



Bonfiglioli

Vectron

Agile

VABus

Communication module

CM-VABus / CM2-VABus

Frequency inverter 230 V / 400 V



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1 General Information about the Documentation

For better clarity, the documentation of the frequency inverter is structured according to the customer-specific requirements. The present manual was created in the German language. The German manual is the original version. Other language versions are translations.

Quick Start Guide

The "Quick Start Guide" describes the basic steps required for mechanical and electrical installation of the frequency inverter. The guided commissioning supports you in the selection of necessary parameters and the configuration of the software of the frequency inverter.

User manual

The user manual documents the complete functionality of the frequency inverter. The parameters required for special purposes, for adjustment to the application and the numerous additional functions are described in detail.

Separate user manuals are supplied for optional components for the frequency inverter. These manuals complement the operating instructions and the "Quick Start Guide" for the frequency inverter.

Application manual

The application manual complements the documentation to ensure goal-directed installation and commissioning of the frequency inverter. Information on various topics in connection with the use of the frequency inverter is described in context with the specific application.

1.1 This document

The present user manual of the CM-VABus and CM2-VABus communication module complements the Operating Instructions and the "Quick Start Guide" for the frequency inverters of the *Agile* series of devices.

The user manual contains important information on the installation and use of the VABus communication module CM-VABus in its specified application range. Compliance with this user manual contributes to avoiding risks, minimizing repair cost and downtimes and increasing the reliability and service life of the frequency inverter.

For this reason, make sure you read the user manual carefully.



WARNING! Compliance with the documentation is required to ensure safe operation of the frequency inverter. BONFIGLIOLI VECTRON GmbH shall not be held liable for any damage caused by any non-compliance with the documentation.

Note

In case any problems occur which are not covered by the documentation sufficiently, please contact the manufacturer.

In this manual, the designation "CM-VABus" also applies to CM2- VABus modules.

The following instruction manuals are available for the *Agile* device series:

<i>Agile</i> Operating Instructions	Frequency inverter functionality.
<i>Agile</i> Quick Start Guide	Installation und commissioning. Supplied with the device.
Communication Application-Manuals	Communication via the RS485 Interface on the X21-Connection (RJ45): Instructions for Modbus and VABus. Communication via the X12.5 and X12.6 Control Terminals: Instructions for Systembus and CANopen® ¹ . Communication via the Communication Modules: CM-232/CM-485: Instructions for Modbus and VABus. CM-CAN: Instructions for Systembus and CANopen®. CM-PDPV1: Instructions for Profibus-DP-V1
PLC Application Manual	Logical interconnections of digital signals. Functions for analog signals such as comparisons and mathematical functions. Graphical support for the programming of functional components.
Service Instructions	For service personnel. Service work, monitoring of service intervals and replacement of ventilators.

1.2 Warranty and liability

BONFIGLIOLI VECTRON GmbH would like to point out that the contents of this user manual do not form part of any previous or existing agreement, assurance or legal relationship. Neither are they intended to supplement or replace such agreements, assurances or legal relationships. Any obligations of the manufacturer shall solely be based on the relevant purchase agreement which also includes the complete and solely valid warranty stipulations. These contractual warranty provisions are neither extended nor limited by the specifications contained in this documentation.

The manufacturer reserves the right to correct or amend the specifications, product information and omissions in these operating instructions without notice. The manufacturer shall not be liable for any damage, injuries or costs which may be caused by the aforementioned reasons.

Furthermore, BONFIGLIOLI VECTRON GmbH excludes any warranty/liability claims for any personal and/or material damage if such damage is due to one or more of the following causes:

- inappropriate use of the frequency inverter,
- non-compliance with the instructions, warnings and prohibitions contained in the documentation,
- unauthorized modifications of the frequency inverter,
- insufficient monitoring of parts of the machine/plant which are subject to wear,
- repair work at the machine/plant not carried out properly or in time,
- catastrophes by external impact and force majeure.

1.3 Obligation

This user manual must be read before commissioning and complied with. Anybody entrusted with tasks in connection with the

- transport,
- assembly,
- installation of the frequency inverter and
- operation of the frequency inverter

must have read and understood the user manual and, in particular, the safety instructions in order to prevent personal and material losses.

¹ The CANopen®-Communication products fulfill the specifications of the CIA® (CAN in Automation) user organization.

1.4 Copyright

In accordance with applicable law against unfair competition, this user manual is a certificate. Any copyrights relating to it shall remain with

BONFIGLIOLI VECTRON GmbH
Europark Fichtenhain B6
47807 Krefeld
Germany

This user manual is intended for the operator of the frequency inverter. Any disclosure or copying of this document, exploitation and communication of its contents (as hardcopy or electronically) shall be forbidden, unless permitted expressly.

Any non-compliance will constitute an offense against the copyright law dated 09 September 1965, the law against unfair competition and the Civil Code and may result in claims for damages. All rights relating to patent, utility model or design registration reserved.

1.5 Storage

The documentation forms an integral part of the frequency inverter. It must be stored such that it is accessible to operating staff at all times. If the frequency inverter is sold on to other users, then this user manual must also be handed over.

1.6 Final decommissioning

After the end of product service life, the user/operator must take the device out of operation.



For more information about the decommissioning of the device refer to the applicable operating instructions document.

Disposal requirements under European Union WEEE regulations

The product is marked with the WEEE symbol shown below.

This product cannot be disposed as general household waste. Users responsible for the final disposal must make sure that it is carried out in accordance with the European Directive 2012/19/EU, where required, as well as the relative national transposition rules. Fulfill disposal also in accordance with any other legislation in force in the country.



2 General safety instructions and information on use

The chapter "General safety instructions and information on use" contains general safety instructions for the Operator and the Operating Staff. At the beginning of certain main chapters, some safety instructions are included which apply to all work described in the relevant chapter. Special work-specific safety instructions are provided before each safety-relevant work step.

2.1 Terminology

According to the documentation, different activities must be performed by certain persons with certain qualifications.

The groups of persons with the required qualification are defined as follows:

Operator

This is the entrepreneur/company who/which operates the frequency inverter and uses it as per the specifications or has it operated by qualified and instructed staff.

Operating staff

The term Operating Staff covers persons instructed by the Operator of the frequency inverter and assigned the task of operating the frequency inverter.

Skilled Personnel The term **Skilled Personnel** covers staff that are assigned special tasks by the Operator of the frequency inverter, e.g. installation, maintenance and service/repair and troubleshooting. Based on their qualification and/or know-how, **Skilled Personnel** must be capable of identifying defects and assessing functions.

Qualified electrician

The term Qualified Electrician covers qualified and trained staff that has special technical know-how and experience with electrical installations. In addition, Qualified Electricians must be familiar with the applicable standards and regulations, they must be able to assess the assigned tasks properly and identify and eliminate potential hazards.

Instructed person

The term Instructed Person covers staff that was instructed and trained about/in the assigned tasks and the potential hazards that might result from inappropriate behavior. In addition, instructed persons must have been instructed in the required protection provisions, protective measures, the applicable directives, accident prevention regulations as well as the operating conditions and verified their qualification.

Expert

The term Expert covers qualified and trained staff that has special technical know-how and experience relating to the frequency inverter. Experts must be familiar with the applicable government work safety directives, accident prevention regulations, guidelines and generally accepted rules of technology in order to assess the operationally safe condition of the frequency inverter.

2.2 Designated use

The frequency inverter is designed according to the state of the art and recognized safety regulations.

The frequency inverters are electrical drive components intended for installation in industrial plants or machines. Commissioning and start of operation is not allowed until it has been verified that the machine meets the requirements of the EC Machinery Directive 2006/42/EC and DIN EN 60204-1.

The frequency inverters meet the requirements of the low voltage directive 2014/35/EU and DIN EN 61800-5-1. CE-labelling is based on these standards. Responsibility for compliance with the EMC Directive 2014/30/EU lies with the operator. Frequency inverters are only

available at specialized dealers and are exclusively intended for commercial use as per EN 61000-3-2.

No capacitive loads may be connected to the frequency inverter.

The technical data, connection specifications and information on ambient conditions are indicated on the rating plate and in the documentation and must be complied with at all times.

2.3 Misuse

Any use other than that described in "Designated use" shall not be permissible and shall be considered as misuse.

For example, the machine/plant must not be operated

- by uninstructed staff,
- while it is not in perfect condition,
- without protection enclosure (e.g. covers),
- without safety equipment or with safety equipment deactivated.

The manufacturer shall not be held liable for any damage resulting from such misuse. The sole risk shall be borne by the operator.

Explosion protection

The frequency inverter is an IP 20 protection class device. For this reason, use of the device in explosive atmospheres is not permitted.

2.4 Residual risks

Residual risks are special hazards involved in handling of the frequency inverter which cannot be eliminated despite the safety-compliant design of the device. Residual risks are not obviously identifiable and can be a potential source of injury or health hazard.

Typical residual hazards include:

Electrical hazard

Danger of contact with energized components due to a defect, opened covers or enclosures or improper working on electrical equipment.

Danger of contact with energized components inside of the frequency inverter if no external disconnection device was installed by the operator.

Electrostatic charging

Touching electronic components bears the risk of electrostatic discharges.

Thermal hazards

Risk of accidents by hot machine/plant surfaces, e.g. heat sink, transformer, fuse or sine filter.

Charged capacitors in DC link

The DC link may have dangerous voltage levels even up to three minutes after shutdown.

Danger of equipment falling down/over, e.g. during transport

Center of gravity is not the middle of the electric cabinet modules.

2.5 Safety and warning signs on the frequency inverter

- Comply with all safety instructions and danger information provided on the frequency inverter.
- Safety information and warnings on the frequency inverter must not be removed.

2.6 Used Pictograms and Signal Words

The following pictograms and signal words are used in the documentation:

**Danger!**

Danger refers to an immediate threat. Non-compliance with the precaution described will result in death, serious injury or material damage.

**Warning!**

Warning refers to a possible threat. Non-compliance with the warning may result in death, serious injury or material damage.

**Caution!**

Caution refers to an immediate hazard. Non-compliance may result in personal or material damage.

Attention!

Attention and the related text refer to a possible behavior or an undesired condition which can occur during operation.

Note

Marks information that facilitates handling for you and supplements the corresponding part of the documentation.

2.7 Directives and guidelines to be adhered to by the operator

The operator must follow the following directives and regulations:

- Ensure that the applicable workplace-related accident prevention regulations as well as other applicable national regulation are accessible to the staff.
- An authorized person must ensure, before using the frequency inverter, that the device is used in compliance with its designated use and that all safety requirements are met.
- Additionally, comply with the applicable laws, regulations and directives of the country in which the frequency inverter is used.
- Any additional guidelines and directives that may be required additionally shall be defined by the operator of the machine/plant considering the operating environment.

2.8 Operator's general plant documentation

- In addition to the user manual, the operator should issue separate internal operating instructions for the frequency inverter. The Operating Instructions of the frequency inverter must be included in the user manual of the whole plant.

2.9 Operator's/operating staff's responsibilities

2.9.1 Selection and qualification of staff

- Any work on the frequency inverter may only be carried out by qualified technical staff. The staff must not be under the influence of any drugs. Note the minimum age required by law. Define the staff's responsibility in connection with all work on the frequency inverter clearly.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering.
- The operating staff must be trained for the relevant work to be performed.

2.9.2 General work safety

- In addition to the user manual of the machine/plant, any applicable legal or other regulations relating to accident prevention and environmental protection must be complied with. The staff must be instructed accordingly.
Such regulations and/or requirements may include, for example, handling of hazardous media and materials or provision/use of personal protective equipment.
- In addition to this user manual, issue any additional directives that may be required to meet specific operating requirements, including supervision and reporting requirements, e.g. directives relating to work organization, workflow and employed staff.
- Unless approved of expressly by the manufacturer, do not modify the frequency inverter in any way, including addition of attachments or retrofits.
- Only use the frequency inverter if the rated connection and setup values specified by the manufacturer are met.
- Provide appropriate tools as may be required for performing all work on the frequency inverter properly.

2.10 Organizational measures

2.10.1 General

- Train your staff in the handling and use of the frequency inverter and the machine/plant as well as the risks involved.
- Use of any individual parts or components of the frequency inverter in other parts of the operator's machine/plant is prohibited.
- Optional components for the frequency inverter must be used in accordance with their designated use and in compliance with the relevant documentation.

2.10.2 Use in combination with third-party products

- Please note that BONFIGLIOLI VECTRON GmbH will not accept any responsibility for compatibility with third-party products (e.g. motors, cables or filters).
- In order to enable optimum system compatibility, BONFIGLIOLI VECTRON GmbH offers components facilitating commissioning and providing optimum synchronization of the machine/plant parts in operation.
- If you use the frequency inverter in combination with third-party products, you do this at your own risk.

2.10.3 Transport and storage

- The frequency inverters must be transported and stored in an appropriate way. During transport and storage the devices must remain in their original packaging.
- The units may only be stored in dry rooms which are protected against dust and moisture and are exposed to small temperature deviations only. The requirements of DIN EN 60721-3-1 for storage, DIN EN 60721-3-2 for transport and labeling on the packaging must be met.
- The duration of storage without connection to the permissible nominal voltage may not exceed one year.

2.10.4 Handling and installation

- Do not commission any damaged or destroyed components.
- Prevent any mechanical overloading of the frequency inverter. Do not bend any components and never change the isolation distances.
- Do not touch any electronic construction elements and contacts. The frequency inverter is equipped with components which are sensitive to electrostatic energy and can be damaged if handled improperly. Any use of damaged or destroyed components will endanger the machine/plant safety and shall be considered as a non-compliance with the applicable standards.
- Only install the frequency inverter in a suitable operating environment. The frequency inverter is exclusively designed for installation in industrial environments.
- If seals are removed from the case, this can result in the warranty becoming null and void.

2.10.5 Electrical connections

- The five safety rules must be complied with.
- Never touch live terminals. The DC link may have dangerous voltage levels even up to three minutes after shutdown.
- When performing any work on/with the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants of the country in which the frequency inverter is used.
- The cables connected to the frequency inverters may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.
- Only connect the frequency inverter to suitable supply mains.

2.10.5.1 The five safety rules

When working on/in electrical plants, always follow the five safety rules:

1. Isolate
2. Secure to prevent restarting
3. Check isolation
4. Earth and short-circuit,
5. Cover or shield neighboring live parts.

2.10.6 Safe operation

- During operation of the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to the applicable national and international safety directives.
- During operation, never open the machine/plant
- Do not connect/disconnect any components/equipment during operation.

- The machine/plant holds high voltage levels during operation, is equipped with rotating parts (fan) and has hot surfaces. Any unauthorized removal of covers, improper use, wrong installation or operation may result in serious injuries or material damage.
- Some components, e.g. the heat sink or brake resistor, may be hot even some time after the machine/plant was shut down. Don't touch any surfaces directly after shutdown. Wear safety gloves where necessary.
- The frequency inverter may hold dangerous voltage levels until the capacitor in the DC link is discharged. Wait for at least 3 minutes after shutdown before starting electrical or mechanical work on the frequency inverter. Even after this waiting time, make sure that the equipment is deenergized in accordance with the safety rules before starting the work.
- In order to avoid accidents or damage, only qualified staff and electricians may carry out the work such as installation, commissioning or setup.
- In the case of a defect of terminals and/or cables, immediately disconnect the frequency inverter from mains supply.
- Persons not familiar with the operation of frequency inverters must not have access to the frequency inverter. Do not bypass nor decommission any protective facilities.
- The frequency inverter may be connected to power supply every 60 s. This must be considered when operating a mains contactor in jog operation mode. For commissioning or after an emergency stop, a non-recurrent, direct restart is permissible.
- After a failure and restoration of the power supply, the motor may start unexpectedly if the Auto Start function is activated.
If staff are endangered, a restart of the motor must be prevented by means of external circuitry.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to EN 60204 and applicable the safety directives (e.g. Working Machines Act or Accident Prevention Directives).

