Bonfiglioli
Vectron

ACTIVE

CANopen Communication module CM-CAN
Frequency Inverter 230 V / 400 V

Bonfiglioli
power, control and green solutions

General points on the documentation

The present supplement of the documentation is valid for the frequency inverter of the device series ACT. The information necessary for the assembly and application of the CANopen communication module CM-CAN is documented in this guidance.

For better clarity, the user documentation is structured according to the customer-specific demands made of the frequency inverter.

Brief instructions
The brief instructions describe the fundamental steps for mechanical and electrical installation of the frequency inverter. The guided commissioning supports you in the selection of necessary parameters and the software configuration of the frequency inverter.

Operating instructions
The operating instructions document the complete functionality of the frequency inverter. The parameters necessary for specific applications for adaptation to the application and the extensive additional functions are described in detail.

Application manual
The application manual supplements the documentation for purposeful installation and commissioning of the frequency inverter. Information on various subjects connected with the use of the frequency inverter are described specific to the application.

Installation instructions
As a complement of the brief instructions and the operating instructions, the installation instructions describe the installation and use of devices.

The documentation and additional information can be requested via your local representation of the firm of BONFIGLIOLI. The following pictograms and signal words are used for the purposes of the present documentation:

Danger!
means a directly threatening danger. Death, serious damage to persons and considerable damage to property will occur if the precautionary measure is not taken.

Warning!
marks a possible threat. Death, serious damage to persons and considerable damage to property can be the consequence if attention is not paid to the text.

Caution!
refers to an indirect threat. Damage to people or property can be the result.

Attention!
refers to a possible operational behavior or an undesired condition that can occur in accordance with the reference text.

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

Warning! In installation and commissioning, comply with the information in the documentation. You as a qualified person must read the documentation carefully before the start of the activity and obey the safety instructions. For the purposes of the instructions, "qualified person" designates a person acquainted with the erection, assembly, commissioning and operation of the frequency inverters and possessing the qualification corresponding to the activity.

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1 General safety and application information

This documentation has been produced with the greatest of care and extensively and repeatedly checked. For reasons of clarity, not all the detailed information on all types of the product and also not every imaginable case of erection, operation or maintenance have been taken into account. If you require further information or if specific problems which are not dealt with extensively enough in the documentation exist, you can request the necessary information via the local representation of the company BONFIGLIOLI.
We would also point out that the contents of this documentation are not part of a previous or existing agreement, assurance or legal relationship and are not intended to amend the same. All obligations of the manufacturer result from the underlying purchase contract, which also contains the complete and solely valid warranty regulation. These contractual warranty provisions are neither extended nor limited by the production of this documentation.
The manufacturer reserves the right to correct or amend the contents and the product information as well as omissions without prior notification and assumes no kind of liability for damage, injuries or expenditure to be put down to the aforementioned reasons.

1.1 General information

Warning! BONFIGLIOLI VECTRON frequency inverters have high voltage levels during operating, depending on their protection class, drive moving parts and have hot surfaces.
In the event of inadmissible removal of the necessary covers, improper use, wrong installation or operation, there is the risk of serious damage to persons or property.
To avoid the damage, only qualified staff may carry out the transport, installation, setup or maintenance work required. Comply with the s EN 50178, IEC 60364 (Cenelec HD 384 or DIN VDE 0100), IEC 60664-1 (Cenelec HD 625 or VDE 0110-1), BGV A2 (VBG 4) and national provisions. Qualified persons within the meaning of this principal safety information are people acquainted with the erection, fitting, commissioning and operating of frequency inverters and the possible hazards and in possession of qualifications matching their activities.

1.2 Proper use

Warning! The frequency inverters are electrical drive components intended for installation in industrial plant or machines. Commissioning and start of intended operation are not allowed until it has been established that the machine corresponds to the provisions of the EC machine directive 98/37/EEC and EN 60204. According to the CE sign, the frequency inverters additionally fulfill the requirements of the low-voltage directive 73/23/EEC and the s EN 50178 / DIN VDE 0160 and EN 61800-2. Responsibility for compliance with the EMC directive 89/336/EEC is with the user. Frequency inverters are available in a limited way and as components exclusively intended for professional use within the meaning of the EN 61000-3-2.
With the issue of the UL according to UL508c, the requirements of the CSA Standard C22.2-No. 14-95 have also been fulfilled.
The technical data and the information on connection and ambient conditions the rating plate and the documentation be complied with. The instructions must have been read and understood before starting work at the device.

1.3 Transport and storage

Transport and storage are to be done in an adequate way in the original packaging. Storage shall be in dry rooms protected against dust and moisture with slight temperature fluctuations. Please observe the climatic conditions according to EN 50178 and the marking on the packaging.
The duration of storage without connection to the admissible reference voltage may not exceed one year.

1.4 Handling and positioning

Warning! Damaged or destroyed components may not be put into operation because they may be a health hazard.

The frequency inverters are to be used according to the documentation, the directives and the standards. Handle carefully and avoid mechanical overload. Do not bend the components or change the isolation distances. Do not touch electronic components or contacts. The devices contain construction elements with a risk of electrostatic, which can easily be damaged by improper handling. Any use of damaged or destroyed components shall be considered as a non-compliance with the applicable standards. Do not remove any warning signs from the device.

1.5 Electrical connection

Warning! Before any assembly or connection work, de-energize the frequency inverter. Make sure that the frequency inverter is de-energized.
Do not touch the sockets, because the capacitors may still be charged.
Comply with the information given in the operating instructions and on the frequency inverter label.

While working on the frequency inverters, obey the applicable standards BGV A2 (VBG 4), VDE 0100 and other national directives. Comply with the information in the documentation on electrical installation and the relevant directives. Responsibility for compliance with and examination of the limit values of the EMC product standard EN 61800-3 for variable-speed electrical drive mechanisms is with the manufacturer of the industrial plant or machine.
The documentation contains information on installation correct for EMC. The cables connected to the frequency inverters may not be subjected to an isolation test with a high test voltage without previous circuit measures.

1.6 Operation information

Warning! Before commissioning and the start of the intended operation, attach all the covers and check the sockets. Check additional monitoring and protective devices pursuant to EN 60204 and the safety directives applicable in each case (e.g. Working Machines Act, Accident Prevention Directives etc.).
No connection work may be performed, while the system is in operation.

1.7 Maintenance and service

Warning! Unauthorized opening and improper interventions can lead to physical injury or damage to property. Repairs on the frequency inverters may only be done by the manufacturer or persons authorized by the latter.

2 Introduction

This document describes the possibilities and the properties of the CANopen communication module CM-CAN for the frequency inverters of the ACT series.

The frequency inverter must be extended by the CANopen communication module CM-CAN for the CAN connection.
The CM-CAN CANopen module is enclosed with the frequency inverter as a separate component and must be fitted by the user. This is described in detail in the "Assembly" chapter.

Note: These instructions are not to be understood as basic information on CANopen. They presuppose fundamental knowledge of the methods and mode of effect of CANopen on the part of the user.
In some chapters, possibilities of setting and display are described as alternatives to the KP500 control unit with the help of the VPlus control software. Operation of a PC with the VPlus control software on the frequency inverter in the use of the CM-CAN CANopen module is only possible as an alternative to the control unit via an optional KP232 interface adapter.

In this document, connecting the hardware, relevant parameters and the available objects are shown.

The available objects are sub-divided according to:

Communication objects	(0x1nnn)	to DS301
Manufacturer objects	(0x2nnn)	to DS301
Common objects	(0x6nnn)	to DS402
Device control objects	(0x6nnn)	to DS402
Velocity mode objects	(0x6nnn)	to DS402

The functions and objects are described as far as necessary in these instructions. For further information, reference is made here to the Draft Standards of the CiA..
The standards to which reference is made are DS102, DS301 and DS402, which are available from:

CiA, CAN in AUTOMATION
Am Weichselgarten 26
D-91058 Erlangen

Tel.: +49 9131 69086-0
Fax: +49 9131 69086-79

Attention! With the help of the CM-CAN CANopen communication module, it is possible to access **ALL** the parameters of the frequency inverter from a control unit. Control of the access via the operation level as in the KP500 manual control unit of the VPlus PC control software does not exist here. A change of parameters with a meaning unknown to the user can lead to the frequency inverter becoming incapable of functioning.

The implementation of CANopen is based on Version 4.01 of DS301. The differences to older implementations based on Version 2.0 are shown in the following table.

Object	Version 2.0	Version 4.01
Boot-up message	Emergency object without data Identifier 128 + NodeID	Heartbeat object with data byte (content = 0) Identifier = 1792 + NodeID
0x1004 Number of supported PDO's	available	not available
0x100E Guarding identifier	available	not available Identifier = 1792 + NodeID
Communication parameter second RxPDO	0x1405 (*)	now object 0x1401
Communication parameter second TxPDO	0x1805 (*)	now object 0x1801
Mapping parameter second RxPDO	0x1605 (*)	now object 0x1601
Mapping parameter second TxPDO	0x1A05 (*)	now object 0x1A01
0x1016 Consumer heartbeat	not available	available three subscribers to monitor
0x1017 Producer heartbeat	not available	available
0x1018 Identity object	not available	available Vendor ID = 0x000000D5

(*) These changes are not changes to the standard, but an adaptation of the implementation compared with older versions.

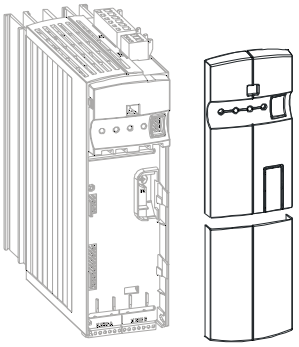
Caution! CANopen to Version 4.01 alternatively supports the guarding **OR** heartbeat monitoring mechanisms. Only one of these two methods may be used.

