INDUSTRY PROCESS
AND AUTOMATION SOLUTIONS

BONFIGLIOLI VECTRON

Operating instructions Part 2

V/f-characteristic control *configuration 110*
- with technology controller *configuration 111*

Frequency inverter 400 V
4.0 kW ... 355.0 kW

VCB

GB

BONFIGLIOLI

Operating instructions Part 2, V/f characteristic control without and with technology controller (configuration 110 and 111) for static frequency inverters VECTRON

VCB 400-010	**—**	**4 kW**
VCB 400-014	**—**	**5.5 kW**
VCB 400-018	**—**	**7.5 kW**
VCB 400-025	**—**	**11 kW**
VCB 400-034	**—**	**15 kW**
VCB 400-045	**—**	**22 kW**
VCB 400-060	**—**	**30 kW**
VCB 400-075	**—**	**37 kW**
VCB 400-090	**—**	**45 kW**
VCB 400-115	**—**	**55 kW**
VCB 400-135	**—**	**65 kW**
VCB 400-150	**—**	**75 kW**
VCB 400-180	**—**	**90 kW**
VCB 400-210	**—**	**110 kW**
VCB 400-250	**—**	**132 kW**
VCB 400-300	**—**	**160 kW**
VCB 400-370	**—**	**200 kW**
VCB 400-460	**—**	**250 kW**
VCB 400-570	**—**	**315 kW**
VCB 400-610	**—**	**355 kW**

Valid from frequency inverter software version V3.0

1. IMPORTANT INFORMATION ON THESE OPERATING INSTRUCTIONS

These operating instructions are valid for the frequency inverter range **VCB 400.**

A **list of contents** is provided for you at the beginning of these operating instructions.
The **Operating Instructions Part 1 General information and power section** contains general information, the construction and layout drawings, technical data, the dimensional drawings and the description of the cable connections.

The **Operating Instructions Part 2 control section and parameterisation** describes the configurations V/f - characteristic control with the relevant control connections and gives information on the handling of the control unit **KP 100**, the individual equipment parameters and their parameterisation.

For a better overall view the **numbering of the chapters** is continued in the **Operating Instructions Part 2 Control section and parameterisation.**

According to the customised request of the frequency inverter, there are also device versions with special hardware functions. The supplements to the operating instructions E1, E2 ... describe equipment options and expansion modules. Among other things the extended control connections with the relevant parameters and setting possibilities are described.

For more clarity the following pictograms are used in the operating instructions for warnings and notes :

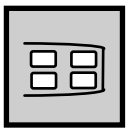
Caution! Lethal risk from high direct contact voltage.

Caution! Instruction must be observed.

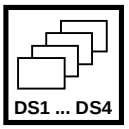
Caution! Disconnect the unit from the mains before performing any operation until the DC - link capacitors have discharged to a safe residual voltage.

Prohibited! Incorrect handling may damage the equipment.

Useful note, tip.



Setting can be changed using the control unit KP 100.



These parameters can be set in each of the four data sets.

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1.1. FURTHER INFORMATION

These operating instructions have been drawn up with the greatest care and have been extensively checked several times. For reasons of clarity not all detailed information on all product models and also not every conceivable case of installation, operation or maintenance could be taken into account. Should you require further information or if particular problems should occur which are not treated in enough detail in the operating instructions you may request the necessary information from the local agent of the company BONFIGLIOLI VECTRON.
We should like to indicate moreover that the contents of these operating instructions are not part of a previous or current agreement, confirmation of legal relationship nor should they amend this. All the manufacturer's obligations ensue from the relevant sales contract which also includes the complete and solely valid guarantee regulation. These contractual guarantee conditions are neither extended nor restricted by implementation of these operating instructions.

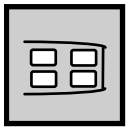
The manufacturer retains the right to correct or alter the contents and product details as well as omissions without previous notice and accepts no liability for damage, injuries or expenses resulting from the above named reasons.