2.10.7 Maintenance and service/troubleshooting

- Visually inspect the frequency inverter when carrying out the required maintenance work and inspections at the machine/plant.
- Perform the maintenance work and inspections prescribed for the machine carefully, including the specifications on parts/equipment replacement.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering. Only use original spare parts.
- Unauthorized opening and improper interventions in the machine/plant can lead to personal injury or material damage. Repairs on the frequency inverters may only be carried out by the manufacturer or persons authorized by the manufacturer. Check protective equipment regularly.
- Before performing any maintenance work, the machine/plant must be disconnected from mains supply and secured against restarting. The five safety rules must be complied with.

2.10.8 Final decommissioning

Unless separate return or disposal agreements were made, recycle the disassembled frequency inverter components:

- Scrap metal materials
- Recycle plastic elements
- Sort and dispose of other component materials

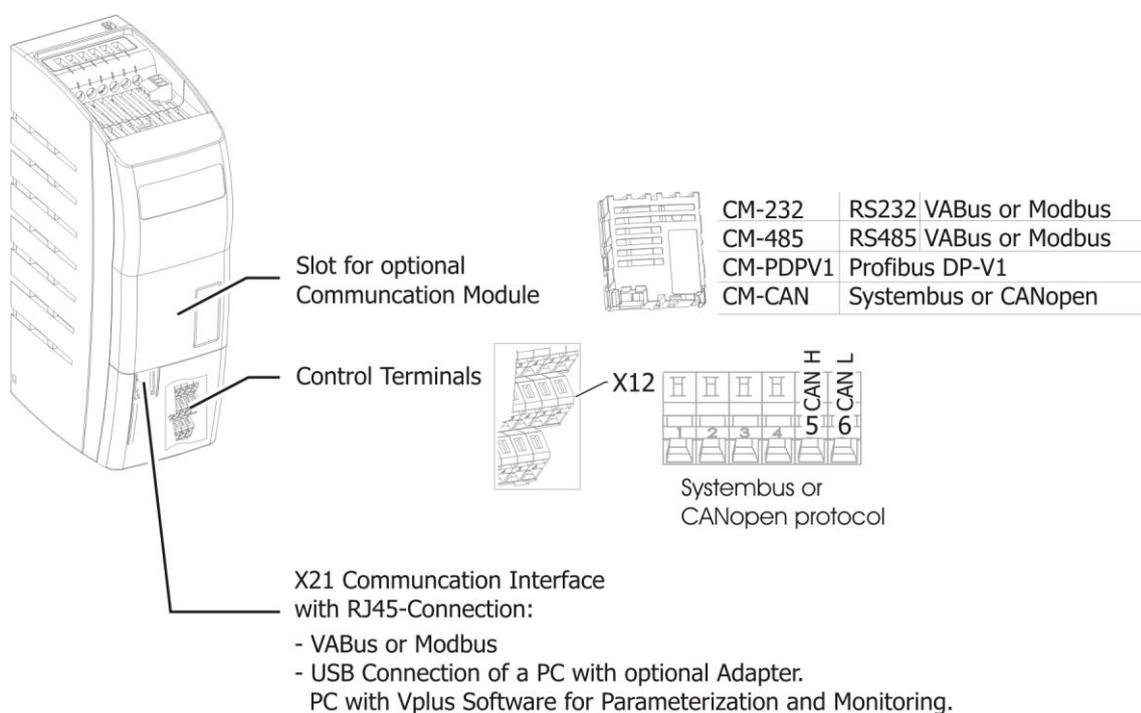


Electric scrap, electronic components, lubricants and other utility materials must be treated as special waste and may only be disposed of by specialized companies.



Always comply with any applicable national disposal regulations as regards environmentally compatible disposal of the frequency inverter. For more details, contact the competent local authorities.

3 Communication Options



Interface	See
X21 ¹	Instructions for VABus or Modbus.
CM-232	Instructions for VABus or Modbus.
CM-485	Instructions for VABus or Modbus.
CM-PDPV1	Instructions for Profibus DP-V1.
CM-CAN	Instructions for Systembus or CANopen® ² .
Control Terminals CAN-Connection	Instructions for Systembus or CANopen®.

¹ Install an interface adapter for connection to a PC. This enables parameterization and monitoring via the VPlus PC-Software.

² The CANopen®-Communication products fulfill the specifications of the CiA® (CAN in Automation) user organization.

4 Installation of an optional Communication Module

This chapter describes the assembly and disassembly of the communication module.

4.1 Assembly

The communication module is pre-assembled in a casing. Additionally, a PE spring is enclosed for PE connection (shield).



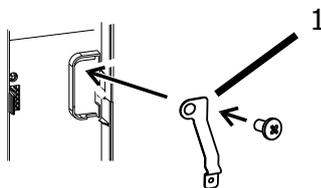
Caution!

The frequency inverter must be disconnected from the power supply before installation of the communication module.

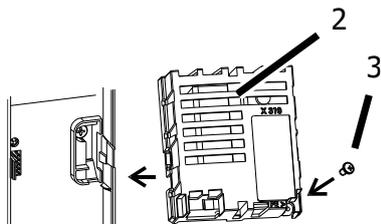
Installation under voltage is not permitted and will destroy the frequency inverter and/or the communication module.

Do not touch the PCB visible on the back of the module, otherwise components may be damaged.

- Remove the cover of the module slot.



- Attach the PE spring (1) using the screw provided on the frequency inverter.

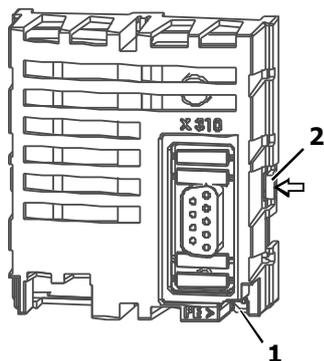


- Insert the communication module (2).
- Screw the communication module (2) onto the frequency inverter with the screw provided (3).

- Break off the pre-punched cut-out from the cover.
- Replace the cover.

4.2 Disassembly

- Remove the cover of the module slot.



- Loosen the screw (1) on the communication module.
- Using a small screwdriver, firstly unlock the right and then the left snap-in hook (2).
- Remove the communication module from the slot.
- Unscrew the PE spring.
- Replace the cover onto the frequency inverter.

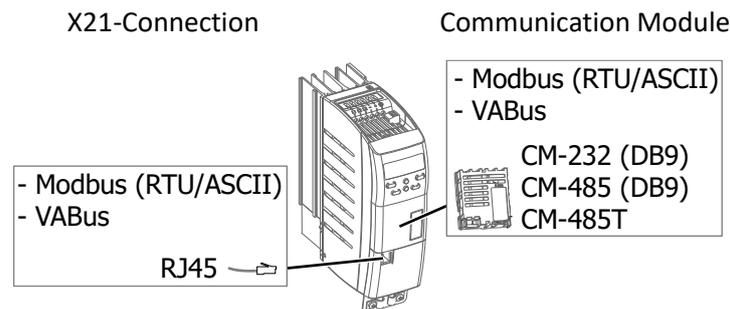
5 RS485 and RS232 Interfaces

The frequency inverter can be controlled from a PLC or another master device via a serial interface using the Modbus or VABus protocol. The VABus protocol is required for the parameterization with the VPlus PC-Software.

The connection can be established via the RJ45-Connector of the X21-Connection or via an optional communication module.

The following protocols can be selected:

- Modbus RTU
- Modbus ASCII
- VABus



The communication with the VABus-Protocol can be established via:

- the RJ45-Connector of the X21-Connection
- the CM-232 Communication Module with RS232-connection using a 9-pin D-Sub connector
- the CM-485 Communication Module with RS485-connection using a 9-pin D-Sub connector
- the CM-485T Communication Module with RS485-connection using a 7-pin terminal socket

The VABus communication is possible either via the RJ45-Connector of the X21-Connection or via an optional Communication Module. Simultaneous Modbus communication via the X21-Connection and an optional Communication Module is not possible.

Simultaneous VABus communication is possible via the X21-Connection and an optional Communication Module.

Possible Combinations of VABus with Modbus:

Communication Module		X21 (RJ45)
Modbus (RTU or ASCII)	and	VABus
VABus	and	Modbus (RTU or ASCII)
VABus	and	VABus

Combination Options with the Scope Function:

Communication Module		X21 (RJ45)
VABus	and	Scope Function (VABus)
Scope Function (VABus)	and	VABus
Scope Function (VABus)	and	Modbus (RTU or ASCII)
Modbus (RTU or ASCII)	and	Scope Function (VABus)

The Scope Function is started via the VPlus PC-Software. The Scope Function cannot be started via VPlus and an optional Communication Module at the same time.

The baud rates for the X21-Connection and the Communication Module can be set separately.

Note:

This document is not basic information for the RS232 or RS485 serial interface. Fundamental knowledge of the VABus protocol and the RS232 and RS485 serial interfaces is a prerequisite.

In some sections – as an alternative to control via the operator panel – settings and display possibilities are described with the help of the VPlus PC-Software. Here, VPlus communicates with the frequency inverter via the X21-Connection or via an optional CM-232 or CM-485 Communication Module.

If the serial interface of an optional CM-232 or CM-485 Communication Module is connected to a PLC, then simultaneous access to the frequency inverter from the VPlus PC-Software is no longer possible. In this case, the connection to the PC can be made via USB with the help of an optional interface adapter on the X21-Connection.

**Warning!**

Via the VABus-Communication, a control unit can access all of the frequency inverter parameters.

The changing of parameters, whose meaning is not known to the user, can lead to the malfunctioning of the frequency inverter and to dangerous situations in the plant.

**Caution!**

If values are to be written regularly with a high repetition rate, then no entry may be made to the EEPROM, as it only has a limited number of admissible write cycles (approx. 1 million cycles). If the number of allowed write cycles is exceeded then the EEPROM will be damaged. See Chapter 8 "Handling of Data Sets / Cyclic".

RS485-Connection

Frequency inverters can be connected to a bus system using CM-485 Communication Modules. The bus structure is linear and implemented as a 2-wire line. Up to 247 frequency inverters can be addressed and polled from a bus master via VABus.

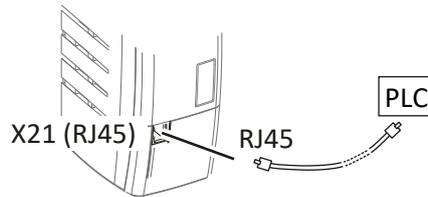
The frequency inverters can be parameterized and controlled via the bus system. During operation data can be requested and set from a PC or PLC.

RS232-Connection

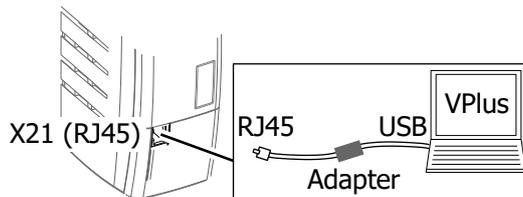
The RS232-Connection allows a point to point connection between the participants.

5.1 X21-Connection

The X21-Connection with the RJ45-Connector enables the connection to the RS485 interface of a PLC.



With an optional USB-Adapter the USB-Interface of a PC can be connected to the X21 Interface. This enables parameterization and monitoring using the VPlus PC-Software.



5.2 Communication Modules

Direct connection of the CM-232 to a PC or PLC

The CM-232 Communication Module enables a direct connection between a 9-pin D-Sub connector (X310) of the CM-232 and the serial interface of a PC or PLC.

The configuration of the installed communication module is carried out using the VPlus PC-Software or using the Operator Panel.

With CM-232 the connection to the PC or PLC is made via a RS232-Connection Line (1:1 occupancy).

Direct connection of the CM-485 to a PC or PLC

For the direct connection between the 9-pin D-Sub Interface (X310) of the CM-485 and the serial RS232-Interface of a PC or PLC, install an RS485/RS232 interface adapter on the signal line.

The configuration of the installed communication module is carried out using the VPlus PC-Software or using the Operator Panel.

Attention!

The transmitter and receiver must be set to the same transfer rate (baud rate).

The set baud rate applies to the CM-232 and CM-485 communication modules.

Work Steps:

- Mount the CM-232 / CM-485 Communication Module onto the frequency inverter.
- For the CM-232 Communication Module:
Connect the CM-232 and PC with an RS232-Cable.
- For the CM-485 Communication Module:
Connect the CM-485 with a RS485-Cable to the RS485/RS232 Interface Adapter.
Connect the RS232-Connection of the Interface Adapter with the PC/PLC.

Setting the type of Protocol

The factory setting of the CM-232/CM-485 Communication Modules is the BONFIGLIOLI VECTRON standard protocol (VABus). Communication with the VPlus PC-Software is only possible using this protocol.

The VABus protocol enables the operation of a straight Master/Slave-System. The Bus-Master can be a PC, a PLC or any arbitrary computer system.

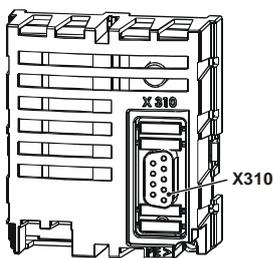
5.2.1 Installation Notes

- For the RS485 bus cable use a twisted, shielded cable.
- Implement the shield as a braided shield (not a foil shield).
- Connect the cable shield surfaces at both ends to PE.
- The connector pin assignments of an RS485-Cable and an RS232-Cable are different. No data transfer is possible if the wrong cable is used.

5.2.2 Pin Assignment

This chapter describes the Pin assignment of the usable modules.

5.2.2.1 RS232 Communication Module CM-232 DB9



The RS232-Interface is connected to a PC or a controller via the 9-pin D-Sub socket X310.

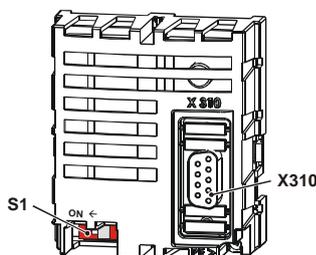
The assignment complies with the standard, so that only an RS232 connection cable (1:1) is required.

Bus Connector X310 CM-232 (9-pin D-Sub)

Pin	Name	Function
Housing	Shield	connected with PE
1	–	n. c.
2	RxD	receive data (input)
3	TxD	transmit data (output)
4	–	n. c.
5	0 V	Ground
6	–	n. c.
7	–	n. c.
8	–	n. c.
9	–	n. c.

n.c: not connected

5.2.2.2 RS485 Communication Module CM-485 DB9



The RS232-Interface is connected to a PC or a controller via the 9-pin D-Sub socket X310.

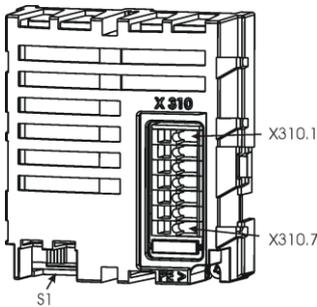
For details on the pin assignment, refer to the following table.

Bus Connector X310 CM-485 (9-pin D-Sub)

Pin	Name	Function
Housing	Shield	connected with PE
1	Data Line B	short-circuit proof and functionally insulated; max. current 60 mA
2	Data Line B'	same as pin 1 – for cable network
3	0 V	GND/earth
4	–	n. c.
5	+5 V	Interface converter supply voltage +5 V
6	–	n. c.
7	Data Line A	short-circuit proof and functionally insulated; max. current 60 mA
8	Data Line A'	same as pin 7 – for cable network
9	–	n. c.

n.c.: not connected

5.2.2.3 RS485 Communication Module CM-485T



The RS485-Interface is connected via the 7-pin terminal socket X310.

For details on the pin assignment, refer to the following table.

Bus Connector X310 CM-485 T (7-pin terminal)

Terminal	Name	Function
1	Data Line A	short-circuit proof and functionally insulated; max. current 60 mA
2	Data Line A'	same as pin 1 – for cable network
3	Data Line B	short-circuit proof and functionally insulated; max. current 60 mA
4	Date Line B'	same as pin 3 – for cable network
5	+5 V	Interface converter supply voltage +5 V
6	0 V	GND/earth
7	PE	Shield

5.2.3 RS485 Bus Termination

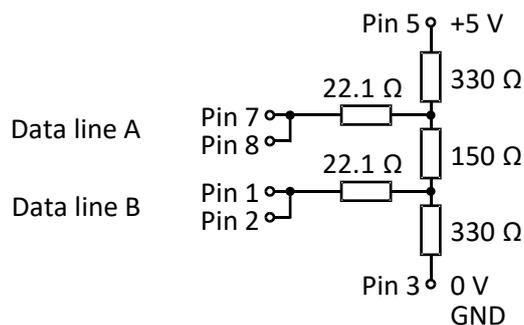
Attention!