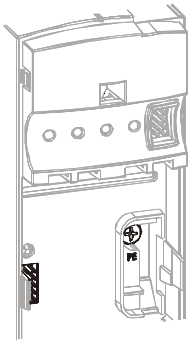
3 Assembly of the CANopen communication module CM-CAN

The CANopen communication module CM-CAN is supplied in a housing for assembly in a card slot of the frequency inverter. The scope of delivery additionally includes a PE spring for a PE connection (shielding) of the communication module.

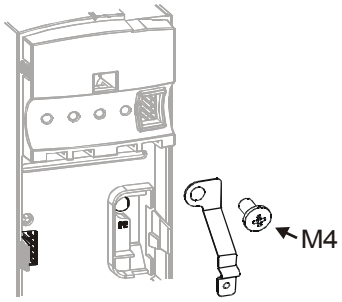
Caution! Before assembly of the CM-CAN CANopen communication module, the frequency inverter must be switched free of voltage.
Assembly under voltage is not admissible and leads to the destruction of the frequency inverter and / or the CANopen module.

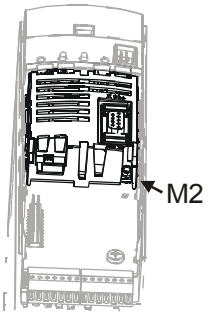
In a first step, please remove the covers of the frequency inverter. The card slot for the CANopen communication module CM-CAN becomes accessible.



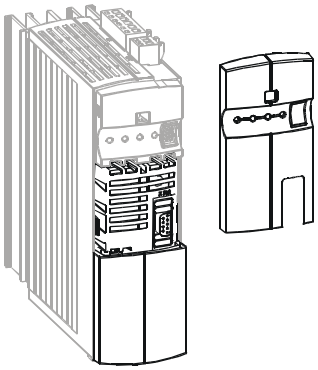


The PE spring supplied is assembled with the help of the M4 screw in the device. The spring must be aligned central.
The CM-CAN communication module can now be positioned and screw connected to the PE spring with the M screw in the device.



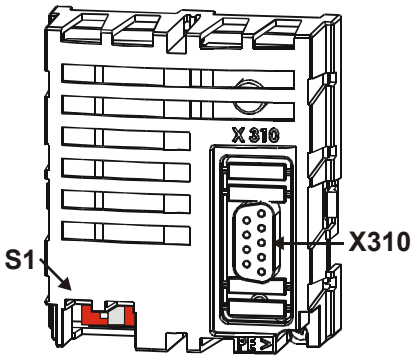


After completion of the assembly, replace the covers. The pre-stamped breakthrough in the upper cover for the X310 plug is to be broken out.



4 Plug occupancy/bus connection/line

The CAN connection is physically designed according to the ISO 11898 standards (CAN High-Speed).

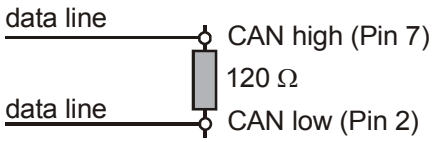


The **X310** (9-pole Sub-D) bus plug has been designed according to DS102 Version 2.0 (Bus node, option A).
Details can be seen from the following table on the occupancy of the bus plug.

The bus connection necessary on a phase in the physically first and last subscriber can be activated via **DIP switch S1** on the communication module.

The factory setting for the bus connection is OFF.

As an alternative, this also possible via corresponding switching in the bus connection plugs.



Attention: Make absolutely sure that only one of the two possibilities for the bus connection is used and the bus connection is only switched on with the first and last subscriber. Otherwise, operation of the CANopen communication is not possible.

Bus plug X310		
Pin	**Name**	**Function**
Housing	Shield	connected with PE
1	CAN_L	CAN Low bus interface, short-circuit resistant and function-insulated, max. current 60 mA
2	CAN_L	CAN Low bus interface, short-circuit resistant and function-insulated, max. current 60 mA
3	CAN_GND	Earth / GND
4	n.c.	not used
5	n.c.	not used
6	CAN_GND	Earth / GND
7	CAN_H	CAN High bus interface, short-circuit resistant and function-insulated, max. current 60 mA
8	CAN_H	CAN-High Bus-interface, short-circuit resistant and function-insulated, max. current 60 mA
9	+5V out	Supply voltage

The drilled and shielded line is to be used for the bus line. The shield is to be implemented as a harness shield (**not a film shield**).

Attention! The line screen is to be connected with PE on the surface at both ends.

5 Baud rate setting/line lengths

The transmission speed of the CANopen communication module CM-CAN can be set via the parameter *CAN Baud rate* **385**.

Parameter		Setting		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
385	CAN Baud rate	1	8	6

The transmission rate is a function of a variety of application-specific parameters. The line length of the communication network limits the transmission speed due to the signal running time of the CANopen protocols.

CANopen interface		
Operation mode	**Function**	**max. Line length**
1 - 10 kBaud	Transmission rate 10 kBaud	5000 meter
2 - 20 kBaud	Transmission rate 20 kBaud	2500 meter
3 - 50 kBaud	Transmission rate 50 kBaud	1000 meter
4 - 100 kBaud	Transmission rate 100 kBaud	500 meter
5 - 125 kBaud	Transmission rate 125 kBaud	500 meter
6 - 250 kBaud	Transmission rate 250 kBaud	250 meter
7 - 500 kBaud	Transmission rate 500 kBaud	100 meter
8 - 1000 kBaud	Transmission rate 1000 kBaud	25 meter

6 Setting node address

The CANopen protocol supports a maximum of 127 nodes in a communication network. Each frequency inverter is given a node ID, which may only exist once in the system, for its unambiguous identification. The setting of the station address is done via the parameter *CAN Node Number* **387**.

Parameter		Setting		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
387	CAN Node Number	0	127	0

Note: The factory setting *CAN Node Number* **387** = 0 means that the CANopen interface has been **deactivated**.
After the node address has been set via parameter *CAN Node Number* **387**, a reset is automatically triggered on the frequency inverter, by which the setting for the station address is taken on.

7 Operational behaviour if the bus connection fails

The operational behaviour if the bus connection fails due to bus OFF, guarding or heartbeat error can be parameterised. The required behaviour is set with the parameter *CAN Error Behaviour* **388**.

Operation mode	Function
0 -No reaction	Operating point is maintained
1 -Error	Switch-off and display of the error report
2 -Switch-off	Status change - "Switched on" to "Operation released", Drive mechanism is stopped with stopping behaviour
3 -Quick stop	Status change - "Switched on" to "Operation released", Drive mechanism is stopped with emergency stop ramp

Attention! The parameter settings *CAN Error Behaviour* **388** = "2 – Switch-off" and "3 – Quick stop" are only relevant if the further parameter *Local/Remote* **412** = "1 - Control via state machine" has been set as a supplement.

The error and warning behaviour of the frequency inverter can be parameterised in various ways. If a failure of the bus system occurs in the setting *CAN Error Behaviour* **388** = "1 – Error", the frequency inverter reports one of the following errors:

Communication error		
Code		**Meaning**
F20	21	Bus OFF
	22	Guarding failure
	23	Error state
	nn	Heartbeat failure – nn = node address of the failed subscriber

8 Objects

The available objects are marked via Index/Subindex and are to be addressed via this identification.

8.1 Communication Objects (0x1nnn)

8.1.1 0x1000/0 Device Type (unsigned 32)

The device identification is done at the start of the network. The information on the device type and the functionality (type) are prescribed by the CANopen protocol in a mandatory way. The object variable 0x1000/0 in the data type "unsigned32" is stored in a readable way.

Object 0x1000/0					
Additional Information				Device Profile Number	
Mode Bits		Type			
31	24	23	16	15	0

The "Drives and Motion Control" standard device profile used by the frequency inverter is portrayed as device profile number 402. The further information specifies the device functionality of the frequency inverter.

Device Profile Number	= 402	drives and motion control
Type	= 1	frequency converter
Mode bits	= 0	manufacturer specific

8.1.2 0x1001/0 Error Register (unsigned 8)

Object 0x1001/0 is the error register for internal errors of the frequency inverter. The date is of the unsigned8 and bit-coded type. The status error-free (0x1001/0 = 0) or error exists (0x1001/0 $\neq$ 0) is displayed.

Object 0x1001/0	
Bit	**Meaning**
0	General error
1	Current
2	Voltage
3	Temperature
4	Communication error
5	Device profile-dependent error
6	Reserved
7	Manufacturer-dependent error

8.1.3 0x1008/0 Manufacturer Device Name (visible string)

The device name is stated as a number of ASCII characters (visible string). This object enables device identification within the network.

Example : "ACT 10"

8.1.4 0x1009/0 Manufacturer Hardware Version (visible string)

The device version is stated as a number of ASCII characters (visible string). The device version can be read via object 0x1009/0. The string available in the frequency inverter under the parameter *Device type name* **14** is read.

Example : "ACT 10-1 ....."

8.1.5 0x100A/0 Manufacturer Software Version (visible string)

The software version is displayed via the object 0x100A/0 as a number of ASCII characters (visible string). The string available in the frequency inverter under the parameter *Inverter software version* **12** is read.

Example : "V4.0.1 ...."

8.1.6 0x100C/0 Guard Time (unsigned 16)

The response monitoring time is calculated by the multiplication of the object "Guard Time" and "Lifetime Factor". The object 0x100C/0 defines the "Guard Time" in steps of a millisecond. The statement "Guard Time" = 0 deactivates the guarding monitoring function.

8.1.7 0x100D/0 Lifetime Factor (unsigned 8)

The object "Lifetime Factor" extends the Guard Time by the set number of cycles. The setting of "Lifetime Factor" = 0 deactivates the guarding monitoring function.

8.1.8 0x1014/0 Emergency ID (unsigned 32)

The setting of the identifier and thus the definition of the priority for the emergency message is done with object 0x1014/0.
The default figure of the identifier is 128 + Node ID.