2. 10 STEPS TO COMMISSIONING

WHAT DO I DO ?	WHERE DO I FIND IT ?
Mount the frequency inverter.	Operating instructions part 1
Connect the mains supply and the motor.	Operating instructions part 1
Select configuration 110 or 111.	Operating instructions part 2 chapter 3
Check all control connections.	Operating instruction part 2 chapter 6
Find out about the handling of the KP 100 control unit.	Operating instructions part 2 chapter 5
Switch on the mains voltage.	Operating instructions part 2 chapter 6.1
Guided commissioning for the basic setting of the frequency inverter.	Operating instructions part 2 chapter 6.2
Make corrections to the basic setting if necessary.	Operating instructions part 2 chapter 6.5
Carry out the first function test.	Operating instructions part 2 chapter 6.6
Perhaps optimise by adding additional functions.	Operating instructions part 2 chapter 7

3. CONTROL CONNECTIONS

The control hardware and software for the VCB frequency inverters is virtually freely configurable. This means that theoretically certain functions can be assigned to the control connections and one has virtually a free choice of the software modules used and their internal connection.
This modular concept allows you to adapt the frequency inverter to a number of different drive tasks.



The demands on the control hardware and software are derived from known standard applications in drive technology. Thus, certain functional assignments for the control connections as well as the internal connection of the software modules can be determined. These fixed assignments can be selected with the parameter *Configuration* **30 (CONF)** (chapter 7.1).

These operating instructions will describe the control connection assignments and parameterisation (chapter 7) for the configurations

- **V/f – characteristic control without technology controller (configuration 110)**
- **V/f – characteristic control with technology controller (configuration 111)**

from the variety of possible fixed assignments.

All control connections for the frequency inverter are located beneath the cover, which may have to be removed.
The standard connections for the frequency inverter are run to the terminal strips X209, X210 and X211.
(see construction and layout drawing in the Operating instructions Part 1).

3.1. SPECIFICATION OF THE CONTROL INPUTS AND OUTPUTS

The wiring of the control inputs and outputs of the frequency inverter is carried out at print terminals of the company Phoenix Contact. The connection consists of the mounted fixed socket and the plug labelled with the terminal designation.

Technical Data		
Nominal voltage / current / diameter	V / A / mm^2	160 / 8 / 1.5 [1)] 150 / 8 / 1.5 [2)]
Tightening torque	Nm	0.22-0.25
Screw thread	metric	M2
Connection capacity		
Rigid / flexible	mm^2	0.14-1.5 / 0.14-1.5
Flexible with wire-end sleeve	mm^2	0.25-1.5
Multiple wire connection (2 wires of the same diameter)		
Rigid / flexible	mm^2	0.14-0.5 / 0.14-0.75
Flexible with wire-end sleeve	mm^2	0.25-0.34

Note: MINI-COMBICON plug connectors may only be connected and isolated without power. Please consult the manufacturer's product information for detailed information.
(Phoenix Contact print terminals [1)]MC1.5 G-3.81 and [2)]MC1.5 G-5.08)

ANALOG INPUTS AND OUTPUTS, TERMINAL STRIP X211	
X211-1	Reference output +10 V for reference value potentiometer, max. load 10 mA
X211-2	Ground/GND 10 V
X211-3/-4	Prog. analog input 1 S1INA, differential input, voltage range 0 V ... ±10 V, Ri = 100 kOhm, resolution 12 bit
X211-5/-6	Prog. analog input 2 S2INA, differential input, voltage range 0 V ... ±10 V, Ri = 100 kOhm, resolution 12 bit
X211-7/-6	Prog. analog input 3 S3INA, current input (differential input), current range 0 mA ... ±20 mA, Ri = 100 Ohm, resolution 12 bit
X211-8	Prog. analog output S1OUTA, current output, current range 0 mA ... ±20 mA (±4 mA ... ±20 mA), max. load resistance 500 Ohm, resolution 10 bit

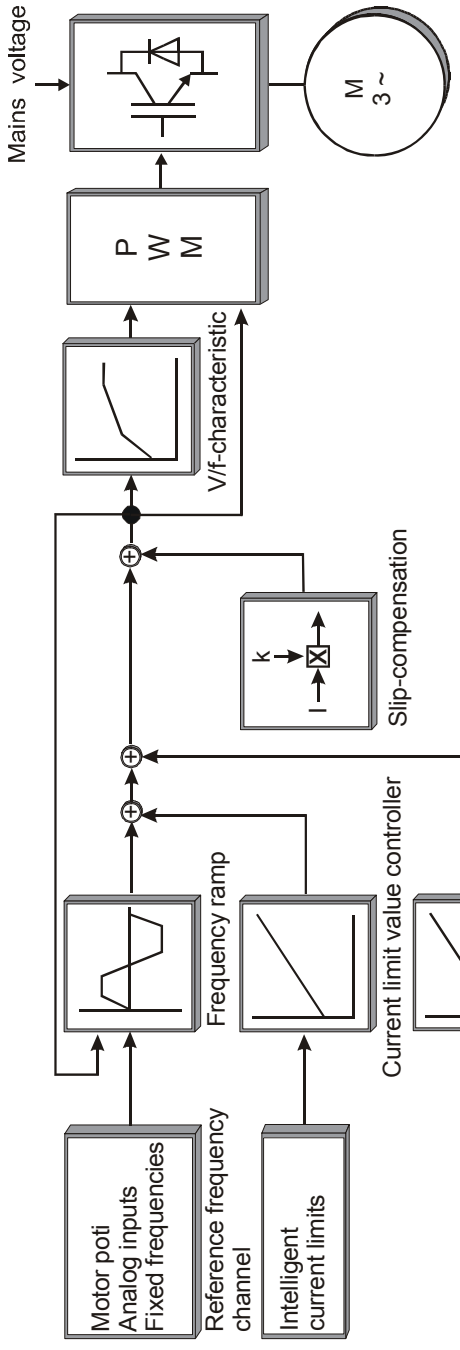
Attention: In the case of reference value and actual value cables which are longer than 4 m and reference and actual value sources with different potentials or which require a high common mode rejection, isolation amplifiers are to be used for the potential isolation.