The passive bus termination (connection of a termination resistor), is required at the physically first and last client. It can be activated by the CM-485 and CM-485T DIP Switch S1.

By default, the bus termination is set to OFF.

It is important to implement a correct termination. Otherwise, no communication is possible via the RS485-Interface.

As an alternative, the active bus termination is possible via a corresponding circuit:

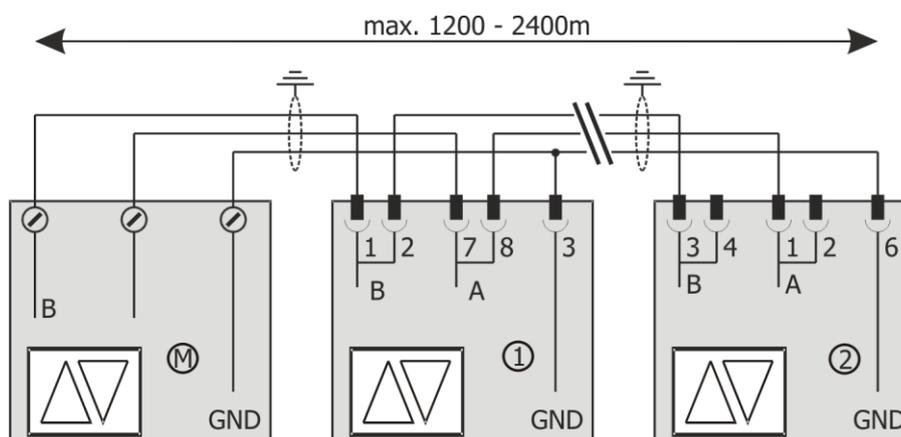


The active termination is only allowed once on each branch. The bus termination via an external circuit and via DIP switch at the same time is not allowed.

Pay attention to the ground wiring. This will protect the communication bus against high noise level.

For easy wiring the signal terminals A and B have parallel contacts.

Example of wiring with different CM-485 modules:



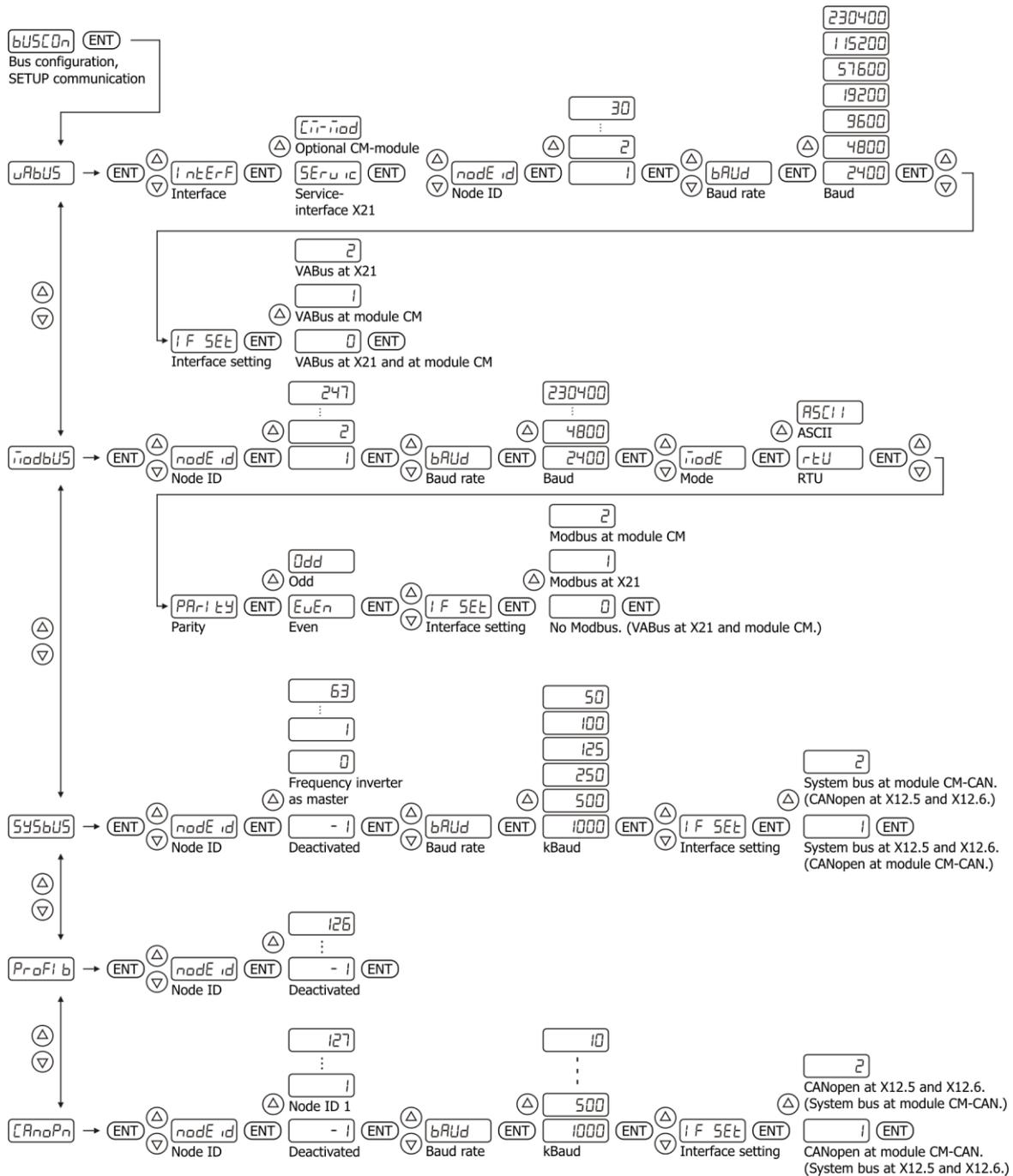
M	Master (i.e. PC)			Termination ON
1	Inverter 1	CM-485 DB9	9-pin D-Sub	Termination OFF
2	Inverter 2	CM-485T	7-pin terminal socket	Termination ON

5.3 Commissioning via the Operator Panel

A communication interface can be set up in the "Setup" menu of the Operator Panel. Further communication parameters can be set in the "Para" menu.

5.3.1 Menu for setting up the Communication

The communication interface can be set up quickly and simple via the Operator Panel.



5.3.2 Select the Protocol

- Select VABus.

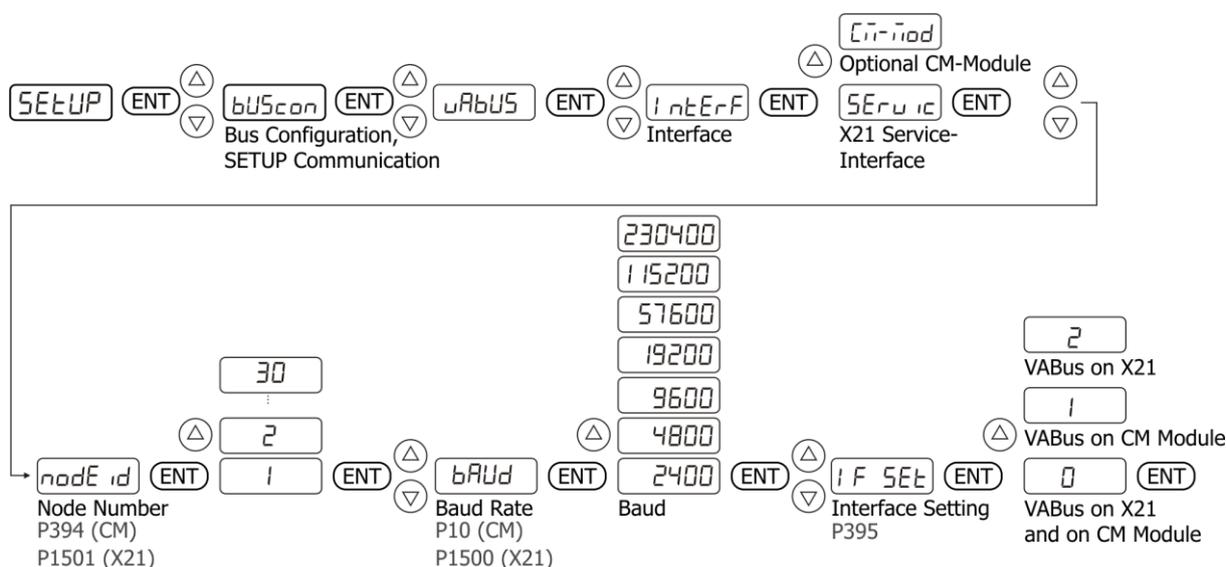
	Display
Select the "Setup" menu using the arrow keys.	SEtUP
	ENT
Using the arrow keys select:	▲ ▼
Setting up a Communication Interface (Bus Configuration)	bUSCOn
	ENT
Select a protocol using the arrow keys:	▲ ▼
CANopen	CAnoPn
Profibus ¹	PrOFI b
Systembus	SYSbUS
Modbus	ModbUS
VABus	vAbUS
	ENT

5.3.3 Set the Communication Parameters

Parameter	Display
Select the interface that is to be parameterized (X21 Service-Interface or Communication Module).	IntErF
<ul style="list-style-type: none"> – Select the X21 Service-Interface for the VABus-Communication. Or:	SErVIC
<ul style="list-style-type: none"> – Select an optional CM-232 or CM-485 Communication Module for the VABus-Communication. The selection will only be displayed, if a communication module has been installed. 	CM-Mod
394 Node Number (CM: VABus NodeID). An optional CM-232 or CM-485 Communication Module was selected.	node id
1501 Node Number (X21: VABus Node-ID). The X21 Service-Interface was selected.	node id
10 CM: VABus Baud Rate. An optional CM-232 or CM-485 Communication Module was selected.	baUD

¹ The selection is only possible if an optional CM-PDPV1 Communication Module is installed.

1500	X21: VABus Baud Rate. The X21 Service-Interface was selected.	bAUD
395	Interface Setting Protocol (CM / X21).	IF SEt
	– Select the VABus protocol for the X21 Service-Interface Or:	2
	– Select the VABus protocol for an optional CM-232 or CM-485 Communication Module Or:	1
	– Select the VABus protocol for the X21 Service-Interface and for an optional CM-232 or CM-485 Communication Module.	0



5.4 Set the Protocol for X21-Connection and Communication Module

▪ 395 Protocol (CM / X21)

With Parameter *Protocol (CM / X21)* **395**, the communication protocol can be selected for an optional Communication Module (CM) and the X21-Connection.

<i>Protocol (CM/X21)</i> 395 (CM / X21)	Function
0 - CM: VABus / X21: VABus	The slot for an optional Communication Module and the X21-Connection (RJ45) are set to the VABus communication protocol. Factory setting.
1 - CM: VABus / X21: Modbus	The slot for an optional Communication Module is set to the VABus communication protocol. The X21-Connection (RJ45) is set to the Modbus communication protocol.
2 - CM: Modbus / X21: VABus	The slot for an optional Communication Module is set to the Modbus communication protocol. The X21-Connection (RJ45) is set to the VABus communication protocol.

6 VABus

The VABus protocol can be used via a fitting CM module or the onboard X21 connection (RJ45)

6.1 VABus on the X21-Connection

- 1500 X21: VABus Baud rate

With Parameter *X21: VABus Baud rate* **1500** the transfer rate of the VABus communication can be set. The setting applies to the X21-Connection. Parameter *Protocol (CM / X21)* **395** must be set

to "0 - CM: VABus / X21: VABus" or "2 - CM: Modbus / X21: VABus".

<i>VABus-X21 Baud rate</i> 1500		Function	max. Line Length
1 –	2400 Baud	Transfer rate 2400 Baud	30 m
2 –	4800 Baud	Transfer rate 4800 Baud	30 m
3 –	9600 Baud	Transfer rate 9600 Baud	30 m
4 –	19200 Baud	Transfer rate 19200 Baud	30 m
5 –	57600 Baud	Transfer rate 57600 Baud	10 m
6 –	115200 Baud	Transfer rate 115200 Baud	10 m
7 –	230400 Baud	Transfer rate 230400 Baud	10 m

Attention!

Changes to the baud rate are effective immediately. A restart of the frequency inverter is not required.

All bus participants must be set to the same baud rate.

1501 X21: VABus Node-ID

With Parameter *X21: VABus Node-ID* **1501** the node address for the VABus communication can be set. The setting applies to the X21-Connection. Parameter *Protocol (CM / X21)* **395** must be set to "0 - CM: VABus / X21: VABus" or "2 - CM: Modbus / X21: VABus".

Parameter		Setting		
No.	Description	Min.	Max.	Factory Setting
1501	VABus-X21 Node-ID	1	30	1

- 1502 X21: VABus Watchdog Timer

The communication can be monitored. If the communication fails, then no data or incorrect data will be transferred. This state will be detected by the Communication Watchdog.

The Watchdog-Function monitors the time within which no correct communication occurs. This time can be set with Parameter *X21: VABus Watchdog Timer* **1502**. The set value is the time in seconds within which at least one correct data exchange must occur.

If the set monitoring time is reached the frequency inverter generates the error F2010.

The setting applies to the X21-Connection. Parameter *Protocol (CM / X21)* **395** must be set to "0 - CM: VABus / X21: VABus" or "2 - CM: Modbus / X21: VABus".

Parameter		Setting		
No.	Description	Min.	Max.	Factory Setting
1502	VABus-X21 Watchdog Timer	0 s	10000 s	0 s

If the parameter is set to zero (factory setting), then monitoring is switched off.

6.2 VABus on the optional Communication Module

- *10 CM: VABus Baud Rate*

With Parameter *CM: VABus Baud Rate* **10** the transfer rate of the VABus communication can be set. The setting applies to the slot for an optional Communication Module. Parameter *Protocol (CM / X21)* **395** must be set to "0 - CM: VABus / X21: VABus" or "1 - CM: VABus / X21: Modbus".

<i>CM: VABus Baud Rate</i> 10		Function	max. Line Length
1 –	2400 Baud	Transfer rate 2400 Baud	30 m
2 –	4800 Baud	Transfer rate 4800 Baud	30 m
3 –	9600 Baud	Transfer rate 9600 Baud	30 m
4 –	19200 Baud	Transfer rate 19200 Baud	30 m
5 –	57600 Baud	Transfer rate 57600 Baud	10 m
6 –	115200 Baud	Transfer rate 115200 Baud	10 m
7 –	230400 Baud	Transfer rate 230400 Baud	10 m

Parameter *CM: VABus Baud Rate* **10** is only available if a communication module is installed.

Caution!

Changes to the baud rate are effective immediately. A restart of the frequency inverter is not required.

All bus participants must be set to the same baud rate.

- 394 CM: VABus NodeID

With Parameter *CM: VABus NodeID* **394** the node address for the VABus communication can be set. The setting applies to the slot for an optional Communication Module. Parameter *Protocol (CM / X21)* **395** must be set to "0 – VABus / VABus" or "1 – VABus / Modbus".

Parameter		Setting		
No.	Description	Min.	Max.	Factory Setting
394	CM: VABus NodeID	1	30	1

CM: Communication Module

Parameter *CM: VABus NodeID* **394** is only available, if a communication module is installed.

- 413 CM: VABus Watchdog Timer

The communication can be monitored. If the communication fails, then no data or incorrect data will be transferred. This state will be detected by the Communication Watchdog.

The Watchdog-Function monitors the time, within which no correct communication occurs. This time can be set with Parameter *CM: VABus Watchdog Timer* **413**. The set value is the time in seconds within which at least one correct data exchange must occur.

If the set monitoring time is reached the frequency inverter generates the error F2011.

The setting applies to the slot for an optional Communication Module. Parameter *Protocol (CM/X21)* **395** must be set to "0 - VABus/VABus" or "1 - VABus/Modbus".

Parameter		Setting		
No.	Description	Min.	Max.	Factory Setting
413	CM: VABus Watchdog Timer	0 s	10000 s	0 s

CM: Communication Module

If the parameter is set to zero (factory setting), then monitoring is switched off.