Object 0x1014/0		
Bit 31	Bit 30 to Bit 11	Bits 10 to Bit 0
valid / not valid	not used	11-bit identifier

Bit 31 : 0 = EMCY existent / valid
1 = EMCY non-existent / not valid

8.1.9 0x1016/n Consumer Heartbeat Time (unsigned 32)

Up to three heartbeat producers can be monitored with the object 0x1016/n (controlled via the subindices n = 1 ... 3). Setting of the object "Consumer Heartbeat Time" = 0 means no monitoring.
Node ID identifies the subscriber to be monitored. The heartbeat time states the maximum time in milliseconds between two heartbeat telegrams of the heartbeat producer to be monitored. If this time is exceeded, the monitoring node generates a corresponding error report.

Object 0x1016/n			
Index	**Subindex**	**Meaning**	**Value**
1016	0	Number of entries	3
	1	Consumer Heartbeat Time	see Table
	2	Consumer Heartbeat Time	see Table
	3	Consumer Heartbeat Time	see Table

Value of the consumer heartbeat time		
Bit 31 to Bit 24	Bit 23 to Bit 16	Bits 15 to Bit 0
not used	Node ID	Heartbeat Time

8.1.10 0x1017/0 Producer Heartbeat Time (unsigned 16)

The time for the transmission of a heartbeat object is set with the object 0x1017/0. The setting "Producer Heartbeat Time" = 0 means that no heartbeat object is transmitted.

8.1.11 0x1018/n Identity Object (unsigned 32)

The identity object gives information about the device manufacturer. The vendor ID "**0xD5**" identifies the manufacturer "**VECTRON Elektronik GmbH**". This vendor ID has been assigned by the CANopen users' organisation CiA in Erlangen.

Object 0x1018/0			
Index	**Subindex**	**Meaning**	**Value**
1018	0	Number of entries	1
	1	Vendor ID	0x000000**D5**

8.1.12 Emergency Message

The emergency message is transmitted with the identifier 128 + Node ID and comprises eight bytes. This object is generated in individual cases and the fault acknowledgement signalised by an emergency message with the data content equal zero. The contents are coded according to the following table:

Emergency Message	
Byte	**Contents**
0	Low-byte error code
1	High-byte error code
2	Error register (= 0x1001)
3	0
4	0
5	0
6	Low-byte, internal error code
7	High-byte, internal error code

Bytes 0, 1 and 2 have been firmly defined within the emergency object. Bytes 6 and 7 are used product-specifically on the basis of the specification. Coding of the error codes corresponds to the object error code 0x603F/0 (integer 16).

8.2 Process data / service data objects

8.2.1 Process data objects (PDO)

8.2.1.1 First Receive PDO

The first receive PDO is defined according to receive PDO No. 1 (DS402).

Receive-PDO No. 1			
Index	**Subindex**	**Meaning**	**Value**
1400	0	Number of entries	1
	1	COB ID	512 + Node ID
	2	Transmission type	255

Mapping Parameter			
Index	**Subindex**	**Meaning**	**Value**
1600	0	Number of mapped objects	1
	1	Control word	6040 0010 (hex)

The object control word 0x6040 is mapped onto the control word inside the product.

8.2.1.2 Second receive PDO

The second receive PDO is defined according to receive PDO No. 6 (DS402).

Receive-PDO No. 6			
Index	**Subindex**	**Meaning**	**Value**
1401	0	Number of entries	1
	1	COB ID	768 + Node ID
	2	Transmission type	255

Mapping Parameter			
Index	**Subindex**	**Meaning**	**Value**
1601	0	Number of mapped objects	1
	1	Control word	6040 0010 (hex)
	2	Target velocity	6042 0010 (hex)

The object control word 0x6040 is mapped onto the control word inside the product.

The object target velocity is mapped onto the reference line value inside the product. In this, please ensure that the object target velocity is stated in the unit RPM and is rescaled to the unit Hz for the reference line value. The number of pole pairs set (Parameter *No. of Pole Pairs* **373**, data set 1) is to be taken into account.

In the default setting, the TxPDO1 is transmitted when a change in the contents of the status word takes place.

8.2.1.3 First Transmit PDO

The first Transmit PDO is defined according to Transmit PDO No. 1 (DS402).

Transmit-PDO No. 1			
Index	**Subindex**	**Meaning**	**Value**
1800	0	Number of entries	1
	1	COB ID	384 + Node ID
	2	Transmission type	255
	3	Inhibit time	0
	4	Reserved	-
	5	Event time	0

Mapping Parameter			
Index	**Subindex**	**Meaning**	**Value**
1A00	0	Number of mapped objects	1
	1	Status word	6041 0010 (hex)

In the default setting, the TxPDO1 is transmitted when a change in the contents of the status word takes place. The object status word corresponds to the product-internal status word.

The TxPDO1 can be deactivated by setting bit 31 (MSB) of the COB-ID in 1800/1. There is then no transmission of the TxPDO1 (see DS301).
The transmission type cannot be altered.

Note: Event time and inhibit time (TxPDO1 and TxPDO2)

The event time is set in the unit milliseconds.
- If event time = 0, the TxPDO is transmitted when the contents of the objects change.
- If event time ≠ 0, the TxPDO is transmitted at the interval of the set event time AND when the contents of the objects change.

The inhibit time is set in integral multiples of 100 µs.
- The inhibit time is the minimum interval between the transmission of the TxPDO.

The inhibit time must be set **<** event time!

8.2.1.4 Second Transmit PDO

The second transmit PDO is defined according to transmit PDO No. 6 (DS402).

Transmit-PDO No. 6			
Index	**Subindex**	**Meaning**	**Value**
1801	0	Number of entries	1
	1	COB ID	640 + Node ID
	2	Transmission type	255
	3	Inhibit time	500 (=50 ms)
	4	Reserved	--
	5	Event time	1000 (=1000 ms

Mapping Parameter			
Index	**Subindex**	**Meaning**	**Value**
1A01	0	Number of mapped objects	2
	1	Status word	6040 0010 (hex)
	2	Control effort	6044 0010 (hex)

In the default setting, TxPDO2 is transmitted when a change in the contents of the status word takes place or the value of control effort changes. An inhibit time of 50 ms is effective. Without a change in the value, the TxPDO2 is transmitted at an interval of 1000 ms (event time). The object status word corresponds to the product-internal status word.

The TxPDO2 can be deactivated by setting bit 31 (MSB) of the COB-ID in 1801/1. There is then no transmission of the TxPDO2 (see DS301).
The transmission type cannot be altered.

With a setting of the inhibit time of ≤ 20 ms, a minimum transmission interval of 20 ms is always complied with. This prevents the frequency inverter from continuously transmitting and thus blocking the bus if the actual value fluctuates (caused by control functions).

The control effort mapping parameter corresponds to the actual speed. Please remember that control effort is stated in the unit RPM and is rescaled into the unit Hz from the product-internal actual value. The set number of pole pairs (parameter *No. of Pole Pairs* **373**, data set 1) is relevant.

8.2.2 Service data object SDO

Transmission and receipt of service data objects demands the exchange of at least two data telegrams. Service data objects are messages of an arbitrary scope which demand a confirmation by the recipient. This type of data is used, for example, for the parameterization of the frequency inverter, as access to the object directory is made possible. The reply entails the data segment and object control information. A defective transmission is notified by an error telegram.
A server SDO has been implemented (Index 0x1200). The server SDO supports Subindex 01 and 02.

Service data object			
Index	**Subindex**	**Meaning**	**Value**
1200	0	Number of entries (unsigned 8)	2
	1	Server-Rx-SDO-ID (unsigned 32)	1536 + Node-Id
	2	Server-Tx-SDO-ID (unsigned 32)	1408 + Node-Id

8.3 Common objects (0x6nnn)

8.3.1 0x6007/0 abort connection option code (unsigned 8)

The object abort connection option code specifies the operational behaviour of the frequency inverter if the bus connection fails. This is recognised via the CAN controller (bus OFF), guarding or heartbeat.

Object 0x6007/0	
Operation mode	**Function**
0 -no reaction	Operating point is maintained
1 -Error	Switch-off and display of the error report
2 -Switch-off	Status change - "Switched on" to "Operation released", Drive mechanism is stopped with stopping behaviour
3 -Quick stop	Status change - "Switched on" to "Operation released", Drive mechanism is stopped with emergency stop ramp

This object corresponds with the parameter *CAN Error behaviour* **388**.

Note: The object 0x605A/quick_stop_option_code has not been implemented. The operational behaviour for the quick stop is set as if this object has been set to the value 2.
For the quick stop, this means: decelerate on the quick stop ramp and switch over when zero has been reached.

8.3.2 0x603F/0 error code (integer 16)

In the object error code, the last error which has occurred is stored.
According to DS402, a large number of possible error reports have been specified. The following list shows the interconnection between the error code displayed internally by the frequency inverter and displayed on control unit KP500 and the error secured in the object error code.

Error reports				
Error		**Error code**		**Meaning**
F00	xx	00	00	No error has occurred
Overload				
F01	xx	23	10	Frequency inverter has been overloaded
Case				
F02	xx	42	10	Case temperature outside the temperature limits
Inside				
F03	xx	41	10	Inside temperature outside the temperature limits
Motor connection				
F04	xx	43	10	Motor temperature too high or sensor defective
Output current				
F05	xx	23	40	Motor phase current above the current limit
DC link voltage				
F07	xx	32	10	DC link voltage outside the voltage range
Electronic voltage				
F08	xx	51	11	Electronic voltage outside the voltage range
Motor connection				
F13	xx	23	30	Earth fault on frequency inverter output
Generic error				
Fyy	xx	10	00	Other error reports

If 1000 = generic error appears as the error code, the error code can be read off via parameter *Current error* **260**. The parameter *Current error* **260** contains the error code in the product-internal format.
The assignment table of the error code to the reports in question can be seen from the operating instructions.

In the emergency message, the error code of the frequency inverter is transmitted on bytes 4 ... 7.

8.4 Device control objects (6nnn)

8.4.1 0x6060/0 modes of operation (integer 8)

With the object modes of operation, the operation mode of the frequency inverter is stipulated.
The frequency inverter supports the **velocity mode** (0x6060 = 2**)** operation mode. Other settings are not possible and are ignored.