DIGITAL INPUTS AND OUTPUTS, TERMINAL STRIP X210	
X210-1	Supply voltage output + 24 V, max. load 140 mA
X210-2	Ground/GND 24 V
X210-3	Control input regulator release S1IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-4	Prog. control input S2IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-5	Prog. control input S3IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-6	Prog. control input S4IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-7	Prog. control input S5IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-8	Prog. control input S6IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-9	Prog. control input S7IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-10	Prog. control input S8IND, PCL compatible, max. 30 V, input current 10 mA at 24 V
X210-11	Supply voltage input for S1OUT and S2OUT, max. voltage 30 V
X210-12	Prog. control output S1OUT, floating, HIGH active, max. load 50 mA, overload proof and short circuit proof
X210-13	Prog. control output S2OUT, floating, HIGH active, max. load 50 mA, overload proof and short circuit proof
X210-14	Ground/GND 8 V
X210-15	Ext. supply voltage input for the controller card, +8 V (+7.6 V...+9 V), at least 1 A, connection only when no mains voltage is present or only via a diode e g 1N4005!

RELAY OUTPUT, TERMINAL STRIP X209	
X209-1/-2/ and 3	Prog. changer contact, floating, response time approximately 40 ms, contact load 240 V AC / 5 A, 24 V DC / 5A (ohmic)