Parameter *CM: VABus Watchdog Timer* **413** is only available if a Communication Module is installed.

7 Protocol

The VABus protocol is the standard protocol of BONFIGLIOLI VECTRON. It defines and describes the communication via the RS232 / RS485 serial interfaces.

By default, the slot for an optional Communication Module and the X21-Connection are set to the VABus protocol. The setting can be changed via Parameter *Protocol (CM/X21)* **395**. See Chapter 5.4 "Set the Protocol for X21-Connection and Communication Modul".

The VABus protocol enables the operation as a pure Master/Slave system. A PC, a PLC or any type of computer system is the bus master.

The transmission protocol corresponds to the ISO standard 1745 for code-based information transfer and applies to the X21-Connection and the CM232 and CM-485 Communication Modules.

Two types of request are used:

- Send Request (Enquiry Telegram) for the request for reading parameters in the frequency inverter by the bus master.
- Setting Request (Select Telegram) for handing over parameter values or parameter settings to the frequency inverter by the bus master.

7.1 Character Format

The characters are based on 7-bit code according to DIN 66003 and consists of:

- 1 start bit
- 7 information bits (7 data bits B1... B7) corresponds to dec. value 0 ... 127
- 1 parity bit (even parity)
- 1 stop bit

Character format:

Start	B1	B2	B3	B4	B5	B6	B7	Parity	Stop
-------	----	----	----	----	----	----	----	--------	------

The start bit is followed by the least significant data bit.

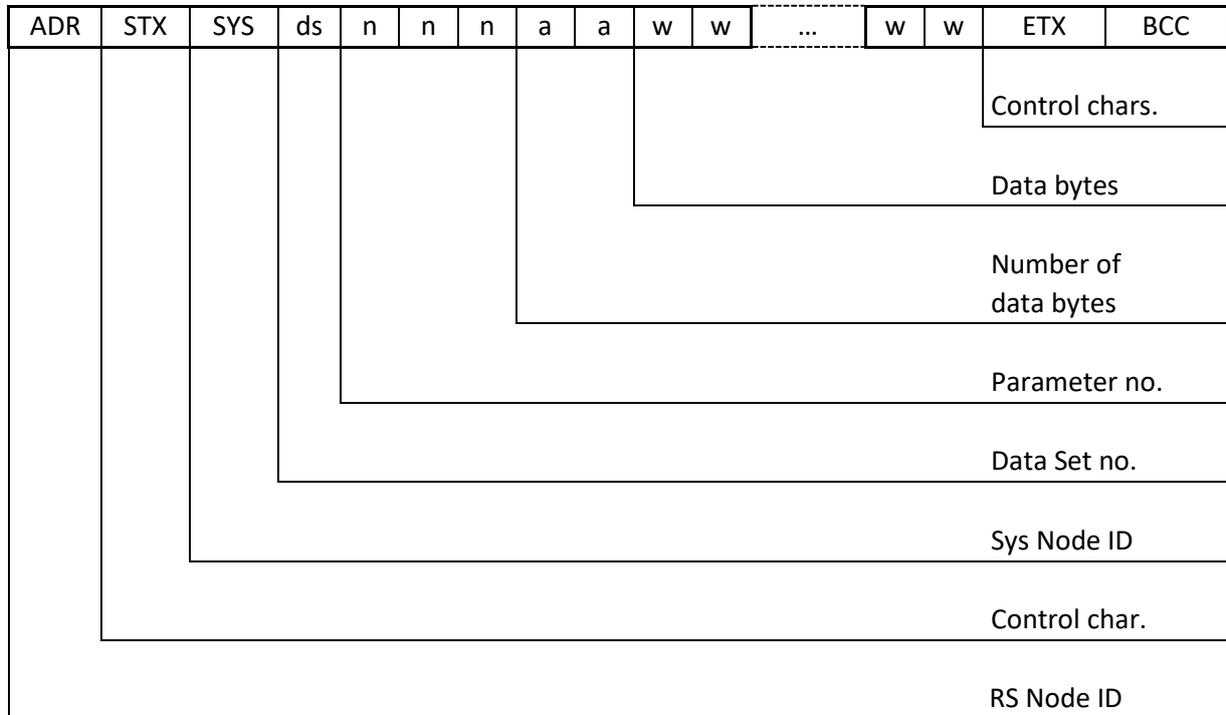
7.2 Telegram Types

The telegram setup must be complied with to ensure the correct communication to the device.

7.2.1 Used Symbols

Control characters and data are transmitted in the sent data telegrams. The information is always represented in ASCII or HEX-ASCII data format (except for the representation of the checksum).

Structure of a data telegram



The following table shows the symbols and data formats used.

Characters in Data Telegram			
Character	Function		
EOT	Control character End_Of_Transmission		
ADR	Address of the selected frequency inverter (Node-ID + 0x40). See Chapter 7.2.5 "Address Representation".		
STX	Control character Start_of_Text		
SYS	System Node-ID (Node-ID + 0x40). See Chapter 7.2.7 "Systembus Node-ID".		
ds	Data Set number	(0, 1, 2, 3 ... 9)	1
nnn	Parameter number	(000 ... F99)	
aa	No. of subsequent data bytes	(01 ... 99)	
www...www	Data bytes	(0 ... F)	2
ETX	Control character End_of_Text		
ENQ	Control character Enquiry		
BCC	BCC Binary-Checksum, any ASCII character. See Chapter 7.2.12. "Binary Checksum (BCC)".		
ACK	Control character Acknowledge (positive acknowledgement)		
NAK	Control character Negative_Acknowledge (negative acknowledgement)		

¹ represented as ASCII decimal numbers

² represented as ASCII-HEX numbers

7.2.2 Data Types

The number of data bytes depends on the type of the corresponding parameter. A maximum of 99 data bytes can be transferred.

Data Types Used				
Data Type	Type	No. of Data Bytes "w"	Value Range	No. of Bits
uInt	unsigned Integer	04	0 ... 65535	16
Int	Integer	04	-32768 ... +37767	16
Long	Long	08	-231 ... +231-1	32
String	char. string	variable, up to 99	-	variable

Parameter values with decimal places are transferred without the decimal point. Depending on the number of decimal places, the values are multiplied by 10, 100 or 1000.

The number of decimal places for the corresponding parameters is set in the frequency inverter. In this way it is made sure that the sent parameter values are processed with the correct number of decimal places.

Example: Frequency value with data type Long:

Value to be transferred = 100.25 Hz. The numerical value transmitted in the telegram is 10025, which corresponds to 0x2729 in HEX format. Since the data type is **Long**, 8 bytes are transferred ("wwwwwwww").

⇒ 00002729

Example: Current value with data type Int:

The value to be transmitted is 10.3 A. The numerical value transmitted in the telegram is 103, which corresponds to 0x67 in HEX format. Since the data type is **Int**, 4 bytes are transferred ("www").

⇒ 0067

7.2.3 Send Request / Enquiry Telegram

Via the enquiry telegram of the bus master, the frequency inverter is requested to send the data content of the relevant parameter. In the enquiry response telegram, the frequency inverter sends the requested data to the bus master. The master completes the transmission with EOT.

Bus Master ⇒ Frequency Inverter

EOT	ADR	SYS	ds	n	n	n	ENQ
-----	-----	-----	----	---	---	---	-----

Frequency Inverter ⇒ Bus Master

ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	w	w	ETX	BCC
-----	-----	-----	----	---	---	---	---	---	---	---	---	-----	-----	---	---	---	-----	-----

or in the case of an error:

ADR	NAK
-----	-----

Bus Master ⇒ Frequency Inverter

EOT

If no response from the frequency inverter is received within an adjustable response time (see chapter 7.4, "Monitoring Function (Timing / Watchdog)"), or if the frequency inverter returns incorrect data, the enquiry telegram is repeated three times (maximum of three transmissions possible). NAK signals an error. An error may have different causes. Errors may be caused by transmission failures, incorrect data or an incorrect string.

Attention!

After a NAK the error register *VABus SST-Error-Register 11* must be read out (see Chapter 7.3 "Telegram Check / Error Acknowledgement").

7.2.4 Setting Request / Select Telegram

Via the select telegram, the data is sent to the frequency inverter.

Bus Master ⇒ Frequency Inverter

EOT	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	...	w	w	w	ETX	BCC
-----	-----	-----	-----	----	---	---	---	---	---	---	---	---	-----	---	---	---	-----	-----

Frequency Inverter ⇒ Bus Master

With ACK, the frequency inverter acknowledges that a valid string was received.

ADR	ACK
-----	-----

Or in the case of an error:

ADR	NAK
-----	-----

Bus Master ⇒ Frequency Inverter

EOT

Attention!

After a NAK the error register *VABus SST Error Register 11* must be read out (see Chapter 7.3 "Telegram Check / Error Acknowledgement").

Broadcast transmissions to address 32 are not acknowledged with ACK, NAK and EOT.

In general, the bus master sends unconfirmed data telegrams in the case of broadcast transmissions.

7.2.5 Address Representation

Up to 30 frequency inverters can be used on an RS485 bus. These are assigned addresses 1...30.

Via address 32, all clients connected can be addressed simultaneously. Address 32 is also referred to as the Broadcast Address.

Attention!

After a transmission to the Broadcast Address 32, there is no response (ACK or NAK) from the frequency inverters.

Address Coding					
Num. Address	ASCII Char	Hex. Address	Num. Address	ASCII Char	Hex. Address
1	A	41	16	P	50
2	B	42	17	Q	51
3	C	43	18	R	52
4	D	44	19	S	53
5	E	45	20	T	54
6	F	46	21	U	55
7	G	47	22	V	56
8	H	48	23	W	57
9	I	49	24	X	58
10	J	4A	25	Y	59
11	K	4B	26	Z	5A
12	L	4C	27	[5B
13	M	4D	28	\	5C
14	N	4E	29]	5D
15	O	4F	30	^	5E
			32 ¹	`	60

¹ Broadcast Address only from the Master

7.2.6 Control Characters

The following control characters are used:

Control Characters		
Control Character	Name	HEX Value
EOT	End_Of_Transmission	04
ENQ	Enquiry	05
STX	Start_Of_Text	02
ETX	End_Of_Text	03
ACK	Acknowledge	06
NAK	Negative_Acknowledge	15

7.2.7 Systembus Node-ID

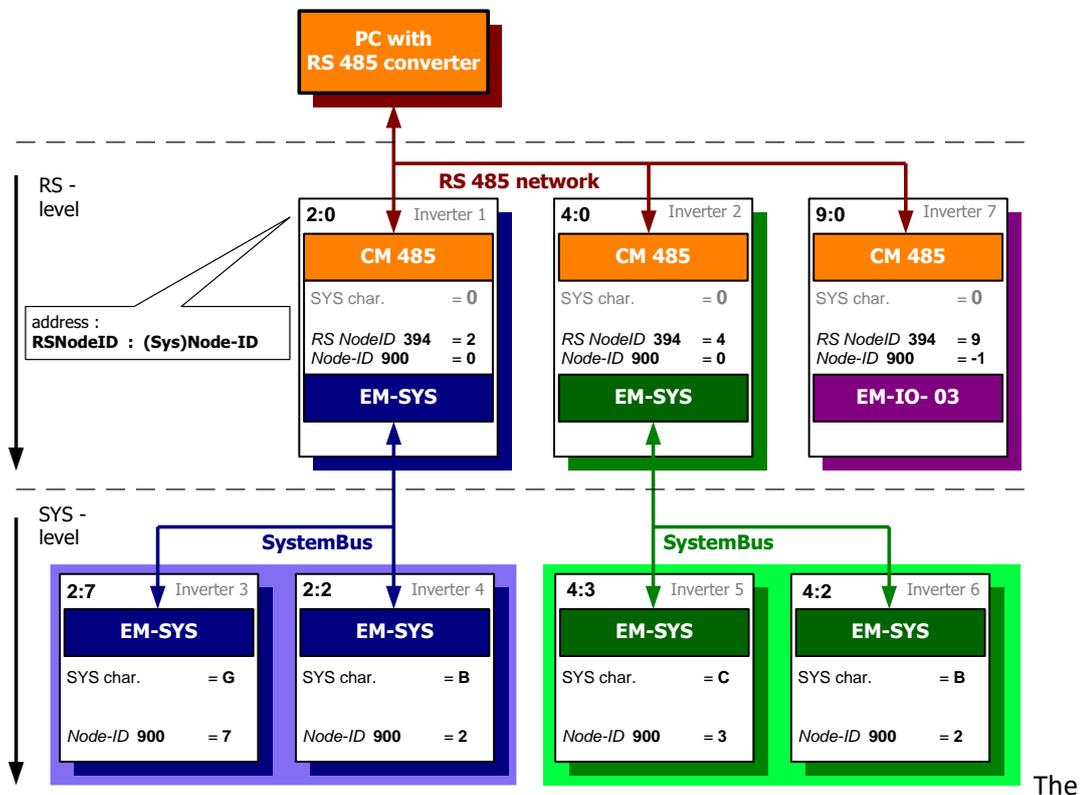
With the Systembus *Node-ID 900* the master communicates with inverters which are connected by a network system. If no network is present or the master communicates directly with the RS485-master inverter the SYS character is always zero (**0x30**). The Systembus *Node-ID 900* has the value range of 0 to 63.

<i>Node-ID 900</i>	Function	SYS Char
-1	No Systembus connected to the inverter.	„-1“ = 0xFFFF
0	The inverter is the Systembus master.	„0“ = 0x30
1 ... 63	The inverter is a Systembus slave with the indicated ID.	0x41 ... 0x7F

If the *Node-ID 900* is unequal to zero the SYS character is calculated by the following formula:

$$\text{SYS Char} = (\text{char}) (\text{Sys Node-ID Nr} + 0x40)$$

For example the *Node-ID 900* of 7 gives the char 0x47 = "G".



Addresses in a Systembus branch must be assigned clearly. The RS485 system can access to several Systembus branches so that identical Systembus addresses are possible in the network, but only via different superior RS485 network subscribers.

7.2.8 Data Set

The data set limits change depending on the information direction. The data set number is transferred as an ASCII_character:

Data Set			
Directions	Number	Char	Target
Master -> Inverter	0 – 4	0x30 .. 0x34	Inverter EEPROM
Master -> Inverter	5 – 9	0x35 .. 0x39	Inverter RAM
Inverter-> Master	0 – 4	0x30 .. 0x34	-

7.2.9 Parameter Number

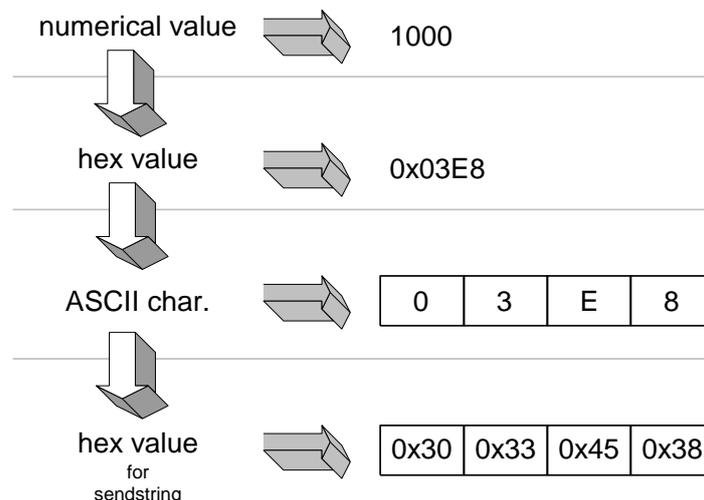
The parameter number is always transferred as 3 ASCII characters. If the parameter number is greater than 999, the first position (hundred) is converted to "A" to "F".

Parameter Number	
Number	In the Data Telegram
0 – 999	"000" .. "999"
1000 – 1099	"A00" .. "A99"
1100 – 1199	"B00" .. "B99"
...	...
1500 – 1599	"F00" .. "F99"

7.2.10 Data Bytes

Numerical values are represented by ASCII-HEX characters. The value is first of all converted to HEX notation and then, for each position transferred to ASCII charters.