8.4.2 0x6061/0 modes of operation display (integer 8)

Under the object modes of operation display, the mode of operation set under modes of operation is read back.
As the only mode of operation possible is **velocity mode**, the parameter value 0x6061 = 2 is reported here generally.

8.4.3 0x6040/0 control word (unsigned 16)

The object control word supports the bits marked as mandatory according to DS402. The object control word is written onto the parameter *Control word* product-internally.

Object 0x6040/0	
Bit	**Meaning**
0	Switch on
1	Block voltage
2	Quick stop
3	Release operation
4	-
5	-
6	-
7	Reset Error
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

Note: The object 0x60A5 quick stop option code defined for the mode of operation of quick stop has not been implemented and can thus not be set. For the quick stop, the behaviour defined for quick stop option code = 2 applies. This is deceleration on the quick stop ramp and switch off when zero has been reached. The transition 16 (quick stop → release operation) possible under certain settings of quick stop option code is thus not possible.

8.4.4 0x6041/0 status word (unsigned 16)

The object status word supports the bits marked as mandatory according to DS402. The object status word is written onto the parameter *Control word* product-internally.

Object 0x6041/0	
Bit	**Meaning**
0	Ready to switch on
1	Switched on
2	Release operation
3	Error
4	Voltage blocked
5	Quick stop
6	Switch-on block
7	Warning
8	-
9	Remote
10	Reference value reached
11	Limit value active
12	-
13	-
14	-
15	Warning2

8.5 Velocity mode objects (0x6nnn)

8.5.1 0x604D/0 pole number (integer 8)

The object pole number states the number of poles (not pole pairs) of the connected machine. This variable is needed in order to convert the reference value object target velocity from RPM into the corresponding internal reference frequency and also the internal actual frequency from a frequency into the actual value object control effort with the unit RPM.

The object pole number is converted inside the product and written into the first data set on the parameter *No. of pole pairs* **373**. The parameter value of the number of pole pairs is to be doubled for the object pole number.

Parameter		Setting	
No.	**Object**	**Min.**	**Max.**
0x604D	Pole number	2	48

8.5.2 0x6042/0 Target velocity (integer 16)

The object target velocity is the reference value for the frequency inverter. As the objects setpoint factor and dimension factor have not been implemented, this value is interpreted as a speed with the unit RPM. There is conversion to a reference frequency with the help of the object pole number.

The object target velocity is evaluated according to the signs in front (Integer16). The set parameter value *No. of pole pairs* **373** in the first data set is relevant.

Parameter		Setting	
No.	**Object**	**Min.**	**Max.**
0x6042	Target velocity	-32768	32767

The target velocity reference value is included product-internally via the **Reference line value**. This reference value is combined with the internal reference frequency value from the frequency reference value channel in the input of the ramp function.

8.5.3 0x6043/0 Target velocity demand (integer16)

The object target velocity demand is the output variable of the ramp function. The object has the same notation as the object target velocity and can be read as an actual value as it is generated internally by the product.

8.5.4 0x6044/0 Control effort (integer16)

The actual value of the drive mechanism converted to the unit RPM is stored in the object control effort. The object has the same notation as the object target velocity and can only be read.

8.5.5 0x6046/n Velocity min max amount

The object velocity min max amount comprises the subindex 01 = velocity min amount and subindex 02 = velocity max amount.

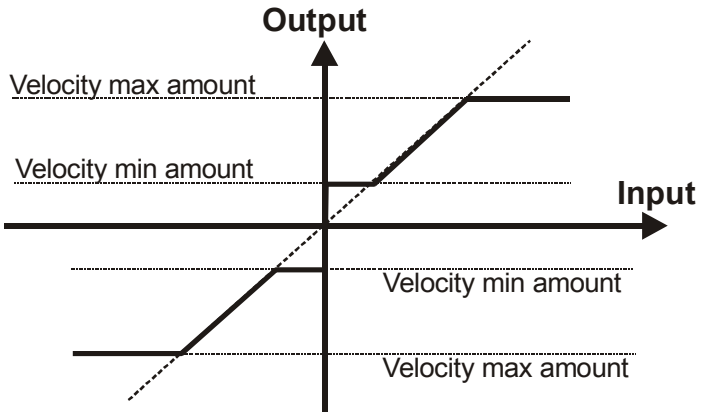
Velocity min max amount			
Index	**Subindex**	**Meaning**	**Value**
0x6046	0	Number of entries (unsigned 8)	2
	1	Velocity min amount (RPM)	(unsigned 32)
	2	Velocity max amount (RPM)	(unsigned 32)

The velocity min amount variable corresponds with the parameter value *Minimum Frequency* **418** in the first data set. The specification is done in the unit RPM (only positive values) and is converted internally to a frequency, taking the object pole number into account. The value is not stored and is set back to zero after the reset.

The value for the object velocity max amount is written internally onto the parameter value *Maximum Frequency* **419** in data set 1 in the form of a converted frequency. After the reset, the object value velocity max amount is converted into the unit RPM from the parameter *Maximum Frequency* **419**.

If the reference value with the object target velocity is specified smaller than the object value velocity min amount or larger than velocity max amount, target velocity is internally limited to the values in question.

Parameter		Setting	
No.	**Object**	**Min.**	**Max.**
0x6046/n	Velocity min max amount	0	32767



Note: The object velocity min amount is always set to the object value = 0 after the reset of the frequency inverter.

8.5.6 0x6048/n Velocity acceleration

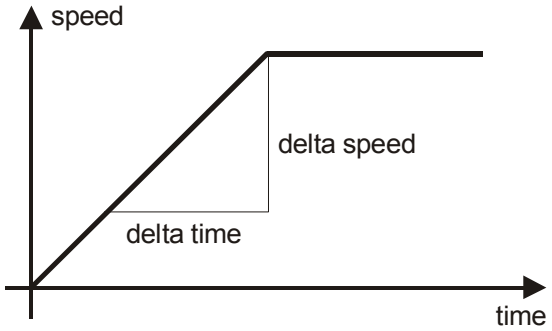
The alteration of the speed and run-up time are set with the object velocity acceleration. The object velocity acceleration defines the value delta speed via subindex 1 in the same notation (RPM) as the object target velocity and the value delta time in seconds via subindex 2.

Velocity acceleration			
Index	**Subindex**	**Meaning**	**Value**
0x6048	0	Number of entries (unsigned 8)	2
	1	Delta speed (RPM)	(unsigned 32)
	2	Delta time (sec)	(unsigned 16)

The gradient of the frequency in the acceleration period is written onto the parameters *Acceleration (clockwise)* **420** and *Acceleration (anti-clockwise)* **422** in the first data set inside the product. The two parameters are set to the same value, which is specified via the object velocity acceleration.

The gradient is changed internally by altering the objects delta time or delta speed. Changing the object value for delta speed, which is internally converted into the unit Hz, is sufficient for a change of the gradient.

Parameter		Setting	
No.	**Object**	**Min.**	**Max.**
0x6048/1	Delta speed (RPM)	1	65536
0x6048/2	Delta time (sec)	1	65535



Note: The object delta time is always set to the object value = 1 after the reset of the frequency inverter.

8.5.7 0x6049/n Velocity deceleration

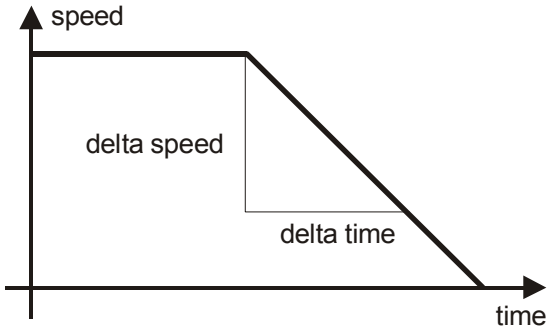
The change of speed and deceleration time are set with the object velocity deceleration. The object velocity deceleration defines the value delta speed in the same notation (RPM) as the object target velocity via subindex 1 and the value delta time in seconds via subindex 2.

Velocity acceleration			
Index	**Subindex**	**Meaning**	**Value**
0x6049	0	Number of entries (unsigned 8)	2
	1	Delta speed (RPM)	(unsigned 32)
	2	Delta time (sec)	(unsigned 16)

The gradient of the frequency in deceleration is internally written onto the parameters *Deceleration (clockwise)* **421** and *Deceleration (anti-clockwise)* **423** in the first data set. The two parameters are set to the same value, which is specified via the object velocity acceleration.

The gradient is internally changed by changing the objects delta time or delta speed. Changing the object value for delta speed, which is internally converted into the unit Hz, is sufficient for a change of the gradient.

Parameter		Setting	
No.	**Object**	**Min.**	**Max.**
0x6049/1	Delta speed (RPM)	1	65536
0x6049/2	Delta time (sec)	1	65535



Note: The object delta time is always set to the object value = 1 after the reset of the frequency inverter.

8.6 Manufacturer object (0x2000/n)

The object 0x2000 is defined as a manufacturer object, via which the parameterization of the frequency inverter can be done.
With the help of the object, an "internal" communication channel, via which **all** the parameters and values are accessible, is implemented. In this way, creation of more than 600 objects, which would be necessary to map all the product-internal parameters under the CANopen communication protocol, is no longer necessary.
The sub indices in question are to be used for writing and reading of parameters/values, depending on the type int/uint, long and string. The data type of the required parameter can be seen from the parameter list of the frequency inverter.

Manufacturer object				
Index	**Subindex**	**Meaning**	**Access**	**Data type**
0x2000	00	Number of entries = 3	read-only	unsigned 8
	01	int/uint parameter	read/write	Domain[6]
	02	long parameter	read/write	Domain[8]
	03	string parameter	read/write	Domain[38]

The standards with regard to error reports under CANopen cannot be used for this "internal" communication channel, as there is no possibility of including the errors in the SDO report.