3.2. CONFIGURATION 110 (WITHOUT TECHNOLOGY CONTROLLER)

3.2.1. FUNCTION OVERVIEW OF CONFIGURATION 110



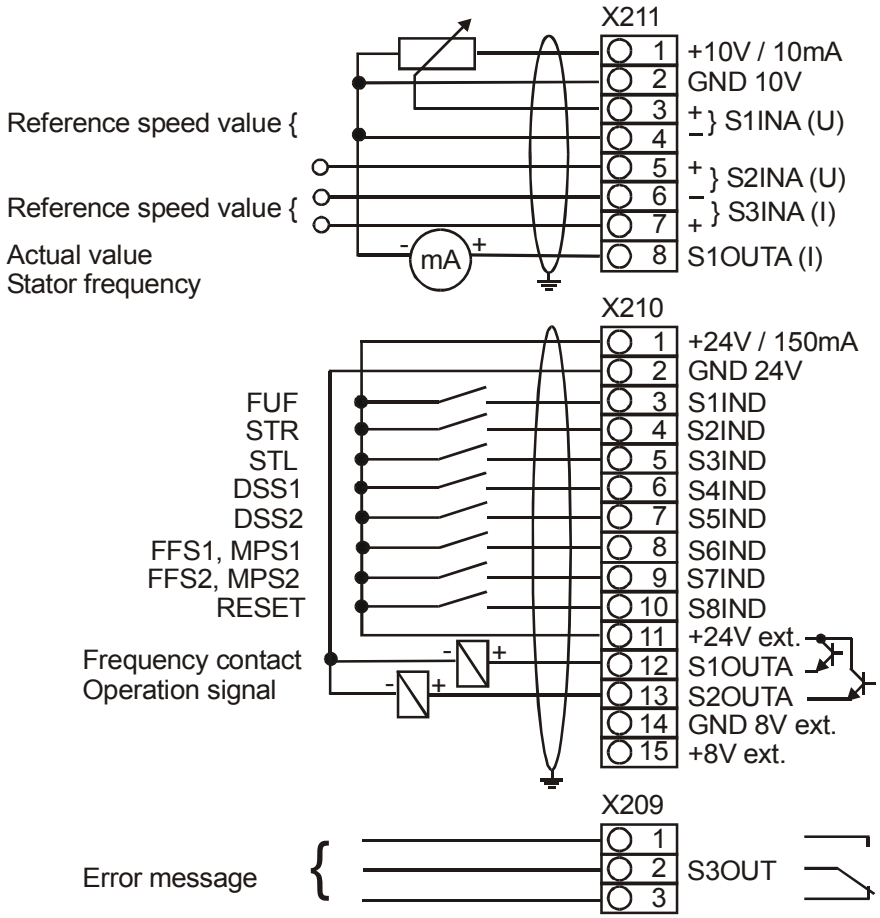
Configuration 110: **Functions:**

- Reference frequency channel — Setting of the reference value source (chapter 7.11)
- Ramps — Setting of the acceleration and deceleration time (chapter 7.15)
- V/f-characteristic — Setting of the motor torque (chapter 7.8)
- Pulse width modulation — Reduction of the motor noise and improvement of the true running (chapter 7.17.9)
- Intelligent current limits — Power reduction with increased drive load (chapter 7.16.1)
- Current limit value controller — Limitation of the output current (chapter 7.16.2)
- Voltage controller — Limitation of the D/C link voltage and power failure regulation (chapter 7.16.3)
- Slip compensation — Simple speed regulation without feedback (chapter 7.16.4)
- Starting behaviour — Different start functions for starting the drive (chapter 7.9)
- Stopping behaviour — Different stop functions for led drive stopping (chapter 7.10)
- Brake chopper — Reduction of braking time by external resistance (chapter 7.17.7)
- Auto-start — Starting the inverter by switching on mains voltage (chapter 7.17.1)
- Synchronisation — Switching onto the rotating motor (chapter 7.17.3)
- Dyn. Phase current limitation — Avoidance of disturbance from load strokes (chapter 7.17.5)
- Progr. digital outputs — Setting of the messages for external control (chapter 7.5)

3.2.2. CONTROL TERMINAL CONNECTION PLAN FOR CONFIGURATION 110

For this connection plan the parameter *Configuration* **30 (CONF)** must be set to value **110** with the control unit KP 100. The V/f - characteristic control described in these operating instructions has a fixed functional arrangement for the control terminals which are set when the configuration is selected (see chapter 7.1).

Note: The suggested wiring of the digital outputs uses the +24V power supply of the frequency inverter. The galvanic isolation of terminals X210-12 and X210-13 to the supply voltage for the frequency inverter, can only be guaranteed with an external supply voltage at terminal X210-11. Any connection of the external power source to the supply voltage of the frequency inverter cancels the galvanic isolation.



Note: The following connection plan shows the standard connections for the frequency inverter. Depending on the extension card used, you will find the connection plan for further control connections in the corresponding **Supplements to the operating instructions**.

3.2.3. EXPLANATION OF THE CONNECTION PLAN FOR CONFIGURATION 110

ANALOG INPUTS AND OUTPUTS, TERMINAL STRIP X211

No.	Symbol	Function	Explanation/Use	Chapter
1	+10V	-	Reference voltage for reference value potentiometer	-
2	GND 10V	-	Ground 10 V	-
3/4	S1INA	-	Ref. speed value input 1, 4.7-10 kOhm Potentiometer or 0 V ... ±10 V	7.2
5/6	S2INA	-	Ref. speed value input 2 [1)]	7.2
7/6	S3INA	-	Ref. speed value input 3, 0 mA ... ±20 mA	7.2
8	S1OUTA	-	Actual value output 0 mA ... ±20 mA proportional to the *Stator Frequency* **210 (FS)**, reference point terminal 2 (Ground/GND 10V)	7.4

DIGITAL INPUTS AND OUTPUTS, TERMINAL STRIP X210

No.	Symbol	Function	Explanation/Use	Chapter
1	+24V	-	Supply voltage for digital inputs and outputs	-
2	GND 24V	-	Ground 24 V	-
3	S1IND	FUF	Controller release	7.3.1
4	S2IND	STR	Start clockwise	7.3.1
5	S3IND	STL	Start anti-clockwise	7.3.1
6	S4IND	DSS1	Data set changeover	7.3.2
7	S5IND	DSS2	Data set changeover	7.3.2
8	S6IND	FFS1, MPS1	Fixed frequencies or motor potentiometer upwards [1)]	7.3.3
9	S7IND	FFS2, MPS2	Fixed frequencies or motor potentiometer downwards [1)]	7.3.3
10	S8IND	RESET	Acknowledge error message	7.3.4
11	+24 V EXT	-	Ext. supply input for S1OUT and S2OUT	-
12	S1OUT	-	Control output HIGH active, frequency contact **210 (FS) > 510 (FTRIG)** (3.00 Hz fact. setting)	7.5
13	S2OUT	-	Control output HIGH active, operation message, signal S1IND/S2IND or S1IND/S3IND	7.5
14	GND 8V	-	Ground 8 V ext.	-
15	+8V EXT	-	Ext. supply input +8V for universal controller	-