Example:



7.2.11 Control Char ETX

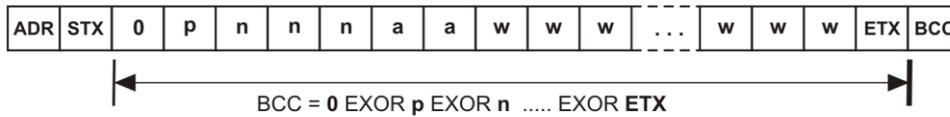
Each data frame with parameter values is finished via the EXT character (0x03).

7.2.12 Binary Checksum (BCC)

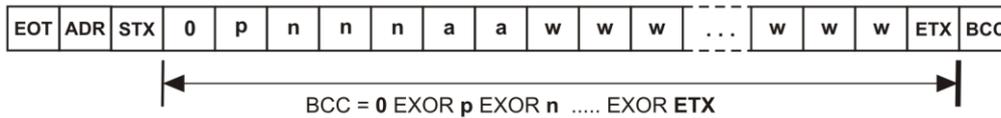
The binary checksum (BCC) is made up of a byte which contains the ExOR operation of all bytes between STX (exclusive) and ETX (inclusive).

Only telegrams with parameter values are extended by the binary checksum. Enquiry, ACK and NAK telegrams do not have a checksum.

Send Request



Setting Request



Example: (see also Chapter 8.2 "Data Type Int (value range -32768 ... +32767)")

SYS Node-ID	= 0	= 0x30										
Data Set	= 2	= 0x32										
Parameter Number	= 520	= 0x35 0x32 0x30										
No. of Bytes (Int)	= 04	= 0x30 x034										
Value	= 1000	= 0x30 0x33 0x45 0x38										

	SYS	ds	n	n	n	a	a	w	w	w	w	ETX
ASCII	0	2	5	2	0	0	4	0	3	E	8	-
Hex-Values	30	32	35	32	30	30	34	30	33	45	38	03

ExOR function over all characters in the data frame :

0x30 ^0x32 = 0x02

↙

0x02 ^0x35 = 0x37
 0x37 ^0x32 = 0x05
 0x05 ^0x30 = 0x35
 0x35 ^0x30 = 0x05
 0x05 ^0x34 = 0x31
 0x31 ^0x30 = 0x01
 0x01 ^0x33 = 0x32
 0x32 ^0x45 = 0x77
 0x77 ^0x38 = 0x4F
 0x4F ^0x03 = 0x4C

Example of ExOR operation for the first two characters :

```

0011 0000   = 0x30
0011 0010   = 0x32
--- EXOR ---
0000 0010   = 0x02
        
```

The BCC is calculated as character "L" = 0x4C.

7.3 Telegram Check / Error Acknowledgement

The frequency inverter and the bus master check the telegrams for correctness. Depending on the type of telegram, the corresponding reaction takes place. The telegrams are checked for correct syntax, address and text part (content, checksum).

In case the telegram contains errors, the frequency inverter either returns NAK or it does not respond at all. The possible causes are listed below:

No response:

- incorrect telegram structure
- incorrect control character
- wrong address
- telegram addressed to address 32 (Broadcast); in this case the frequency inverter does not reply

NAK

See Chapter 12.1 "Warning Messages".

▪ *11 VABus SST-Error-Register*

If a transmission (enquiry or select telegram) is answered by the frequency inverter with NAK, the error register *VABus SST-Error-Register 11* of the interface must be read out before a new **select telegram** is sent.

<i>VABus SST-Error-Register 11</i>	
Error No.	Meaning
0	no error
1	inadmissible parameter value
2	inadmissible data set
3	parameter not readable (write-only)
4	parameter not writeable (read-only)
5	EEPROM read error
6	EEPROM write error
7	EEPROM checksum error
8	parameter cannot be written while the drive is running
9	values of the data sets differ from one another
10	wrong parameter type
11	unknown parameter
12	checksum error in received telegram
13	syntax error in received telegram
14	data type of parameter does not correspond to the number of bytes in the telegram
15	unknown error
20	Systembus client not reachable.

When the error register *VABus SST-Error-Register 11* is read out, it is cleared at the same time.

Attention!

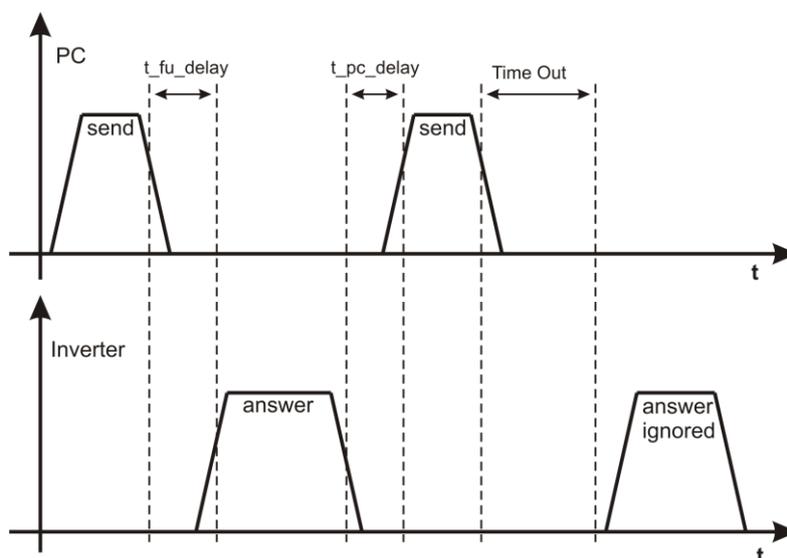
The frequency inverter will not accept a new select telegram until the error register has been read. Enquiry telegrams will be accepted and answered.

7.4 Monitoring Function (Timing / Watchdog)

The protocol defines a pure Master/Slave operation. If a frequency inverter is addressed by the bus master, other frequency inverters will only be addressed after the protocol with the first frequency inverter has been completed or the timeout time has expired.

After a frequency inverter has sent a telegram, a waiting time of 2 ms must be kept (t_{pc_delay}), which the frequency inverter requires in order to switch off the RS485-Transmitter. The bus master may not send a new telegram until this time has elapsed.

The frequency inverter replies 1 ms after receipt of a telegram (t_{fu_delay}) at the earliest. This means that the bus master must have switched off its RS485-Transmitter after 1 ms at the latest.



Attention!

If the CPU utilization is high (> 90%), then the response time can be more than 500 ms.

Note:

The specified times are valid for operation with RS485 and RS232.

If the frequency inverter has not received a character after 500 ms, it rejects the character string received so far and waits for a new transmission.

If the frequency inverter is operated via the serial interface (RS232, RS485), it may be important to monitor the presence of the communication line. For example it may be that the frequency inverter is switched on/off in Remote Mode, or it only receives its reference value cyclically via the serial interface. If the communication fails, no or faulty data are transmitted. This is recognized by the communication watchdog.

The watchdog function monitors the time in which no correct communication takes place.

Interface	Parameter	See Chapter
X21-Interface	X21: VABus Watchdog Timer 1502	6.1 "VABus on the X21-Connection"
optional Communication Mod- ule	CM: VABus Watchdog Timer 413	6.2 "VABus on the optional Communica- tion Module"

7.5 Block Access

If a number of parameters are to be transmitted regularly block by block, a block transmission can be carried out using the pseudo parameter described here. Since this type of block transmission only requires one communication overhead it can be carried out faster and may be easier to implement. The error evaluation and diagnosis for this block access is more difficult than for a separate parameter access.

The block definition has to be written in the parameter *Block definition* **017** before a block transmission can be carried out. (This block definition is only saved until the next Reset.) A block can then be written on the parameter *Write block* **018** and/or read from the parameter *Read block* **019**. Only parameters of the type word and/or double word can be transferred during block transmission. The check sum is calculated (like a separate parameter access) from SYS and ETX (both inclusively). Each transmission is responded by the frequency inverter with ACK or NAK.

Parameter *Block definition* **17**

The block definition is a string containing the parameter numbers of the parameters in the block as five-digit decimal figures in succession.

The digits have the following functions:

1. Digit S: Systembus node
 2. Digit d: Data set number
- Digit 3 to 5: Parameter number

The block can have a maximum string length of 80 characters.

SdnnnSdnnn ... Sdnnn

Parameter *Write Block* **18**

Parameter *Read Block* **19**

The data block is a string containing the values of the parameters in an ASCII-Hex form in succession.

The maximum string length is 80 characters, enabling the transmission of blocks of up to 20 parameters of the type "word" (each with 4 Hex digits). If the block contains parameters of the type double word (each with 8 Hex digits) the number of parameters which can be transmitted in a block is reduced accordingly.

Examples of a block transfer

Read parameters *Stator frequency* **210** (FS), *R.m.s current* **211** (I RMS) and *Active power* **213** (PW), each from data set 0.

Parameter string for *Write Parameter* **017**: „002100021100213“

Parameter string for *Read Parameter* **019**: „00002A5D00660028“

Set Parameter 017 Master ⇒ Frequency Inverter

	EOT	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	w	w	w	w	w	w	w	w	w	ETX	BCC	
ASCII	◆	A	⊙	0	0	0	1	7	1	5	0	0	2	1	0	0	0	2	1	1	0	0	2	1	3	♥
Hex-Values	04	41	02	30	30	30	31	37	31	35	30	30	32	31	30	30	30	³ ₂	31	31	30	30	32	31	33	♥ 00

Enquiry Telegram Master ⇒ Frequency Inverter

	EOT	ADR	SYS	ds	n	n	n	ENQ
ASCII	◆	A	0	0	0	1	9	♣
Hex-Values	04	41	30	30	30	31	39	05

Response Frequency Inverter ⇒ Master

	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	ETX	BCC
ASCII	A	⊙	0	0	0	1	9	1	6	0	0	0	0	2	A	5	D	0	0	6	6	0	0	2	8	♥ 4
Hex-Values	41	02	30	30	30	31	39	31	36	30	30	30	30	32	41	35	44	30	30	36	36	30	30	32	38	♥ 34

Parameter	Data Type	Hex-Value	Decimal	Result
210 Stator frequency	Double word = 8 Hex-digits	00002A5D _{hex}	10845 _{dec}	108,45 Hz
211 R.m.s current	Word = 4 Hex-digits	0066 _{hex}	102 _{dec}	10,2 A
213 Active power	Word = 4 Hex-digits	0028 _{hex}	40 _{dec}	4,0 kW

Write the parameters *Fixed Frequency 2* **481** (FF2) and *Fixed frequency 3* **482** (FF3) in data set 1.

Values:

FF2 (double word = 8 hex-digits) = 123.50 Hz, 12350_{dec} = 0000303E_{hex}

FF3 (double word = 8 hex-digits) = 43.45 Hz, 4345_{dec} = 000010F9_{hex}

Write parameter 017: "0148101482"

Write parameter 018: "0000303E000010F9"

8 Handling of Data Sets / Cyclic Writing

Access to the parameter values is carried out on the basis of the parameter number and the required data set.

There are parameters the values of which exist once (data set 0) as well as parameters the values of which exist four times (data set 1...4). These are used for data set change-over.

If parameters which exist four times in the data sets are set to data set = 0, all four data sets are set to the same value.

A read access with data set = 0 to such parameters is only successful if all four data sets are set to the same value. If this is not the case, error 9 = "different values in data sets" is signaled via the error register *VABus SST Error Register 11*. In this case, you must read out each data set separately for the relevant parameter (see chapter 7.3 "Telegram Check / Error Acknowledgement").

New setting requests (select telegrams) will be blocked by the error register *VABus SST Error Register 11*. For this reason, the error register must be read out, i.e. acknowledged, before a new select telegram can be sent.

Regardless of the signal status of the error register, reading access (enquiry telegrams) is still possible.

The values are entered into the EEPROM automatically on the controller. If values are to be written cyclically with a high repetition rate, there must be no entry into the EEPROM, as it only has a limited number of admissible writing cycles (about 1 million cycles).



Caution!

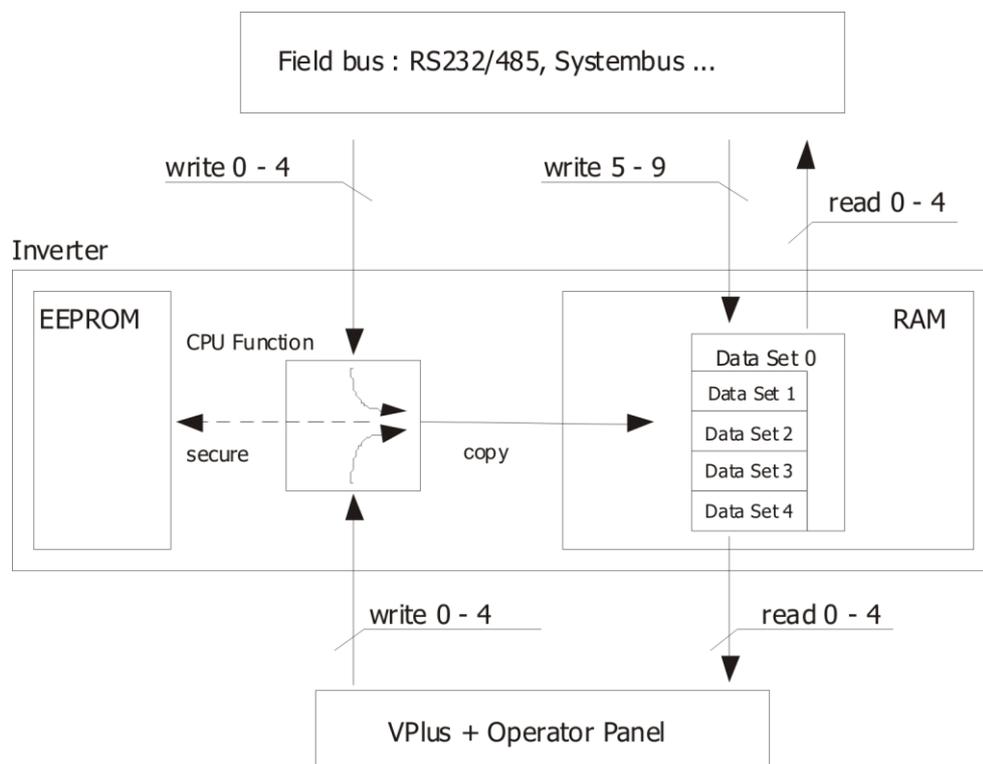
If the number of admissible writing cycles is exceeded, the EEPROM is destroyed.

In order to avoid the destruction of the EEPROM, data which are to be written cyclically can be entered in the RAM exclusively without a writing cycle on the EEPROM. In this case, the data are volatile, i.e. they are lost when the supply voltage is switched off (Mains Off). They must be written into the RAM again after the restart (Mains On).

The RAM writing operation is activated by increasing the number of the target data set by five.

Exceptions are the parameters *Control Word 410*, *Reference Frequency RAM 484* and *Reference Percentage RAM 524*. These parameters will be written into the RAM although their addresses are always 0.

Access to the Data Sets of the Frequency Inverter		
Parameter	EEPROM	RAM
Data Set 0	0	5
Data Set 1	1	6
Data Set 2	2	7
Data Set 3	3	8
Data Set 4	4	9



Example Telegrams

8.1 Data Type uInt (value range 0 ...65535)

Example 1:

Reading of parameter *Rated Speed* **372** in data set 2 from the frequency inverter with address 1.

Enquiry Telegram Master ⇒ Frequency Inverter

	EOT	ADR	SYS	ds	n	n	n	ENQ
ASCII	◆	A	0	2	3	7	2	♣
Hex-Values	04	41	30	32	33	37	32	05

Reply Frequency Inverter ⇒ Master

	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	ETX	BCC
ASCII	A	⊙	0	2	3	7	2	0	4	0	5	6	E	♥	E
Hex-Values	41	02	30	32	33	37	32	30	34	30	35	36	45	03	45

The sent hexadecimal value is 0x056E = decimal 1390. Parameter *Rated Speed* **372** has no decimal places.

Thus, the rated speed is 1390 min⁻¹.

Example 2:

Writing of parameter *Rated Mech. Power* **376** in data set 4 to the frequency inverter with address 3.