8.6.1 Reading/writing of parameters/values

Reading of a parameter:
1. Writing to sub-index (SDO Write)

Subindex (SDO Write)								
Byte	**0**	**1**	**2**	**3**	**4**			**n**
Contents	Parameter number + data set x 1000		ENQ	00	undefined nn			

2. Reading from sub-index (SDO Write)

Subindex (SDO Read)										
Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**			**n**
Contents	Parameter number + data set x 1000		ACK	00	Parameter value					
			NAK	00	Error code			undefined		

After the writing of parameter number and data set per SDO Write, the corresponding sub-index is read back with SDO Read.
In the reply in the reading from the sub-index, the frequency inverter states whether the reading process was successful (ACK), then also supplying the required parameter figure, or whether an error has occurred (NAK). If an error has occurred, a corresponding error code is reported.

Writing of a parameter:
1. Writing to sub-index

Subindex (Write)								
Byte	**0**	**1**	**2**	**3**	**4**			**n**
Contents	Parameter number + data set x 1000		SEL	00	Parameter figure			

2. Reading from sub-index

Subindex (Read)										
Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**			**n**
Contents	Parameter number + data set x 1000		ACK	00	Parameter figure					
			NAK	00	Error code			undefined		

After parameter number, data set and parameter value have been written per SDO Write, the corresponding sub-index is read back with SDO Read.

In the reply in the reading of sub-index, the frequency inverter states whether the writing process was successful (ACK) or whether an error occurred (NAK). If an error occurred, a corresponding error code is reported.

SEL = 2
ENQ = 5
ACK = 6
NAK = 15

Access to a parameter figure is done by stating the parameter number and the data set.

Example: Parameter number = 370, data set = 3

Byte 0/1 = 370 + 3*1000
Byte 0/1 = 3370

8.6.2 Error code list

Read/Write	
Error code	**Meaning**
1	Inadmissible parameter value
2	Inadmissible data set
3	Parameter not readable
4	Parameter not write-capable
5	Reading error, EEPROM
6	Writing error, EEPROM
7	Check sum error EEPROM
8	Parameter cannot be changed while the drive mechanism is running
9	Values of the data sets differ
10	Parameter has the wrong type
11	Unknown parameter
15	Unknown error

Note: If the ID ENQ or SEL is not stated in SDO Write, the report is done with NAK and error code = 0.

8.6.3 Handling of the data sets / cyclic writing

Access to the parameter values is done on the basis of the parameter number and the required data set. Parameters, the values of which exist once (data set 0), and also parameters, the value of which exist four times (data set 1...4), exist. The latter are used for the data record change-over of a parameter.

If parameters existing four times in the data sets are described with the specification data set = 0, all four data sets are set to the same transmitted value. A reading access with data set = 0 to such parameters is only successful if all four data sets are on the same value. If this is not the case, error 9 = "Values of the data sets differ" is reported.

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

To avoid this, cyclically written data can be entered in the RAM without a writing cycle taking place on the EEPROM. The data are then not stored safe against zero voltage and have to be rewritten after a power off/on.
This mechanism is activated by the target data set being increased by five in the specification of the data set.

Writing onto a virtual data set in the RAM

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

8.6.4 Subindex 01, int/uint parameters

The int/uint parameters have a length of 2 bytes. The distinction between int and uint is specified via the internal parameter tables. A data type is firmly assigned to each parameter. Evaluation corresponding to the sign in front is done product-internally on the basis of the data type in question.

Subindex 01 has a data length of 6 bytes.

Subindex 01						
Byte	**0**	**1**	**2**	**3**	**4**	**5**
Contents	low Parameter number + data set x 1000	high	SEL ENQ ACK NAK	00	low Parameter figure	high

8.6.5 Subindex 02, long parameters

The parameters of the long data type have a length of 4 bytes. The long parameters always have a sign in front.

Subindex 02 has a data length of 8 bytes.

Subindex 02								
Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Contents	low	high	SEL ENQ ACK NAK	00	low			high
	Parameter number + data set x 1000				Parameter figure			

8.6.6 Subindex 03, string parameters

The string parameters have a length of up to 32 bytes. The data length is variable according to the contents.

Subindex 03 has a data length of 36 bytes.

Subindex 03								
Byte	**0**	**1**	**2**	**3**	**4**	**...**	**...**	**35**
Contents	low	high	SEL ENQ ACK NAK	00	char 1			char m
	Parameter number + data set x 1000				Parameter text			

Note: As the parameter texts manifest a variable length, the end must be marked within subindex 03. The string end is defined with 00 according to the standard (= \0 "C" standard)

8.7 Manufacturer objects (0x2nnn)

Access to the parameters of the **uint/int/long** type according to the standards for the SDO channel to CANopen is additionally possible via the index area 0x2nnn (manufacturer objects).
This method is simpler and quicker than the method described in the chapter "manufacturer object (0x2000/n)", but is limited to the aforementioned types of data.
Due to the maximum data size of four bytes (long), SDO dealings are always handled with an "expedited transfer". This means that the data exchange is done with **one** request and **one** response telegram each time.
For write/read accesses via the SDO channel, an object is addressed via index and sub-index. Index and sub-index are used as follows for the accesses to the inverter parameters:

Index = Parameter number + 0x2000
Subindex = required data set (0, 1 ... 4, 5, 6 ... 9)

The handling of the sub-index/data set corresponds to the specifications and descriptions in the chapter "Handling of the data sets / cyclic writing". As a deviation from the said chapter, setting of parameters in all four data sets with writing onto data set 0 is only possible if the contents of the four data sets are already identical (= factory setting).

Note: The mapping of the data is always done in the integer/long data type.
Figures with places behind the decimal are extended accordingly:
(value = 17.35 → transmitted 1735)

Writing parameters:

Client ➔ Server SDO Download (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x22	LSB	MSB	0xnn	LSB			MSB
uint/int				LSB	MSB	...	...
long				LSB	...	...	MSB

Server ➔ Client Download Response ➔ writing process free of errors

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x60	LSB	MSB	0xnn	...			

Server ➔ Client Abort SDO Transfer ➔ writing process with error

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x80	LSB	MSB	0xnn	Error code			

If the writing process is faulty, the matching error code is stated in Byte 4 (see Error code table).

Reading parameters:

Client ➔ Server SDO Upload (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x40	LSB	MSB	0xnn	...			

Server ➔ Client Upload Response ➔ reading process without errors

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x42	LSB	MSB	0xnn	LSB			MSB
uint/int				LSB	MSB	...	...
long				LSB	...	...	MSB

Server ➔ Client Abort SDO Transfer ➔ reading process faulty

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x80	LSB	MSB	0xnn	Error code			

If the reading process is faulty, the matching error code is stated in Byte 4 (see Error code table).

Error code table:

If an error occurs in reading or writing, the server SDO of the frequency inverter replies with the abort telegram. In it, the index/subindex and an error code are reported back.

Server ➔ Client Abort SDO Transfer

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	abort code low		abort code high	
0x80	LSB	MSB	0xnn	LSB	MSB	LSB	MSB

Error codes			
Abort code high	**Abort code low**	**Description to CANopen**	**Product-specific allocation**
0x0601	0x0000	Unsupported access to an object	- Parameter cannot be written or read
0x0602	0x0000	Object does not exist	- Parameter does not exist
0x0604	0x0047	General internal incompatibility in the device	- Data type = string - Data sets differ - other errors
0x0609	0x0011	Subindex does not exist	- Data set does not exist
0x0609	0x0030	Value range of parameter exceeded	- Parameter value too large or too small
0x0800	0x0021	Data cannot be transferred because of local control	- parameter cannot be written in operation

Examples of the writing of parameters:

Writing of the parameter *Rated Speed* **372** (type: uint) in data set 2 with the parameter value 2980.
Index = 372 + 0x2000 = 0x2174, value = 2980 = 0x0BA4

Client ➔ Server SDO Download (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x22	0x74	0x21	0x02	0xA4	0x0B	--	--

Writing of the parameter warning limit Tk 407 (type: int) in data set 0 with the parameter value -15.
Index = 407 + 0x2000 = 0x2197, value = -15 = 0xFFF1

Client ➔ Server SDO Download (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x22	0x97	0x21	0x00	0xF1	0xFF	--	--

Writing of the parameter *Fixed frequency 1* **480** (type: long) in data set 1 with the parameter value 100.00 Hz.
Index = 480 + 0x2000 = 0x2174, value = 10000 = 0x00002710

Client ➔ Server SDO Download (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x22	0x74	0x21	0x01	0x10	0x27	0x00	0x00

Writing of the parameter *Fixed Frequency 1* **480** (type: long) in data set 3 with the parameter value -50.00 Hz.
Index = 480 + 0x2000 = 0x2174, value = -5000 = 0xFFFFEC78

Client ➔ Server SDO Download (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x22	0x74	0x21	0x03	0x78	0xEC	0xFF	0xFF

Examples of the reading of parameters:

Reading of the parameter *Rated speed* **372** (type: uint) in data set 2 with the current parameter value 1460.
Index = 372 + 0x2000 = 0x2174, value = 1460 = 0x05B4

Client ➔ Server SDO Upload (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x42	0x74	0x21	0x02	--	--	--	--

Server ➔ Client Download Response

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x60	0x74	0x21	0x02	0xB4	0x05	--	--

Reading of the parameter *Warning Limit Tk* **407** (type: int) in data set 0 with the current parameter value –5.
Index = 407 + 0x2000 = 0x2197, value = -5 = 0xFFFB

Client ➔ Server SDO Upload (expedited)

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x42	0x97	0x21	0x00	--	--	--	--

Server ➔ Client Download Response

0	1	2	3	4	5	6	7
Control byte	Index		Subindex	Data			
0x60	0x97	0x21	0x00	0xFB	0xFF	--	--

Reading of the parameter *Fixed Frequency 1* **480** (type: long) in data set 1 with the current parameter value 75.00 Hz.
Index = 480 + 0x2000 = 0x2174, value = 7500 = 0x00001D4C

Client ➔ Server SDO Upload (expedited)

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Control byte	Index		Subindex	Data			
0x42	0x74	0x21	0x01	--	--	--	--

Server ➔ Client Download Response

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Control byte	Index		Subindex	Data			
0x60	0x74	0x21	0x01	0x4C	0x1D	0x00	0x00

Reading of the parameter *Fixed Frequency 1* **480** (type: long) in data set 3 with the current parameter value –10.00 Hz.
Index = 480 + 0x2000 = 0x2174, value = -1000 = 0xFFFFFC18

Client ➔ Server SDO Upload (expedited)

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Control byte	Index		Subindex	Data			
0x42	0x74	0x21	0x03	--	--	--	--

Server ➔ Client Download Response

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Control byte	Index		Subindex	Data			
0x60	0x74	0x21	0x03	0x18	0xFC	0xFF	0xFF

9 Control / reference value

A control gives its control commands (control word) to the frequency inverter via the object 0x6040/0 control word and receives the information about its status (status word) back via the object 0x6041/0 status word.
A control gives its reference speed to the frequency inverter (mapped onto the reference line value) via the object 0x6042/0 target velocity and receives the actual speed via the object 0x6044/0 control effort.