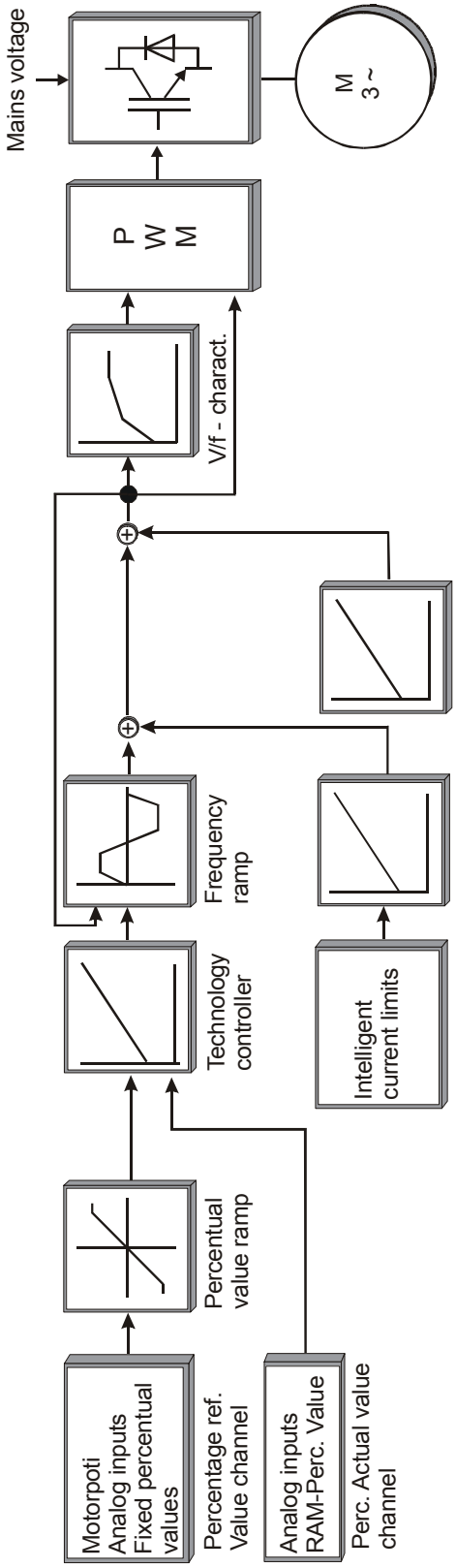
RELAY OUTPUT, TERMINAL STRIP X209

No.	Symbol	Function	Explanation/Use	Chapter
1	S3OUT	-	Relay output make contact, error message, opened	7.5
2	S3OUT	-	Relay root contact	7.5
3	S3OUT	-	Relay output break contact, error message, closed	7.5