The rated mechanical power is to be set to 1.5 kW. Parameter *Rated Mech. Power* **376** has one decimal place.

Thus the value to be sent is 15, hexadecimal 0x000F.

Select Telegram Master ⇨ Frequency Inverter

	EOT	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	ETX	BCC
ASCII	◆	C	⊙	0	4	3	7	6	0	4	0	0	0	F	♥	G
Hex-Values	04	43	02	30	34	33	37	36	30	34	30	30	30	46	03	47

Reply Frequency Inverter ⇨ Master

	ADR	ACK
ASCII	C	♠
Hex-Values	43	06

In the case of an error, the reply would have resulted a NAK.

	ADR	NAK
ASCII	C	§
Hex-Values	43	15

8.2 Data Type Int (value range -32768 ... +32767)

Example 1:

Reading of parameter *Fixed Percentage 1* **520** in data set 2 from the frequency inverter with address 10.

Enquiry Telegram Master ⇨ Frequency Inverter

	EOT	ADR	SYS	Ds	n	n	n	ENQ
ASCII	◆	J	0	2	5	2	0	♣
Hex-Values	04	4A	30	32	35	32	30	05

Reply Frequency Inverter ⇨ Master

	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	ETX	BCC
ASCII	J	⊙	0	2	5	2	0	0	4	0	3	E	8	♥	L
Hex-Values	4A	02	30	32	35	32	30	30	34	30	33	45	38	03	4C

The sent hexadecimal value is 0x03E8 = decimal 1000. Parameter *Fixed Percentage 1* **520** has two decimal places.

Thus the reference percentage 1 = 10.00 %.

Example 2:

Writing of parameter *Fixed Percentage 4* **376** in data set 0 to the frequency inverter with address 30.

The reference percentage 4 is to be set to 70.05 %. Parameter *Fixed Percentage 4* **523** has two decimal places.

Thus the value to be sent is 7005, hexadecimal 0x1B5D.

Select Telegram Master ⇨ Frequency Inverter

	EOT	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	ETX	BCC
ASCII	◆	^	⊙	0	0	5	2	3	0	4	1	B	5	D	♥	1
Hex-Values	04	5E	02	30	30	35	32	33	30	34	31	42	35	44	03	31

Reply Frequency Inverter ⇨ Master

	ADR	ACK
ASCII	^	♠
Hex-Values	5E	06

In the case of an error, the reply would have resulted in a NAK.

	ADR	NAK
ASCII	^	§
Hex-Values	5E	15

8.3 Data Type Long (value range $-2^{31} \dots +2^{31}-1$)

Example 1:

Reading of parameter *Fixed Frequency 2* **481** in data set 0 from the frequency inverter with address 1.

Enquiry Telegram Master ⇨ Frequency Inverter

	EOT	ADR	SYS	ds	n	n	n	ENQ
ASCII	◆	A	0	0	4	8	1	♣
Hex-Values	04	41	30	30	34	38	31	05

Reply Frequency Inverter ⇨ Master

	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	w	w	w	w	ETX	BCC
ASCII	A	⊙	0	0	4	8	1	0	8	0	0	0	0	0	3	E	8	♥	H
Hex-Values	41	02	30	30	34	38	31	30	38	30	30	30	30	30	33	45	38	03	48

The sent hexadecimal value is 0x03E8 = decimal 1000. Parameter *Fixed Frequency 2* **481** has two decimal places.

Thus, fixed frequency 2 = 10.00 Hz.

Example 2:

Writing of parameter *Fixed Frequency 1* **480** in data set 0 to the frequency inverter with address 1.

Fixed frequency 1 is to be set to -120.00 Hz. Parameter *Fixed Frequency 1* **480** has two decimal places.

Thus the value to be sent is -12000, hexadecimal 0xFFFFD120.

Select Telegram Master ⇨ Frequency Inverter

	EOT	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	w	w	w	w	ETX	BCC
ASCII	◆	A	⊙	0	0	4	8	0	0	8	F	F	F	F	D	1	2	0	♥	@
Hex-Values	04	41	02	30	30	34	38	30	30	38	46	46	46	46	44	31	32	30	03	40

Reply Frequency Inverter ⇨ Master

	ADR	ACK
ASCII	A	♠
Hex-Values	41	06

In the case of an error, the reply would have resulted in a NAK.

	ADR	NAK
ASCII	A	§
Hex-Values	41	15

8.4 Data Type String (max. 99 characters)

Example 1:

Reading of parameter *User Name* **29** in data set 0 from the frequency inverter with address 1.

Enquiry Telegram Master ⇒ Frequency Inverter

	EOT	ADR	SYS	ds	n	n	n	ENQ
ASCII	◆	A	0	0	0	2	9	♣
Hex-Values	04	41	30	30	30	32	39	05

Reply Frequency Inverter ⇒ Master

	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	w	w	w	w	w	ETX	BCC
ASCII	A	⊕	0	0	0	2	9	0	7	V	e	c	t	r	o	n	♥	h		
Hex-Values	41	02	30	30	30	32	39	30	37	56	65	63	74	72	6F	6E	03	68		

The sent string for parameter *User Name* **29** reads "Vectron".

Example 2:

Writing of parameter *User Name* **29** in data set 0 to the frequency inverter with address 1.

The user name is to be set to "Inverter_17".

	EOT	ADR	STX	SYS	ds	n	n	n	a	a	w	w	w	w	w	w	w	w	w	w	ETX	BCC	
ASCII	◆	A	⊕	0	0	0	2	9	1	1	I	n	v	e	r	t	e	r	_	1	7	♥	D
Hex-Values	04	41	02	30	30	30	32	39	31	31	49	6E	76	65	72	74	65	72	5F	31	37	03	44

Reply Frequency Inverter ⇒ Master

	ADR	ACK
ASCII	A	♠
Hex-Values	41	06

In the case of an error, the reply would have resulted in a NAK.

	ADR	NAK
ASCII	A	§
Hex-Values	41	15

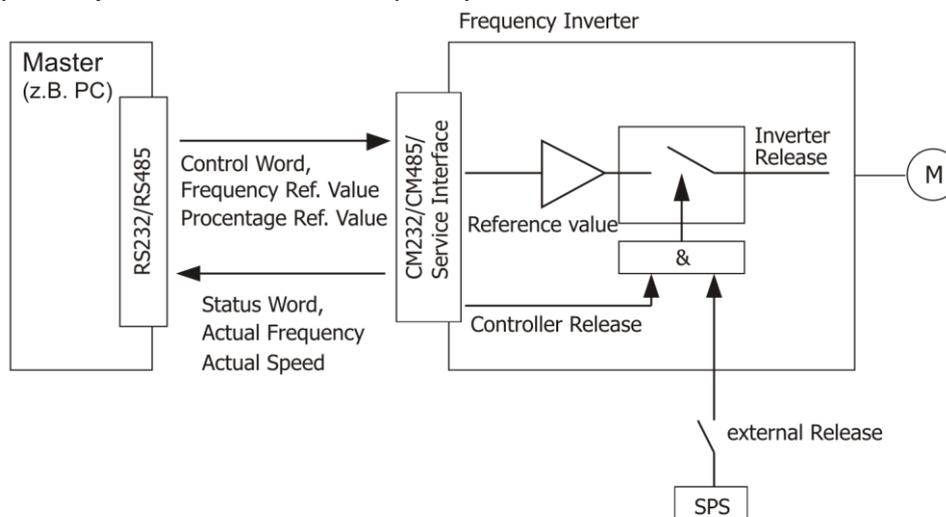
9 Control / Reference Value

- 410 Control Word
- 411 Status Word
- 484 Reference Frequency RAM [Hz]
- 524 Reference Percentage RAM[%]

The frequency inverter can be controlled completely via the serial interface. The following parameters and actual values are used for this:

Parameter		Setting			
No.	Name/Meaning	Min.	Max.	Factory Setting	Type
410	Control Word	0x0000	0xFFFF	-	uInt
411	Status Word	0x0000	0xFFFF	-	uInt
484	Ref. Frequency Value RAM [Hz]	-999,99	999,99	0,00	Long
524	Ref. Percentage RAM [%]	-300,00	300,00	0,00	Long

With the *Control Word* **410** (data type uInt), control commands are sent to the frequency inverter. With the *Reference Frequency RAM* **484** (data type Long [Hz]) or *Reference Percentage RAM* **524** (data type Long [%]), the reference line value is sent. Via the *Status Word* **411** (data type uInt), the status of the frequency inverter is read out.



Note:

Control Word **410**, *Reference Frequency RAM* **484** and *Reference Percentage RAM* **524** are stored in the RAM of the frequency inverter. This is generally addressed via data set 0.

- 412 Local/Remote

The frequency inverter can be controlled with various operation modes. These operation modes can be selected with parameter *Local/Remote* **412**.

<i>Local/Remote</i> 412	Function
0 - Control via Contacts	The Start and Stop commands as well as the direction of rotation are set via digital signals.
1 - Control via Statemachine	The Start and Stop commands as well as the direction of rotation are controlled via the Remote Statemachine ¹ of the communication interface.
2 - Control via Remote Contacts	The Start and Stop commands as well as the direction of rotation are controlled via virtual digital signals through the communication protocol.

For operation via the serial interface, settings 0, 1 and 2 are relevant. Further possible operation modes *Local/Remote* **412** are described in the frequency inverter operating instructions. These relate to the control via the Operator Panel and the control via digital signals.

Parameter *Local/Remote* **412** is data set related, i.e. by selecting a data set, you can switch over between the different operation modes.

- *414 Data Set Selection*

The data set switch-over can be carried out via control contacts at the digital inputs of the frequency inverter or via the bus. For data set change-over via the bus, parameter *Data Set Selection* **414** is used.

Parameter		Setting		
No.	Name	Min.	Max.	Factory Setting
414	Data Set Selection	0	5	0

With the default setting *Data Set Selection* **414** = 0, the data set change-over is carried out via the digital inputs.

If *Data Set Selection* **414** is set to 1, 2, 3 or 4, the selected data set is activated via the bus. At the same time, data set change-over via the digital inputs is deactivated.

If *Data Set selection* **414** = 5, then data set switching is only carried out whenever the frequency inverter is not released.

The currently selected data set can be read out with Parameter *Active Data Set* **249**. *Active data set* **249** states the activated data set with the value 1, 2, 3 or 4. This is independent of whether the data set change-over was carried out via control inputs or via *Data Set Selection* **414**.

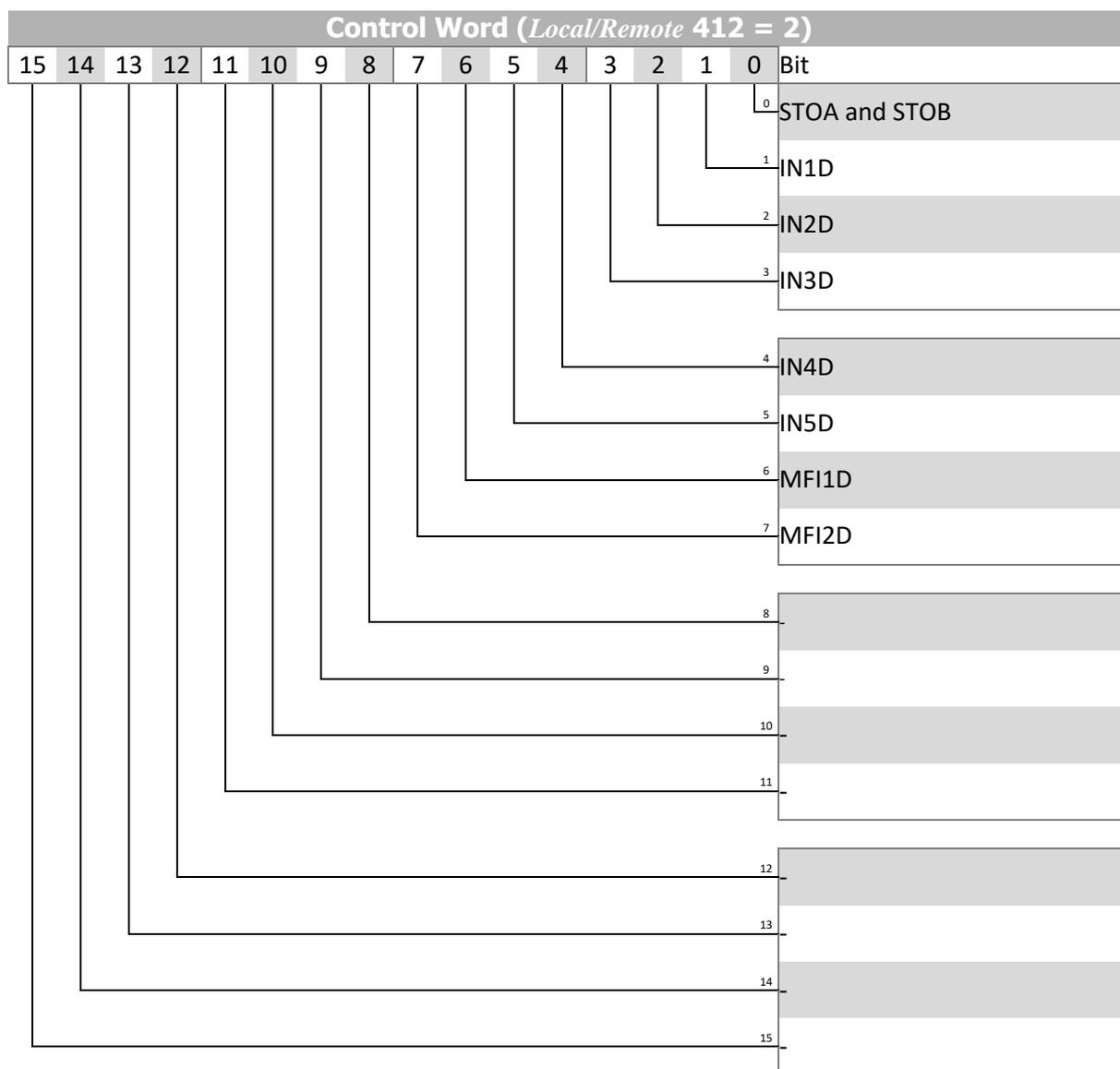
9.1 Control via Contacts / Remote-Contacts

In the operation mode "Control via Contacts" (*Local/Remote* **412** = 0), the frequency inverter is controlled via the digital inputs or via the multi-functional inputs that have been set to digital inputs.

In the operation mode "Control via Remote Contacts" (Parameter *Local/Remote* **412** = 2), the frequency inverter is controlled via the individual bits of the virtual digital inputs in the Control Word.

If the frequency inverter is controlled via the digital inputs, then in this operation mode control via the *Control Word* **410** does not apply.

¹ Statemachine is a standardized software module within the controller of the frequency inverter. The Statemachine represents the specified operating states and control within the frequency inverter.



If the operation mode "Control via Remote Contacts" is used, then the Controller Release "STOA+STOB" must be switched on and bit 0 of the Control Word must be set, in order to start the drive.