Note: The objects 0x6040/0 control word, 0x6041/0 status word, 0x6042/0 target velocity and 0x6044/0 control effort are contents of the available Rx/TxPDO's. Detailed information is to be found in the previous chapters.
In the following explanations and descriptions, the standardized designations control word and status word are used.

The control of the frequency inverter can be done with three operation modes. They are set via the data set change-over capable parameter *Local/Remote* **412**.

Parameter		Setting		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
412	Local/Remote	0	44	44

For operation on the CANopen, only the settings 0, 1 and 2 are relevant. The further settings relate to the possibilities of control via the KP500 control unit.

Operation mode	Function
0 - Control via contacts	The Start and Stop command as well as the statement of the direction of rotation are via digital signals.
1 - Control via state machine	The Start and Stop command as well as the statement of the direction of rotation are via the DRIVECOM State machine of the communication interface.
2 - Control via remote contacts	The Start and Stop command as well as the statement of the direction of rotation are via logic signals by the communication protocol.

Control word STW and state word ZSW have differing contents as a function of the operation mode. In each case, all or only some of the bits in the control word are relevant and also only certain feedbacks are possible via the status word. These are then explained in the descriptions of the three possible operation modes.

Control and state word have been created according to DRIVECOM. In this way, there is compatibility to CANopen DS402.

Note: The parameter *Local/Remote* **412** is data set change-over capable. Thus, switching over between various operation modes via the data set selection is possible. For example, it is possible to control an frequency inverter via the bus and to activate a local emergency operation if the bus master breaks down. This switch-over is also visible via the state word (Bit Remote).

The data set change-over can be done locally at the frequency inverter via contact inputs or via the bus. For the data set change-over via the bus, the parameter *Data set selection* **414** is used.

Parameter		Setting		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
414	Data set selection	0	4	0

With *Data set selection* **414** = 0, the data set switch-over via contact inputs is active. If *Data set selection* **414** has been set to 1, 2, 3, or 4, the data set selected in this way has been activated. The data set switch-over via the contact inputs is then deactivated.

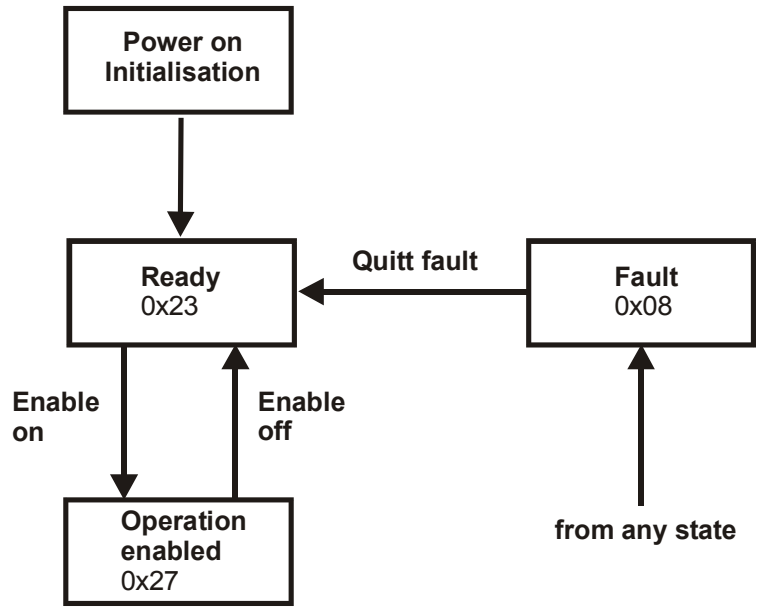
Via the parameter *Active data set* **249** the data set currently selected can be read out. *Active data set* **249** states the activated data set with the value 1, 2, 3 or 4. This is independent of whether the data set change-over has been done via control inputs or via *Data set selection* **414**.

9.1 Control via contacts

In the operation mode control via contacts (*Local/Remote* **412** = 0) the frequency inverter is controlled via the contact inputs S2IND to S6IND. The meaning of these inputs can be seen from the operating instructions. The control word in is not relevant for this operation mode.

State machine:

The values contained in the states report give the feedback about the state word (Bit 0 to Bit 6).



Control word	
Bit No.	**Name**
0	-
1	-
2	-
3	-
4	-
5	-
6	-
7	-
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

State word	
Bit No.	**Name**
0	Ready to switch on
1	Ready
2	Operation enabled
3	Fault
4	Voltage -inhibited
5	Quick-stop
6	Switch on inhibit
7	Warning
8	-
9	Remote
10	Reference value reached
11	Limit value reached
12	-
13	-
14	-
15	Warning 2

The state word reflects the operation state.

State word							
State	**HEX (*)**	**Bit 6**	**Bit 5**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Ready	0x23	0	1	0	0	1	1
Operation enabled	0x27	0	1	0	1	1	1
Fault	0x08	0	x	1	0	0	0

(*)without considering bits 7 to bit 15

Note: A fault occurring leads to a switch-over to the "Fault" state.
A fault can only be acknowledged 15 seconds after the occurrence of the fault, as a blocking time is active internally.

The **Warning bit "Bit No. 7"** can be set at any time. It displays an device-internal warning message. The evaluation of the warning available is done by reading out the warning status with the parameter *Warnings* **270**.

The **Remote bit "Bit No. 9"** is always = 0.

The bit **Reference value reached "Bit No. 10"** is set when the reference value specified has been reached. In the special case of power failure regulation, the bit is also set if the power failure regulation has reached the frequency 0 Hz (see operating instructions). For "Reference value reached" there is a hysteresis (tolerance range), which can be set via the parameter *max. Control deviation* **549** (see operating instructions).

The bit **Limit value active "Bit No. 11"** displays that an internal limit is active. This can, for example, be the present current limit, the torque limit or the overvoltage limit. All the functions lead to the reference value being quit or not reached.

The bit **Warning 2 "Bit No. 15"** reports a warning which leads to a fault switch-off of the frequency inverter within a short time. This bit is set if there is a warning for motor temperature, heat sink/inside temperature, Ixt monitoring or mains phase failure.

9.2 Control via state machine

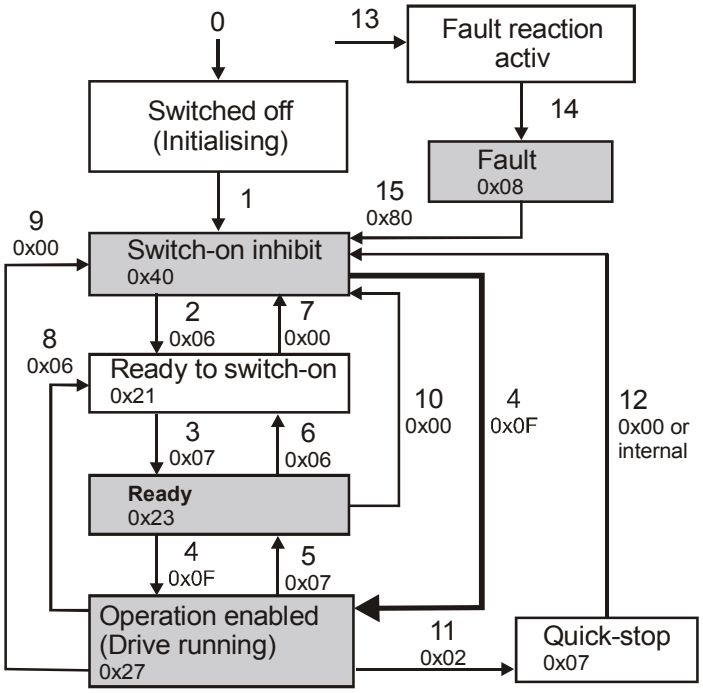
In the operation mode control via state machine (*Local/Remote* **412** = 1) the frequency inverter is controlled via the control word. The possible states are shown in the diagram. The values on the transition identify these transitions between the states. The codes shown on the transitions, 0xnn, are the control word needed in each case (Bit 0 to Bit 7). The codes contained in the states, 0xnn, display the contents of the state word (Bit 0 to Bit 7).

After mains on (Reset), the frequency inverter is in the state "Switch-on inhibit" (0x40). With the transitions 4 and 5, there is a change between "Operation enabled" (0x27, power parts enabled, drive working) and "Ready" (0x23, power parts blocked).

Release (transition 4) is only possible if the hardware release is available via contact inputs S1IND/FUF **AND** (S2IND/STR **OR** S3IND/STL). They can be firmly wired or also firmly connected to On/Off via the configuration of the digital inputs. If contact input S1IND/FUF is switched off, the inverter outputs can be blocked at any time. The drive then stops freely. There is a transition to "Ready" (0x23, power parts blocked).

The behavior of transition 5 can be set via the parameter *State transition 5* **392**. Here, free stopping, shutdown via ramp (reversible) or DC braking (see Chapter " Behavior in transition 5") can be used.