[1)] Functions not activated in the factory setting

3.3. CONFIGURATION 111 (WITH TECHNOLOGY CONTROLLER)

3.3.1. FUNCTION OVERVIEW OF CONFIGURATION 111



Configuration 111

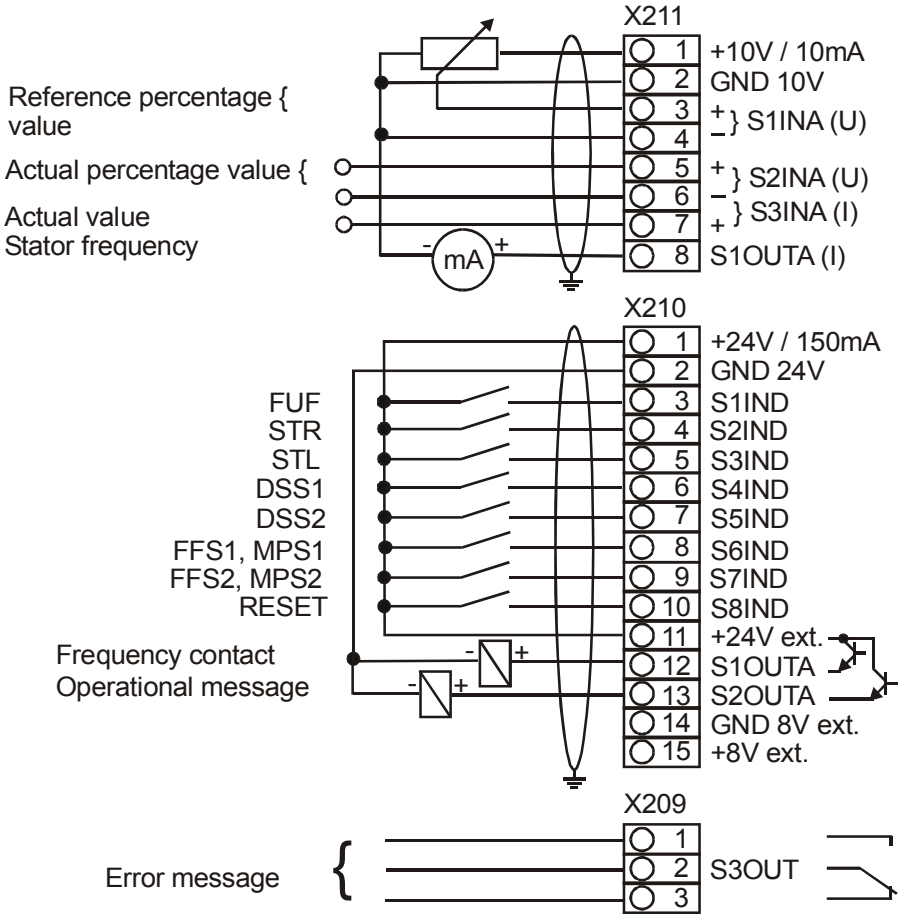
Functions:

- Reference percentage channel — Setting the reference value source (chapter. 7.12)
- Percentage value ramp — Definition of modification speed of the reference value signal (chapter 7.13)
- Actual percentage value source — Setting of actual value source (chapter 7.14)
- Technology controller — PI-controller e. g. for pressure, volume flow or speed control (chapter 7.16.5)
- Ramps — Setting of the acceleration and deceleration time (chapter 7.15)
- V/f – characteristic — Setting of the motor torque (chapter 7.8)
- Pulse width modulation — Reduction of the motor noise and improvement of the true running (chapter 7.17.9)
- Intelligent current limits — Power reduction with increased drive load (chapter 7.16.1)
- Current limit value controller — Limitation of the output current (chapter 7.16.2)
- Voltage controller — Limitation of the D/C link voltage and power failure regulation (chapter 7.16.3)
- Starting behaviour — Different start functions for starting the drive (chapter 7.9)
- Stopping behaviour — Different stop functions for led drive stopping (chapter 7.10)
- Brake chopper — Reduction of braking time by external resistance (chapter 7.17.7)
- Auto start — Starting the inverter by switching on mains voltage (chapter 7.17.1)
- Synchronisation — Switching onto the rotating motor (chapter 7.17.3)
- Dyn. phase current limitation — Avoidance of disturbance from load strokes (chapter 7.17.5)
- Progr. digital outputs — Setting of the messages for external control (chapter 7.5)

3.3.2. CONTROL TERMINAL CONNECTION PLAN FOR CONFIGURATION 111

For this connection plan the parameter *Configuration* **30 (CONF)** must be set to value **111** with the control unit KP 100. The V/f - characteristic control described in these operating instructions has a fixed functional arrangement for the control terminals which are set when the configuration is selected (see chapter 7.1).

Note: The suggested wiring of the digital outputs uses the +24V power supply of the frequency inverter. The galvanic isolation of terminals X210-12 and X210-13 to the supply voltage for the frequency inverter, can only be guaranteed with an external supply voltage at terminal X210-11. Any connection of the external power source to the supply voltage of the frequency inverter cancels the galvanic isolation.



Note: The following connection plan shows the standard connections of frequency inverters. Depending on the extension card used, you will find the connection plan for further control connections in the corresponding **Supplements to the operating instructions**.