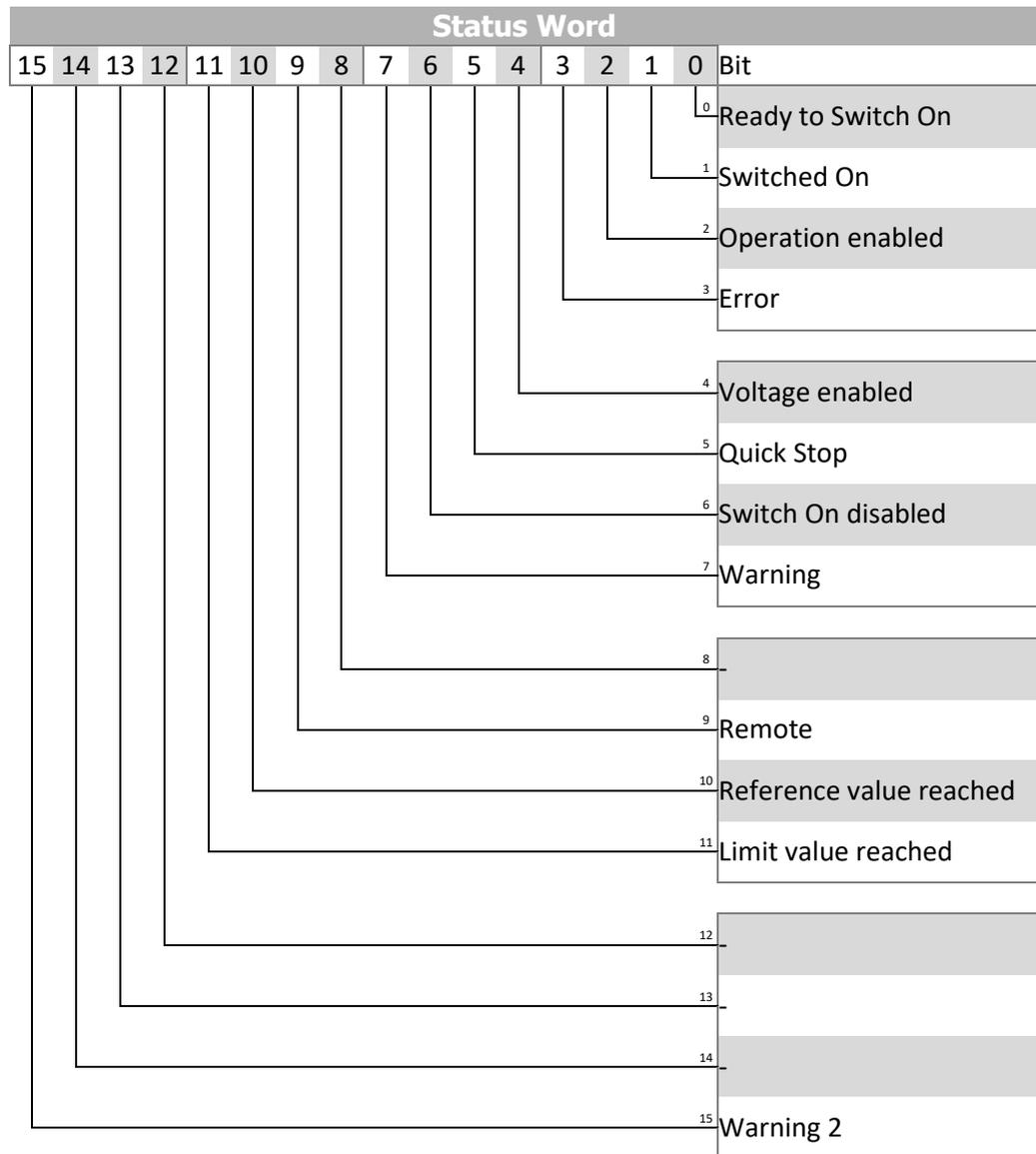
With the use of Remote Contacts the signal sources (digital inputs or multifunctional inputs set as digital inputs) are taken virtually from the *Control Word* **410**. Signals at the hardware terminals are not evaluated in the standard operation modes (e.g. 72 - IN2D).

Operation modes which are marked with the extension "(Hardware)" are available in order to evaluate signals at the hardware terminals.

Exceptions: The release must always be made via the Hardware-Inputs STOA (Terminal X11.3) and STOB (Terminal X13.3) and bit 0 "STOA+STOB" of the Control Word.

A Controller Release by software alone is not possible.

Parameter *Status Word* **411** has a length of 16 bits. The set bits have the following meaning:



Note:

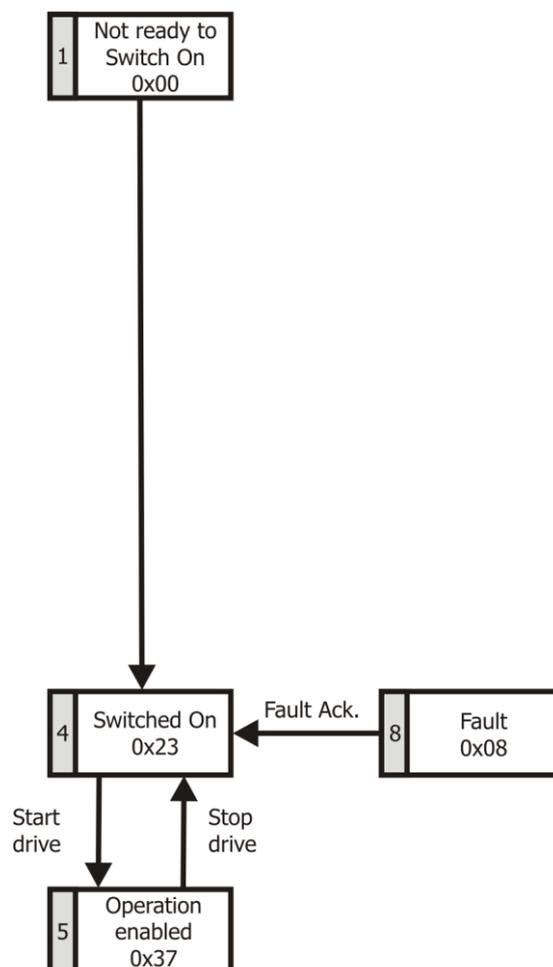
The frequency inverter supports an external 24 V voltage supply for the control electronics of the frequency inverter. Communication between the controlling device (PLC) and the frequency inverter is still possible even when the mains supply has been switched off.

Bit 4 "Voltage enabled" in the Status Word indicates the current status of the mains supply.

Bit 4 "Voltage enabled" = 0 signals "no mains supply" and that starting the drive is not possible.

Bit 4 "Voltage enabled" = 1 signals "mains supply switched on" and drive ready for starting.

9.1.1.1 Device State machine



Status Word	Bit 5	Bit 3	Bit 2	Bit 1	Bit 0
Switched On	1	0	0	1	1
Operation enabled	1	0	1	1	1
Error	x	1	x	x	x

"x" means any value.

If a fault has occurred, the cause of the fault can be read out via parameter *Current Error* **260**.

Status Word Bits 7 to 15:

Bit 7 "**Warning**" can signal an internal warning and results in the frequency inverter being switched off, depending on the cause. The evaluation of the warning is done by reading out the warning status via parameter *Warnings* **270**.

Bit 9, "**Remote**" is always set to 0 in the case of the control via contacts.

Bit 10 "**Reference value reached**" is set when the specified reference value is reached. In the special case of power failure regulation, the bit is also set when the power failure regulation reaches the frequency 0 Hz. For "Reference value reached" there is a hysteresis (tolerance range) which can be set via parameter *Reference Value Reached: Hysteresis* **549**.

Bit 11 "**Limit value reached**" indicates that an internal limit is active. This may be the current limit, the torque limit or the overvoltage control. All functions result in the reference value being left or not reached.

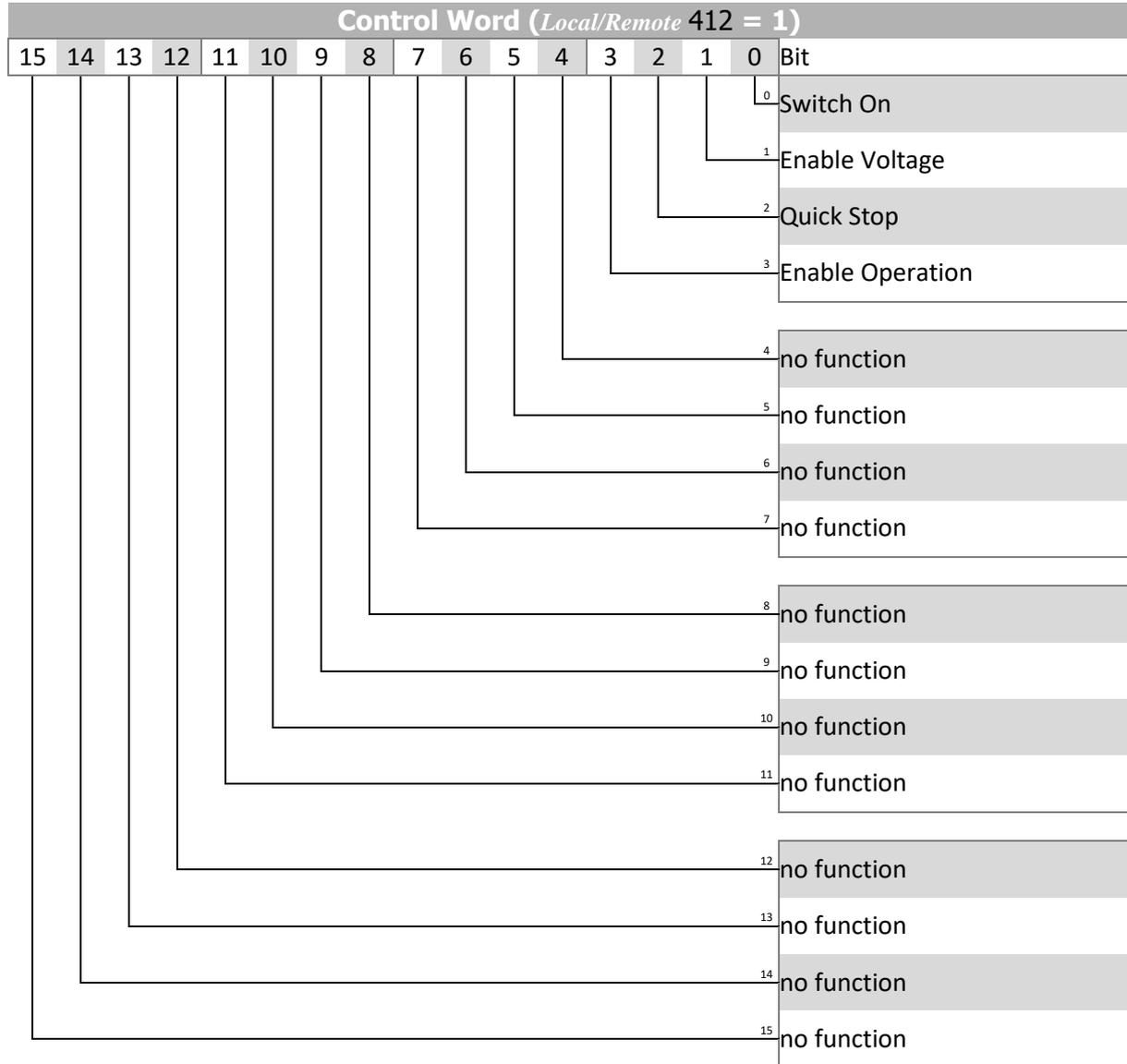
Bit 15 "**Warning 2**" signals a critical operating state which will result in a fault switch-off of the frequency inverter within a short time. This bit is set if there is a delayed warning relat-

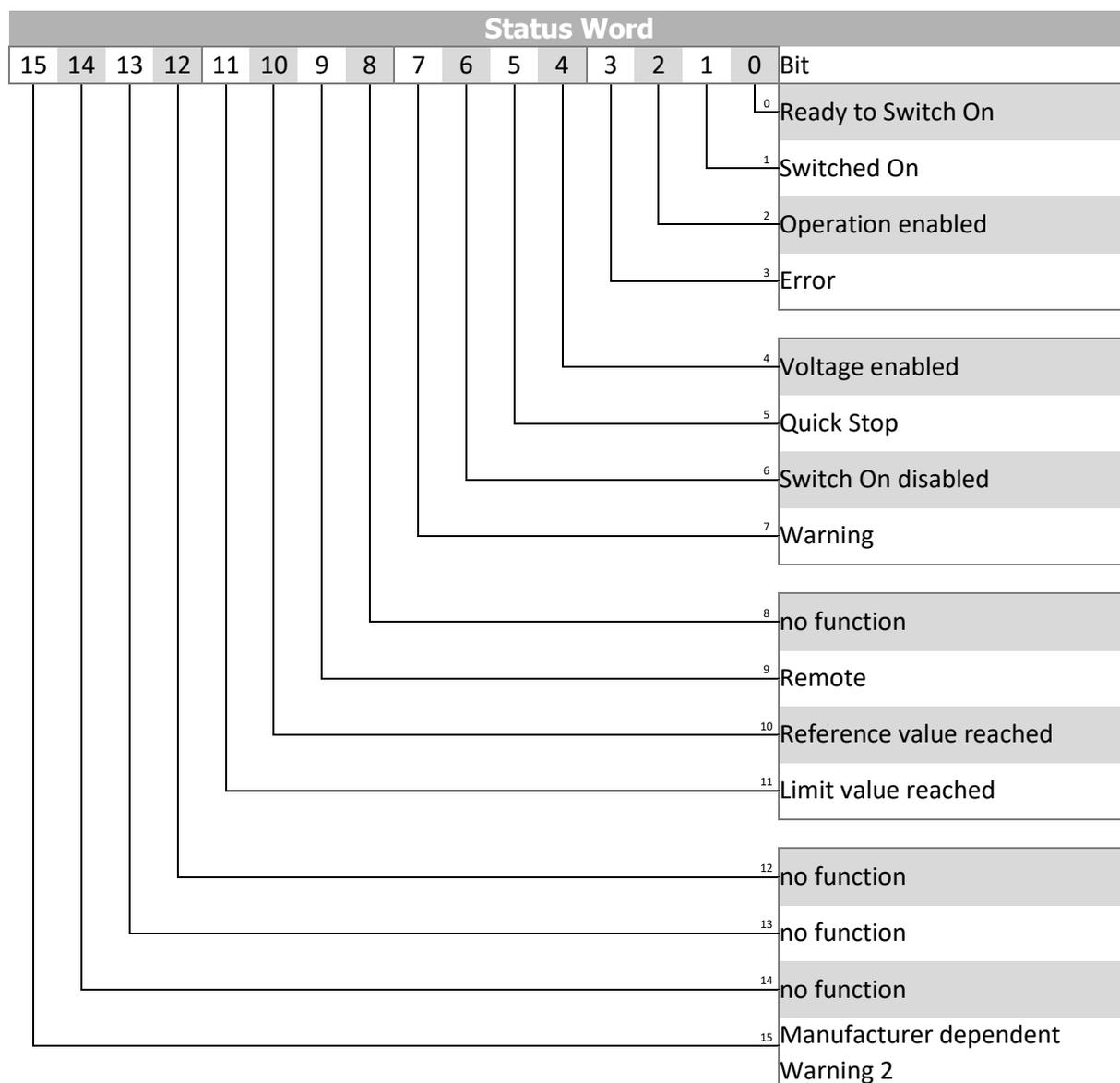
ing to the motor temperature, heat sink/inside temperature, Ixt monitoring or mains phase failure.

9.2 Control via Statemachine

In the operation mode "Control via Statemachine" (*Local/Remote* **412** = 1) the frequency inverter is controlled via the Control Word of the Statemachine .

Transition 4 to state "Operation enabled" is only possible if the Controller Release via STOA and STOB and one of the digital inputs for Start Right or Start Left is set.





Note:

The frequency inverter supports an external 24 V voltage supply for the control electronics of the frequency inverter. Communication between the controlling device (PLC) and the frequency inverter is still possible even when the mains supply has been switched off.

Bit 4 "Voltage enabled" in the Status Word indicates the current status of the mains supply.

Bit 4 "Voltage enabled" = 0 signals "no mains supply" and that starting the drive is not possible.

Bit 4 "Voltage enabled" = 1 signals "mains supply switched on" and drive ready for starting.

The device control commands are triggered by the following bit combinations in the Control Word:

Control Word						
Command	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	Transitions
	Reset Fault	Enable Operation	Quick Stop	Enable Voltage	Switch On	
Shutdown	X	X	1	1	0	2, 6, 8
Switch On	X	0	1	1	1	3
Enable Operation	X	1	1	1	1	4
Disable Voltage	X	X	X	0	X	7, 9, 10, 12
Quick Stop	X	X	0	1	X	7, 10, 11
Disable Operation	X	0	1	1	1	5
Reset Fault	0 ⇒ 1	x	x	x	x	15

"X" means any value.

Transition 3 (Command "Switch On") is only processed if Bit 4 "Voltage enabled" in the Status Word is set.

The Status Word reflects the operation state.