State machine:



Control word	
Bit No.	**Name**
0	Switch on
1	Voltage-inhibit
2	Quick stop
3	Operation-enabled
4	-
5	-
6	-
7	Reset-fault

Control word	
Bit No.	**Name**
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

Control commands

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

Control word							
Command	**HEX**	**Bit 7**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**	**Transition**
Shutdown	0x06	X	X	1	1	0	2, 6, 8
Switch-on	0x07	X	X	1	1	1	3
Voltage-inhibit	0x00	X	X	X	0	X	7, 9, 10
Quick-stop	0x02	X	X	0	1	X	11
Operation-inhibit	0x07	X	0	1	1	1	5
Operation enabled	0x0F	X	1	1	1	1	4
Reset faults	0x80	0 ⇨ 1	x	x	x	x	15

To make operation of the device simpler, a simplification has been implemented in the extension to the state machine defined under DRIVECOM. An additional transition from "Switch-on inhibit" to "Operation enabled" exists.

The shaded commands are the commands relevant for the simplified state machine.

Note: A fault occurring leads to a switch-over to the "Fault" state. The acknowledge of the fault is done by a positive edge of Bit 7.
A fault can only be acknowledged 15 seconds after the occurrence of the fault, as a blocking time is active internally.

State word	
Bit No.	**Name**
0	Ready to switch on
1	Ready
2	Operation enabled
3	Fault
4	Voltage inhibit
5	Quick stop
6	switch on inhibit
7	Warning

State word	
Bit No.	**Name**
8	-
9	Remote
10	Reference value reached
11	Limit value reached
12	-
13	-
14	-
15	Warning 2

The state word reflects the operation state.

State word							
Meaning	**HEX (*)**	**Bit 6**	**Bit 5**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Switched-off	0x00	0	x	0	0	0	0
Switch-on inhibit	0x40	1	x	0	0	0	0
Ready to switch-on	0x21	0	1	0	0	0	1
Quick-stop	0x07	0	0	0	1	1	1
Ready	0x23	0	1	0	0	1	1
Operation enabled	0x27	0	1	0	1	1	1
Fault	0x08	0	x	1	0	0	0
Fault reaction active	0x0F	0	x	1	1	1	1

(*) without considering bits 7 to bit 15

The shaded commands are the commands relevant for the simplified state machine.

The **Warning bit "Bit No. 7"** can be set at any time. It displays an device-internal warning message. The evaluation of the warning available is done by reading out the warning status with the parameter *Warnings* **270**.

The **Remote bit "Bit No. 9"** is set if the operation mode control via state machine (*Local/Remote* **412** = 1) has been set **and** the hardware release is available.

Logic linking of the digital control signals:

(S1IND **AND** (S2IND **OR** S3IND))

Only if the logic linking is true the frequency inverter can be controlled via the control word.

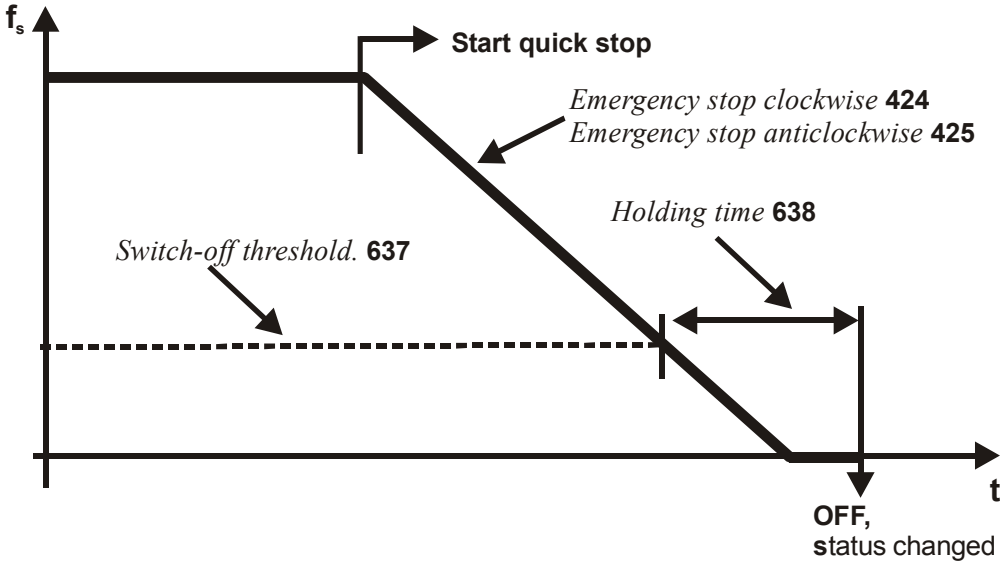
The bit **Reference value reached "Bit No. 10"** is set when the reference value specified has been reached. In the special case of power failure regulation, the bit is also set if the power failure regulation has reached the frequency 0 Hz (see operating instructions). For "Reference value reached" there is a hysteresis (tolerance range), which can be set via the parameter *max. Control deviation* **549** (see operating instructions).

The bit **Limit value active "Bit No. 11"** displays that an internal limit is active. This can, for example, be the present current limit, the torque limit or the over-voltage limit. All the functions lead to the reference value being quit or not reached.

The bit **Warning 2 "Bit No. 15"** reports a warning which leads to a fault switch-off of the frequency inverter within a short time. This bit is set if there is a warning for motor temperature, heat sink/inside temperature, Ixt monitoring or mains phase failure.

9.2.1 Behavior in quick stop

In this, the parameters *Switch-off threshold* **637** (percent of fmax) and *Holding time* **638** (holding time after falling short of the switch-off threshold) are relevant. In a quick stop, the drive is shutdown via the emergency stop ramps (*Emergency stop clockwise* **424** or *Emergency stop anti-clockwise* **425**).



If frequency/speed zero has been reached during the holding time, the drive continues to be supplied with direct current until the switch-off time has expired. With this measure, there is an assurance that the drive is stationary in a change of state.

9.2.2 Behavior in transition 5

The behavior in transition 5 from "Operation enabled" to "Switched on" can be parameterized. The behavior is set via parameter *State transition 5* **392**.

Parameter		Setting		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
392	State transition 5	0	2	2

Operation mode	Function
0 -Coast to stop	immediate transition from "Operation enabled‟ to "Ready‟, free stoppage of the drive
1 -DC brake	activation of DC brake, with the end of DC braking, there is the change from "Operation enabled‟ to "Ready‟
2 -Ramp	transmission with normal stop ramp, after reaching standstill, there is a change from "Operation enabled‟ to "Ready‟

Note: Setting operation mode "1 - DC brake‟ is only possible in applications with v/f characteristic (e.g. configuration 110), as other applications do not know such an operation mode.
If the frequency inverter is operated with a configuration which does not know the DC braking operation mode (e.g. configuration 210, field-orientation speed controlled), value "1" cannot be set. It is also not offered in the selection menus of the KP500 control unit or the VPlus program.

Note: The default value for the parameter *State transition 5* **392** is operation mode "2 – Ramp". For configurations with torque control, the default value is operation mode "0 - Coast to stop". In a switch-over of the configuration, the setting value for *State transition 5* **392** is also altered if necessary.

If transition 5 has been triggered with *State transition 5* **392** = "1 - DC brake", a new control word is only accepted after the completion of the transition process. The change of state from "Operation enabled" to "Ready" is done after the expiry of the time *Braking time* **632** parameterized for the DC brake.

If the parameter *State transition 5* **392** = "2 - Ramp" has been set, the control word can be set back to 0x0F during the stoppage of the drive. In this way, the drive runs back up to its set reference value and remains in the state "Operation enabled".

The change of state from "Operation enabled" to "Ready" is done after the set switch-off threshold has been reached **and** expiry of the set holding time (equivalent to the behavior in a quick stop). In this, the parameters *Switch-off threshold* **637** (percent of fmax) and *Holding time* **638** (holding time after switch-off threshold reached) are relevant.

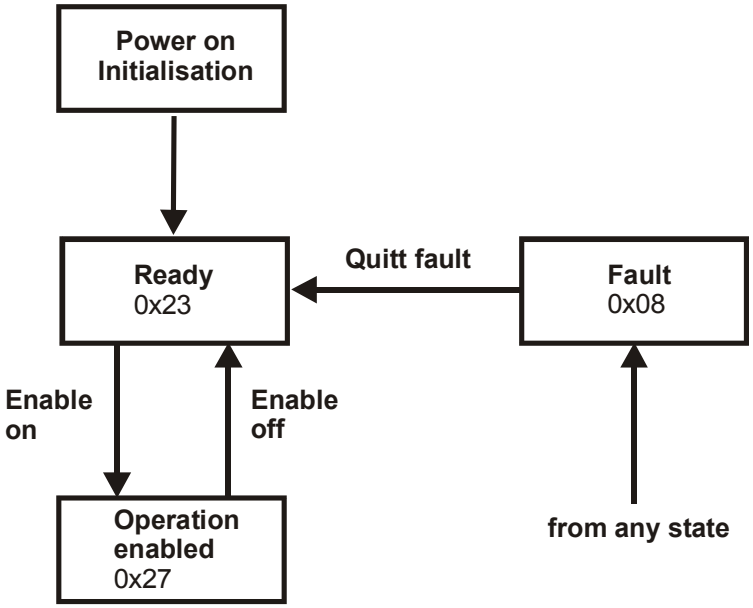
9.3 Control via remote contacts

In the operation mode *Local/Remote* **412** = "2 - Control via remote contacts" the frequency inverter is controlled via the control word, with the bits 0 to 5 corresponding to the contact inputs S1IND to S6IND. In addition, two virtual contact inputs S7IND and S8IND are available. These virtual contact inputs are not supported as a standard feature and are reserved for special applications. In the use of the remote contact, the frequency inverter behaves in the same way as in control via the hardware contact inputs. The meaning of these inputs can be seen from the operating instructions.

Note: Release is only possible if the hardware release is available via digital input S1IND.

State machine:

The values in the states report the feedback message via the state word (Bit 0 to 6).