3.3.3. EXPLANATION ON THE CONNECTION PLAN FOR CONFIGURATION 111

ANALOG INPUTS AND OUTPUTS, TERMINAL STRIP X211

No.	Symbol	Function	Explanation/Use	Chapter
1	+10V	-	Reference voltage for reference value potentiometer	-
2	GND 10V	-	Ground 10 V	-
3/4	S1INA	-	Reference value input 1, 4.7 - 10 kOhm Potentiometer or 0 V ... ±10 V	7.2
5/6	S2INA	-	Actual value input 2	7.2
6/7	S3INA	-	Reference value input 3, 0 mA ...±20 mA	7.2
8	S1OUTA	-	Actual value output 0 mA ... ±20 mA proportional to the *Stator frequency* **210 (FS)** reference point terminal 2 (Ground/GND 10V)	7.4

DIGITAL INPUTS AND OUTPUTS TERMINAL STRIP X 210

No.	Symbol	Function	Explanation/Use	Chapter
1	+24V	-	Supply voltage for digital inputs and outputs	-
2	GND 24V	-	Ground 24 V	-
3	S1IND	FUF	Regulator release	7.3.1
4	S2IND	STR	Start clockwise	7.3.1
5	S3IND	-	-	7.3.1
6	S4IND	DSS1	Data set changeover	7.3.2
7	S5IND	DSS2	Data set changeover	7.3.2
8	S6IND	FPS1, MPPS1	Fixed percentage value or motor potentiometer upwards **1)**	7.3.3
9	S7IND	FPS2 MPPS2	Fixed percentage value or motor potentiometer downwards **1)**	7.3.3
10	S8IND	RESET	Acknowledge fault message	7.3.4
11	+24V EXT	-	Ext. supply input for S1OUT and S2OUT	-
12	S1OUT	-	Control output high active, frequency contact **210 (FS) > 510 (FTRIG)** (3.00 Hz fact. setting)	7.5
13	S2OUT	-	Control output high active, operation message, signal S1IND/S2IND	7.5
14	GND 8V	-	Ground 8 V	-
15	+8V EXT	-	Ext. supply input +8 V for universal controller	-

RELAY OUTPUT, TERMINAL STRIP X209

No.	Symbol	Function	Explanation/Use	Chapter
1	S3OUT	-	Relay output make contact, fault message opened	7.5
2	S3OUT	-	Relay root contact	7.5
3	S3OUT	-	Relay output break contact, fault message closed	7.5

1) Functions not activated in the factory setting

4. OPTIONAL COMPONENTS

4.1. EXPANSION OF THE FREQUENCY INVERTER

Expansion module EAL-1
The connections to the expansion module EAL-1 are led to the terminal strips X460, X461, X462 and X464. These are an input for an incremental speed sensor, a potential isolated output as a repetition frequency to the speed sensor simulation, as well as digital and analog control outputs. There is additionally the connection of a motor temperature monitoring by a thermistor (PTC) or a bimetallic sensor.

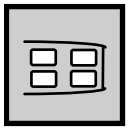
Speed sensor module ENC-1
The connections to the speed sensor module ENC-1 are led to the terminal strips X450, X451 and X455. These are two inputs for incremental speed sensors as well as a potential isolated repetition frequency output which is carried out as an incremental speed sensor simulation. There is additionally the connection of a motor temperature monitoring by a thermistor (PTC) or a bimetallic sensor.

Motor PTC connection VCM-PTC
The connection to the expansion card motor PTC connection VCM-PTC is led to the terminal strip X455. Motor temperature monitoring is possible with the connection of a thermistor (PTC) or bimetallic sensor.

Communication cards
The parameterisation of the frequency inverters can also be carried out via a communication interface as well as with the control unit KP100. At present the following interfaces are available:

- RS232 - Interface VCI-RS232
- RS485 - Interface VCI-RS485
- CANopen – Interface VCI-CAN
- Profibus DP Connection VCI-PROF
- LON - Interface VCI-LON

4.2. PC-CONNECTION



To parameterise, document, monitor and administer the settings right up to commissioning using PC and laptop a PC - program is available.
For the connection of the PC to the inverter an interface converter or an communication card, available as an option, is necessary. The connection of the interface converter is effected at the plug X215.
(Connection for the KP 100 control unit, see construction and layout drawing).

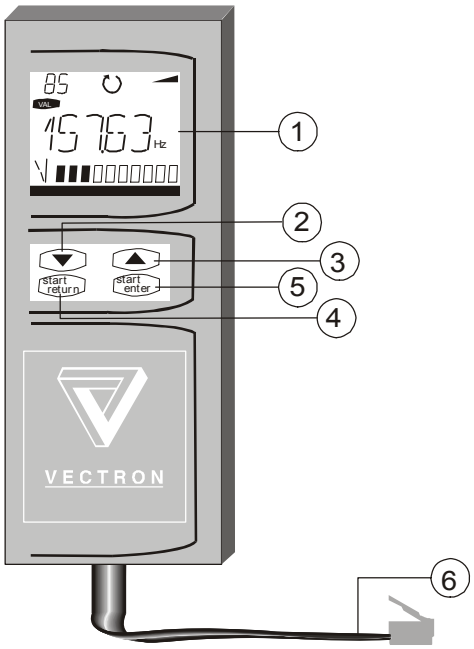
Further information supplied on request.

