION MAP]** (С П П -) **[Modbus network diag]** (П н д -) submenu):



Modbus Counters

- **[Mdb Frame Nb]** П I C E indicate the number of Modbus frames received. The counter counts both correct and incorrect frames.

- **[Mb NET CRC errors]** $\Pi I E C$ indicate the number of Modbus frames containing checksum errors.

In the case of these two counters, only frames that are destined for the drive and whose Modbus address is supplied by the **[Modbus Address]** $\Pi d d$ parameter are counted. Broadcast frames are not counted.

[Mdb Frame Nb] $\Pi I C E$ is modulo 65 536 counters, this means that, the value is reset to zero once the value of 65 535 is reached.

By contrast, the **[Mb NET CRC errors]** $\Pi I E C$ remain at 65 535 once this value is reached.

Each Modbus counter corresponds to a drive parameter:

Menu	Parameter Name	Code	Logical Address
[Modbus network diag] $\Pi n d -$	[Mdb Frame Nb]	$\Pi I C E$	6011
	[Mb NET CRC errors]	$\Pi I E C$	6010

Checking Connections

Description

If the product cannot be addressed using the fieldbus, verify that

- The connector is plugged in correctly.
- The wires are correctly connected to connector (if possible).
- The ends of line resistors are connected on both sides of the complete network.
- The ends of line resistors have the good values.
- The wiring of the all devices on the network is consistent.

Monitoring of Communication Channel

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

- The control word containing the switch for reference value 1'1B (bit configured on **[Ref 1B switching]**).
- The control word containing the switch for reference value 1'2 (bit configured on **[Freq Switch Assign]**).
- The reference frequency or reference speed (**[Ref Frequency]** or **[Speed Setpoint]**: Nominal speed value) from the active channel for reference value.
- Summing reference frequency or reference speed (**[Ref Frequency]** or **[Speed Setpoint]**: Nominal speed value) 2 (assigned to **[Summing Input 2]**).
- Summing reference frequency or reference speed (**[Ref Frequency]** or **[Speed Setpoint]**: Nominal speed value) 3 (assigned to **[Summing Input 3]**).
- Subtracting reference frequency or reference speed (**[Ref Frequency]** or **[Speed Setpoint]**: Nominal speed value) 2 (assigned to **[Subtract Ref Freq 2]**).
- Subtracting reference frequency or reference speed (**[Ref Frequency]** or **[Speed Setpoint]**: Nominal speed value) 3 (assigned to **[Subtract Ref Freq 3]**).
- The reference value given by the PID controller (**[PID Set Point]**).
- The PID controller feedback (**[AI Virtual 1]**).
- The multiplication coefficient of the reference values (**[Multiplying coeff.]** 2 (assigned to **[Ref Freq 2 Multiply]**).
- The multiplication coefficient of the reference values (**[Multiplying coeff.]** 3 (assigned to **[Ref Freq 3 Multiply]**).
-

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 one parameter involved has been written at least one time. The drive is only able to start if the channel involved in command and reference value are enabled.

Example:

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

It is mandatory to write at least one 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 *forced local* mode.

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]**. After this time if command channel not valid, **[Modbus Com Interruption]** `SLF1` is trigger.
- Drive control only takes effect once the drive has received the reference and the command from the active channels.

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	Fieldbus Module
Control word	(C P d)	(C P d I)	(C P d E)
Extended control word	(C P i)	(C P i I)	(C P i E)
Reference speed (rpm)	(L F r d)	(L F r d I)	(L F r d E)
Reference frequency (0.1 Hz)	(L F r)	(L F r I)	(L F r E)
Reference value supplied by PI controller	(P i S P)	(P i r I)	(P i r E)
Reference value supplied by analog multiplier function	(P F r)	(P F r I)	(P F r E)

Communication Interruption Message

Description

If the device does not receive any Modbus request sent to its address for a predefined time **[Modbus Timeout]** ($t_{t o}$), a **[Modbus Com Interruption]** ($S L F I$) is triggered.

Glossary

A

Abbreviations:

Req. = Required

Opt. = Optional

AC:

Alternating Current

Adjustment parameter: A parameter always accessible as **[Access Level]**.

C

Client:

A **client** is a device that is actively polling for data from one or multiple devices.

Configuration Parameter: A parameter affects by the operating states of the machine as **[Motor Nom Current]**.

CRC16:

Cyclical Redundancy Check.

D

DC:

Direct Current

dec.:

Decimal

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:

Machine status in factory settings when the product was shipped.

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.

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).

H

hex:

Hexadecimal

M

MEI:

Modbus Encapsulated Interface

P

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

R/WS:

Read and write (write only possible when the drive is not in RUN mode). It is not possible to write these parameters in "5-Operation enabled" or "6-Quick stop active" states. If the parameter is written in the "4-Switched on" state, transition to "2-Switch on disabled" is activated.

S

Server:

A **server** is the passive device, waiting for the **client** to poll for data to actually send it.

V

VSD:

Variable Speed Drive

W

Warning:

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

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