Note: The inputs set via the control word can be observed with the help of parameter *Digital Inputs* **250**. Digital input S1IND is only displayed as being set if the hardware release is available **and** the control word / Bit 0 has been set.
If the data set switch-over is used, please make sure that the parameter *Local/Remote* **412** is set to operation mode "2 - Control via remote contacts" in all the data sets used.

Control word	
Bit No.	**Name**
0	S1IND / FUF
1	S2IND
2	S3IND
3	S4IND
4	S5IND
5	S6IND
6	S7IND
7	S8IND
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

State word	
Bit No.	**Name**
0	Ready to switch on
1	Ready
2	Operation enabled
3	Fault
4	Voltage-inhibit
5	Quick stop
6	Switch on inhibit
7	Warning
8	-
9	Remote
10	Reference value reached
11	Limit value reached
12	-
13	-
14	-
15	Warning 2

State word							
State	**HEX (*)**	**Bit 6**	**Bit 5**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Ready	0x23	0	1	0	0	1	1
Operation enabled	0x27	0	1	0	1	1	1
Fault	0x08	0	x	1	0	0	0

(*) without considering bits 7 to bit 15

Note: A fault occurring leads to a switch-over to the "Fault" state.
A fault can only be acknowledged 15 seconds after the occurrence of the fault, as a blocking time is active internally.

The **Warning bit "Bit No. 7"** can be set at any time. It displays an device-internal warning message. The evaluation of the warning available is done by reading out the warning status with the parameter *Warnings* **270**.

The **Remote bit "Bit No. 9"** is set if the operation mode control via remote contacts (*Local/Remote* **412** = 2) has been set **and** the hardware release is available (S1IND = 1). Only then can the frequency inverter be controlled via the control word.

The bit **Reference value reached "Bit No. 10"** is set when the reference value specified has been reached. In the special case of power failure regulation, the bit is also set if the power failure regulation has reached the frequency 0 Hz (see operating instructions). For "Reference value reached" there is a hysteresis (tolerance range), which can be set via the parameter *max. Control deviation* **549** (see operating instructions).

The bit **Limit value active "Bit No. 11"** displays that an internal limit is active. This can, for example, be the present current limit, the torque limit or the overvoltage limit. All the functions lead to the reference value being quit or not reached.

The bit **Warning 2 "Bit No. 15"** reports a warning which leads to a fault switch-off of the frequency inverter within a short time. This bit is set if there is a warning for motor temperature, heat sink/inside temperature, Ixt monitoring or mains phase failure.

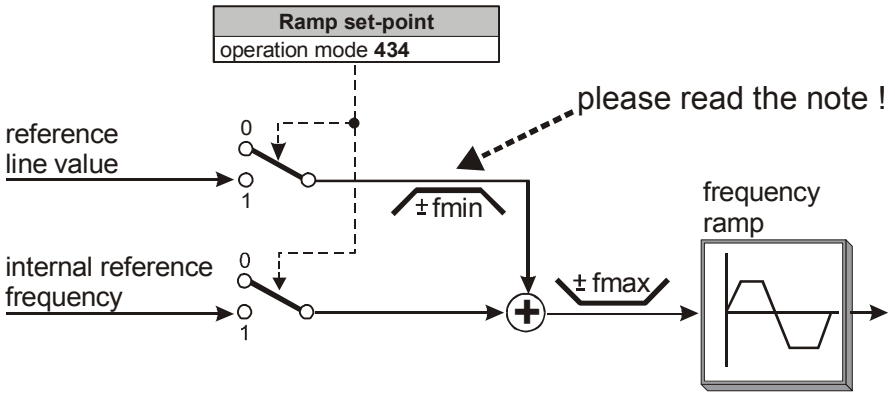
9.4 Reference value / actual value

The control gives its reference value to the frequency inverter via the object 0x6042/0 target velocity in the RxPDO used and receives the information about its actual value back via the object 0x6044/0 control effort in the TxPDO used.

The use of the reference/actual value channel depends on the set configuration (control system). The actual value is generated from the correct source depending on the control system used.

Note: The reference value in the object 0x6042/0 target velocity and the actual value in the object 0x6044/0 control effort are interpreted by the control in the notation xxxx RPM. Conversion into a frequency (reference value) or from a frequency (actual value) is done in the frequency inverter.
The object pole number is converted inside the product and related to the parameter *No. of pole pairs* **373** in the first data set. The parameter value of the number of pole pairs is to be doubled for the object 0x604D/0 pole number.

The reference value for the frequency inverter from the object 0x6042/0 target velocity is included via the reference line value. This reference value is combined with the internal reference value from the reference frequency value channel in the input of the ramp function. Reference frequency value channel: see operating instructions.



The internal reference value from the reference frequency value channel and the reference line value can be fed to the ramp individually or as an added variable. Setting is done via the data set change-over capable parameter *Ramp set-point* **434**.

Parameter		Setting		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
434	Ramp set-point	1	3	3

Operation mode		Function
0 -	Internal reference frequency value	Reference value from the sources of the percentage of reference frequency value channel
1 -	Reference line value	Reference value via a communication interface
2 -	Internal reference frequency value + reference line value	Sum of internal reference frequency value and reference line value

Note: If *Ramp set-point* **434** = 2 (only reference line value), this reference line value is limited to fmin. Please consider that the sign in front of fmin at reference value = 0 is derived from the sign in front of the last reference line value ≠ 0.
After Power On, the reference line value is limited to +fmin!

For *Ramp set-point* **434** = 3, the sign in front of the overall reference value results from the sum of internal reference frequency value and reference line value.

The reference values can be read out on the frequency inverter with the help of the KP500 control unit or VPlus operating software.

Actual values		
Parameter	**Contents**	**Format**
Internal reference frequency **228**	Internal reference value from frequency reference value channel	xxx.xx Hz
Reference bus frequency **282**	Reference line value from CANopen bus	xxx.xx Hz
Reference ramp frequency **283**	Sum of internal + reference line value	xxx.xx Hz

10 Parameter list

The parameter list is structured according to the menu branches of the operating unit. For better clarity, the parameters have been marked with pictograms:

The parameter is available in the four data sets.

☑ The parameter value is set by the SET-UP routine.

⊗ This parameter cannot be written in the operation of the frequency inverter.

10.1 Actual value

Actual values of the frequency inverter				
No.	**Description**	**Unit**	**Display range**	**Chapter**
228	Internal reference frequency	Hz	-1000.00 ... 1000.00	9.4
249	Active data set	-	1 ... 4	9
250	Digital inputs	-	0 ... 255	9.3
260	Current error	-	0 ... 0xFFFF	8.3.2
270	Warnings	-	0 ... 0xFFFF	9.1
282	Reference bus frequency	Hz	-1000.00 ... 1000.00	9.4
283	Reference ramp frequency	Hz	-1000.00 ... 1000.00	9.4

Note: The parameters *Current error* **260** and *Warnings* **270** are only accessible via the manufacturer objects 0x2nnn. It cannot be addressed via the VPlus program or the KP500 control unit.

10.2 Parameter

	Rated motor parameters				
	No.	**Description**	**Unit**	**Display range**	**Chapter**
	373	No. of pole pairs	-	1 ... 24	8.5.1
		Bus control			
	392	State-transition 5	-	0 ... 2	9.2
	412	Local/Remote	-	0 ... 44	9
		Data set change-over			
	414	Data set selection	-	0 ... 4	9
		Frequency ramps			
	420	Acceleration (Clockwise)	Hz/s	0,01 ... 999,99	8.5.6
	421	Deceleration (Clockwise)	Hz/s	0,01 ... 999,99	8.5.7
	422	Acceleration (Anticlockwise)	Hz/s	-0,01 ... 999,99	8.5.6
	423	Deceleration (Anticlockwise)	Hz/s	-0,01 ... 999,99	8.5.7
	424	Emergency stop (Clockwise)	Hz/s	0,01 ... 9999,99	9.2.1
	425	Emergency stop (Anticlockwise)	Hz/s	0,01 ... 9999,99	9.2.1
		Frequency ramps			
	434	Ramp set point	-	1 ... 3	9.4
		Digital outputs			
	549	max. Control deviation	%	0,01 ... 20,00	9.1
		Stopping behavior			
	637	Switch-off threshold	%	0,0 ... 100,0	9.2.1
	638	Holding time"	s	0,0 ... 200,0	9.2.1

Note: The parameter *Data set selection* **414** is only accessible via the manufacturer objects 0x2nnn. It cannot be addressed via the VPlus program or the KP500 control unit.

11 Annex

11.1 Warning messages

The various control functions and methods and the hardware of the frequency inverter contain functions that continuously monitor the application. In addition ones to the messages documented in the manual the following fault messages are activated by the CANopen communication module CM-CAN.
The warning reports are given via the parameter *Warnings* **270** bit-coded according to the following scheme.

Warning messages		
Bit no.	**Warning code**	**Meaning**
0	0x0001	Warning Ixt
1	0x0002	Warning Short Term - Ixt
2	0x0004	Warning Long Term - Ixt
3	0x0008	Warning Heat sink Temperature Tc
4	0x0010	Warning Inside Temperature Ti
5	0x0020	Warning Limit
6	0x0040	Warning Init
7	0x0080	Warning Motor Temperature
8	0x0100	Warning Mains Failure
9	0x0200	Warning Motor Protective Switch
10	0x0400	Warning Fmax
11	0x0800	Warning Analog Input MFI1A
12	0x1000	Warning Analog Input A2
13	0x2000	Warning System bus
14	0x4000	Warning Udc
15	0x8000	Warning V-Belt

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

11.2 Fault messages

The fault code that is stored after an fault occurs is made up of fault group FXX (high Byte, hexadecimal) and the following code number XX (low Byte, hexadecimal).

Communication fault		
Code		**Meaning**
F20	21	CAN Bus-OFF
	22	CAN Guarding
	25	CAN Error-State
F23	nn	CAN Heartbeat failure - nn = node address of the failed subscriber

Alongside the fault messages stated, there are further fault messages, however they are only used for internal purposes and are not listed here. If you receive fault messages which are not listed here, please contact us by phone.

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VEC 227 R1