Status Word						
State	Bit 6	Bit 5	Bit 3	Bit 2	Bit 1	Bit 0
	Switch On disabled	Quick Stop	Error	Operation enabled	Switched On	Ready to Switch On
Switch On disabled	1	X	0	0	0	0
Ready to Switch On	0	1	0	0	0	1
Switched On	0	1	0	0	1	1
Operation enabled	0	1	0	1	1	1
Quick Stop active	0	0	0	1	1	1
Error Reaction active	0	X	1	1	1	1
Error	0	X	1	0	0	0

"X" means any value.

Bit 7 "**Warning**" can be set at any time. It signals a device-internal warning. The active warning can be read out from the Warning Status with Parameter *Warnings* **270**.

Bit 9 "**Remote**" is set if the operation mode "Control via Statemachine" (*Local/Remote* **412** = 1) is set, and the Controller Release is switched on.

Logical combination of the digital control signals:

STO = (STOA and STOB) AND (Start Right OR Start Left).

The frequency inverter can only be controlled, if the logical combination is true. The logical inputs for Start Right and Start Left can be directly linked to "On" or "Off" (Parameter *Start Clockwise* **68** and *Start Anticlockwise* **69**).

Bit 10 "**Reference frequency reached**" is set when the specified reference value is reached. In the special case of power failure regulation, the bit is also set when the power failure regulation reaches the frequency 0 Hz (see frequency inverter operating instructions). For "Reference value reached" there is a hysteresis (tolerance range) which can be set via

Parameter *Reference Value Reached: Hysteresis* **549** (see frequency inverter operating instructions).

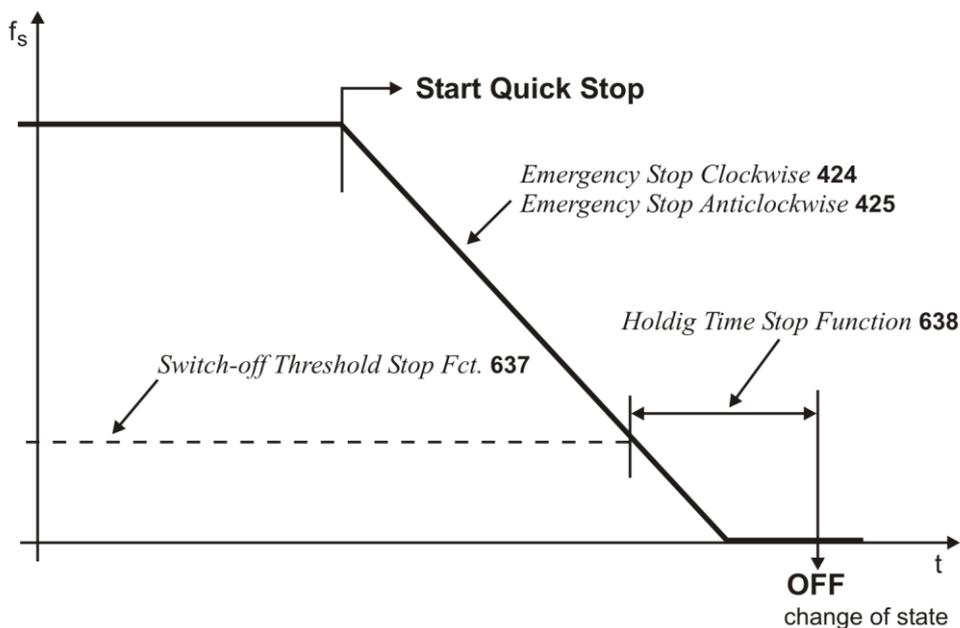
Bit 11 "**Limit value reached**" indicates that an internal limit is active. This may be the current limit, the torque limit or the overvoltage control. All functions result in the reference value being left or not reached.

Bit 15 "**Warning 2**" signals a critical operating state which will result in a fault switch-off of the frequency inverter within a short time. This bit is set if there is a delayed warning relating to the motor temperature, heat sink/inside temperature, Ixt monitoring or mains phase failure.

Behavior in Quick Stop

In this case, the parameters *Switch-Off Threshold Stop Function* **637** (percentage of parameter *Maximum Frequency* **419**) and *Holding Time Stop Function* **638** (holding time after the value drops below the switch-off limit) are relevant.

In a quick stop, the drive is brought to a standstill via the emergency stop ramps (*Emergency Stop Clockwise* **424** or *Emergency Stop Anticlockwise* **425**).



If the frequency/speed reaches the value zero during the switch-off time, the drive continues to be supplied with current until the switch-off time has elapsed. This ensures that the drive is at a standstill when the state changes.

9.3 Behavior in State-Transition 5

- 392 state-transition 5

The behavior in transition 5 (from "Operation enabled" to "Switched On") can be set via Parameter *state-transition 5* **392**.

<i>Transition 5 392</i>	Function
0 - Coast to Stop	Immediate transition from "Operation released" to "Switched On", drive coasts to a standstill.
1 - DC-Brake	Activation of DC brake, at the end of DC deceleration there is the change from "Operation enabled" to "Switched On".
2 - Ramp	Transition at normal ramp, when the drive has come to a standstill, there is the change from "Operation enabled" to "Switched On".

Setting 1 "DC-Brake" is only possible with applications with sensor-less control (e.g. configuration 110). Other configurations do not support this operation mode.

If the frequency inverter is operated with a configuration which does not support the operation mode DC-Brake (e.g. configuration 210, field-oriented control), value "1" cannot be used. In this case, the operation mode is not offered in the selection menus of the Operator Panel or VPlus PC-Software.

The default value for *state-transition 5 392* is operation mode 2 (ramp). For configurations with torque control, the default value is 0 (coasting).

If the configuration is changed, the value set for *state-transition 5 392* is also changed, if necessary.

If *state-transition 5 392* was triggered with value 1 "Direct current brake", a new Control Word will only be accepted after the transition process is complete. The change of state from "Operation released" to "Switched On" is carried out after the *Braking Time 632* parameterized for the DC brake has elapsed.

If parameter *state-transition 5 392* = 2 "ramp" is set, the Control Word can be set to 0x0F again, while the drive is decelerating. In this way, the drive accelerates to its set reference value again and remains in the state "Operation enabled".

The change of state from "Operation enabled" to "Switched On" is done after the value has dropped below the set switch-off threshold **and** the set holding time has elapsed (equivalent to the behavior in the case of a quick stop). In this case, the parameters *Switch-Off Threshold Stop Function 637* (percentage of parameter *Maximum Frequency 419*) and *Holding Time Stop Function 638* (holding time after the value drops below the switch-off limit) are relevant.

10 Actual Values

Actual Values		
No.	Description	Function
11	VABus SST-Error-Register	VABus Error Register. See Chapter 6 "VABus" und 7.3 "Telegram Check / Error Acknowledgement".
282	Reference Bus Frequency	Reference value from the serial interface.
283	Reference Ramp Frequency	Reference value from the Reference Frequency Channel.
411	Status Word	Modbus or VABus Status Word. See Chapter 9 "Control / Reference Value".

11 Parameter List

 The parameter is available in the four data sets.

11.1 Actual Values ("Actual" Menu)

Actual Value Parameters				
No.	Description	Units	Value Range	Chapter
RS485/RS232				
11	VABus SST-Error-Register	-	0... 15	7.3
Actual Frequency Inverter Values				
249	Active Data Set	-	0 ... 4	10
260	Actual Error	-	0 ... 0xFFFF	12.3
270	Warnings	-	0 ... 0xFFFF	12.1
274	Application Warnings	-	0 ... 0xFFFF	12.2
282	Reference Bus Frequency	Hz	-999,99 ... 999,99	10
283	Reference Ramp Frequency	Hz	-999,99 ... 999,99	10
Bus Control				
411	Status Word	-	0 ... 0xFFFF	9

11.2 Parameters ("Para" Menu)

Parameter				
No.	Description	Units	Value Range	Chapter
RS485/RS232				
10	VABus-CM Baud rate	-	Selection	6.2
Bus Control				
392	state-transition 5	-	Selection	9.3
RS485/RS232				
394	CM: VABus NodeID	-	1 ... 30	6.2
395	Protocol (CM / X21)	-	Selection	5.4
Bus Control				
410	Control Word	-	0 ... 0xFFFF	9
412	Local/Remote	-	Selection	9
414	Data Set Selection	-	0 ... 4	10
RS485/RS232				
413	CM: VABus Watchdog Timer	s	0 ... 1000	6.2, 7.4
Fixed Frequency Values				
484	Reference Frequency RAM	Hz	-999,99 ... 999,99	9
Fixed Percentage Values				
524	Reference Percentage RAM	%	-300,00 ... 300,00	9
VABus (X21-Connection)				
1500	X21: VABus Baud rate	-	Selection	6.1
1501	X21: VABus Node-ID	-	1 ... 30	6.1
1502	X21: VABus Watchdog Timer	s	0 ... 1000	6.1

12 Annex

12.1 Warning Messages

The warning messages are given via parameter *Warnings* **270**, bit-coded according to the following scheme.

Parameter *Warnings* **269** shows the warnings in clear text on the operator panel and the PC software tool VPlus.

Use Parameter *Warnings* **270** to access the warning codes via VABus.

Warning Messages			
Bit-No.	Warning Code	Description	
0	0x0001	Warning Ixt	1) 2)
1	0x0002	Warning Short Time Ixt	1)
2	0x0004	Warning Long Time Ixt	2)
3	0x0008	Warning Heat Sink Temperature Tk	
4	0x0010	Warning Inside Temperature Ti	
5	0x0020	Warning I-Limit	
6	0x0040	Warning Init	
7	0x0080	Warning Motor Temperature	
8	0x0100	Warning Mains Phase Failure	
9	0x0200	Warning Motor Protective Switch	
10	0x0400	Warning Fmax	
11	0x0800	Warning Analog Input MF11A	
12	0x1000	Warning Analog Input MF12A	
13	0x2000	Warning Systembus Slave in Fault	
14	0x4000	Warning Udc	
15	0x8000	Warning <i>Application warning status 273</i>	

^{1) 2)}: Bit 0 "Warning Ixt" is set,

- if Bit 1 "Warning Short Term Ixt" or
- if Bit 2 "Warning Long Term Ixt" is set.

In Parameter *Warnings* **270** several warnings can be set at the same time.

Example:

Message	Warning Code	Comment
Warning Ixt	0x0001	Set on Short Term or Long Term Ixt.
Short Term Ixt	0x0002	
Warning Limit Heat Sink Temperature	0x0008	
Warning Limit Motor Temperature	0x0080	
Sum	0x008B	

12.2 Warning Messages Application

When the highest bit in the Warning messages is set, a "Warning Message Application" is present. The Application warning messages are given via parameter *Application Warnings* **274**, bit-coded according to the following scheme.

Parameter *Application Warnings* **273** shows the warnings in clear text on the operator panel and the PC software tool VPlus.

Use Parameter *Application Warnings* **274** to access the Application warning codes via Profibus.

Warning Messages		
Bit-No.	Warning Code	Description
0	0x0001	BELT - Keilriemen
1	0x0002	(reserviert)
2	0x0004	(reserviert)
3	0x0008	(reserviert)
4	0x0010	(reserviert)
5	0x0020	(reserviert)
6	0x0040	SERVICE
7	0x0080	User 1
8	0x0100	User 2
9	0x0200	(reserviert)
10	0x0400	(reserviert)
11	0x0800	(reserviert)
12	0x1000	(reserviert)
13	0x2000	(reserviert)
14	0x4000	(reserviert)
15	0x8000	(reserviert)

Note:

The meaning of the individual warnings are described in detail in the operating instructions.

12.3 Error Messages

VABus		
F20	10	Watchdog for X21-Connection. Communication error according to Parameter <i>X21: VABus Watchdog Timer</i> 1502 .
	11	Watchdog for Communication Module. Communication error according to Parameter <i>CM: VABus Watchdog Timer</i> 413 .

The Actual error message can also be read out by parameter access via parameter *Actual Fault* **260**.

Parameter *Actual Error* **259** shows the actual error in clear text on the operator panel and the PC software tool VPlus.

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Bonfiglioli Worldwide Locations

Australia

Bonfiglioli Transmission (Aust.) Pty Ltd
2, Cox Place Glendenning NSW 2761
Locked Bag 1000 Plumpton NSW 2761
Tel. +61 2 8811 8000



Brazil

Bonfiglioli Redutores do Brasil Ltda
Travessa Cláudio Armando 171 - Bloco 3
CEP 09861-730 - Bairro Assunção
São Bernardo do Campo - São Paulo
Tel. +55 11 4344 2322



China

Bonfiglioli Drives (Shanghai) Co. Ltd.
#68, Hui-Lian Road, QingPu District,
201707 Shanghai
Tel. +86 21 6700 2000



France

Bonfiglioli Transmission s.a.
14 Rue Eugène Pottier
Zone Industrielle de Moimont II
95670 Marly la Ville
Tel. +33 1 34474510



Germany

Bonfiglioli Deutschland GmbH
Sperberweg 12 - 41468 Neuss
Tel. +49 0 2131 2988 0



Bonfiglioli Vectron GmbH

Europark Fichtenhain B6 - 47807 Krefeld
Tel. +49 0 2151 8396 0



O&K Antriebstechnik GmbH

Ruhrallee 8-12 - 45525 Hattingen
Tel. +49 0 2324 2050 1



India

Bonfiglioli Transmission Pvt. Ltd.
Mobility & Wind Industries
AC 7 - AC 11 Sidco Industrial Estate
Thirumudivakkam Chennai - 600 044
Tel. +91 844 844 8649



Discrete Manufacturing & Process Industries - Mechatronic & Motion

Survey No. 528/1
Perambakkam High Road Mannur Village,
Sriperumbudur Taluk Chennai - 602 105
Tel. +91 844 844 8649



Discrete Manufacturing & Process Industries

Plot No.A-9/5, Phase IV MIDC Chakan,
Village Nighoje Pune - 410 501
Tel. +91 844 844 8649



Italy

Bonfiglioli Riduttori S.p.A.
Discrete Manufacturing & Process Industries
Via Bazzane, 33/A
40012 Calderara di Reno
Tel. +39 051 6473111



Mobility & Wind Industries

Via Enrico Mattei, 12 Z.I. Villa Selva
47100 Forlì
Tel. +39 0543 789111



Discrete Manufacturing & Process Industries

Via Sandro Pertini lotto 7b
20080 Carpiano
Tel. +39 02985081



Bonfiglioli Mechatronic Research S.p.A

Via Unione 49 - 38068 Rovereto
Tel. +39 0464 443435/36



New Zealand

Bonfiglioli Transmission (Aust.) Pty Ltd
88 Hastie Avenue, Mangere Bridge,
2022 Auckland
PO Box 11795, Ellerslie
Tel. +64 09 634 6441



Singapore

Bonfiglioli South East Asia Pte Ltd
8 Boon Lay Way, #04-09,
8@ Tadehub 21, Singapore 609964
Tel. +65 6268 9869



Slovakia

Bonfiglioli Slovakia s.r.o.
Robotnícka 2129
Považská Bystrica, 01701 Slovakia
Tel. +421 42 430 75 64



South Africa

Bonfiglioli South Africa Pty Ltd.
55 Galaxy Avenue, Linbro Business Park,
Sandton, Johannesburg
2090 South Africa
Tel. +27 11 608 2030



Spain

Tecnotrans Bonfiglioli S.A
Pol. Ind. Zona Franca, Sector C,
Calle F, nº 6 - 08040 Barcelona
Tel. +34 93 447 84 00



Turkey

Bonfiglioli Turkey Jsc
Atatürk Organize Sanayi Bölgesi,
10007 Sk. No. 30
Atatürk Organize Sanayi Bölgesi,
35620 Çiğli - İzmir
Tel. +90 0 232 328 22 77



United Kingdom

Bonfiglioli UK Ltd.
Unit 1 Calver Quay, Calver Road, Winwick
Warrington, Cheshire - WA2 8UD
Tel. +44 1925 852667



USA

Bonfiglioli USA Inc.
3541 Hargrave Drive
Hebron, Kentucky 41048
Tel. +1 859 334 3333



Vietnam

Bonfiglioli Vietnam Ltd.
Lot C-9D-CN My Phuoc Industrial Park 3
Ben Cat - Binh Duong Province
Tel. +84 650 3577411



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