5. HANDLING OF THE CONTROL UNIT KP 100

5.1. CONNECTION AND FIXING OF THE KP 100

The KP 100 control unit is connected at the plug X215 (see operating instructions Part 1 construction and layout drawing).
The control unit can be fixed under the inverter lid. Please remove the removable cover in the lid for this purpose.

5.2. LAYOUT DRAWING AND TECHNICAL DATA



Elements of KP100		
Item	**Description**	**Function**
1	LCD display panel	140 Segments, red/green illuminated background
2	Key arrow down	Move backwards (scrolling) within the menu structure, reduce value
3	Key arrow up	Move forwards (scrolling) within the menu structure, increase value
4	Key stop/return	Stop (menu CTRL), cancel or leave selected menu
5	Key start/enter	Start (menu CTRL), confirm or select menu
6	Connection cable	Connection to X215, length maximum 0.30 m

Technical Data			
Dimensions	W x H x D	mm	62 x 158 x 21
Weight	M	g	100
Protection class	-	-	IP 20, VBG4
Ambient temperature	T	°C	0 ... 45

5.3. GENERAL

5.3.1. MENU BRANCHES

After the mains voltage is switched on the frequency inverter carries out a self-test.

The inverter completes this with a direct jump to the actual value chosen in the menu branch VAL (background of display is illuminated green).

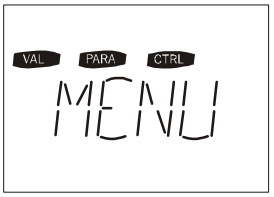
Note: The actual value display set in the factory, *Actual Frequency* **241 (FREQ)**, can be adapted to your individual needs by selecting a different actual value in the menu branch VAL.

The menu branch VAL is active. By touching the start/return key twice the display changes to menu and opens the selection of further menu branches.

VAL = show actual values

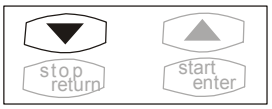
PARA = alter parameter setting (parameterise)

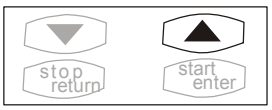
CTRL = Set-up for guided commissioning, control motor via the KP100 control unit and the self-test



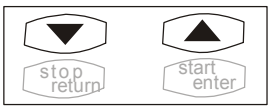
5.3.2. KEY FUNCTIONS

The arrow keys are used for the selection of menu branches and individual parameters and facilitate the change of their values.
Touched once in the main menu they cause a jump to the next menu branch or in the submenus they jump to the next parameter.
Within the parameter level the smallest possible change of the parameter value is achieved by touching the key.
If the key is held down an automatic run (scrolling) results which is stopped by leaving go of the key.

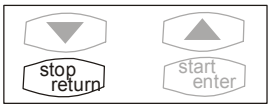




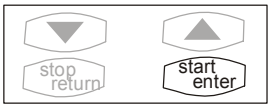
If the arrow keys on the parameter level are pressed simultaneously, the factory setting for the parameter value is set.



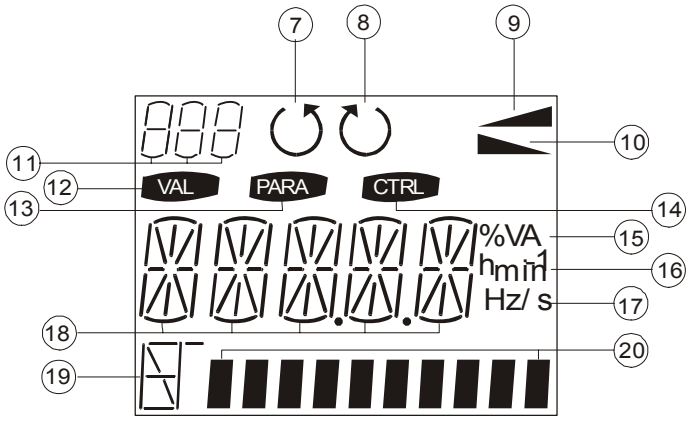
With the stop/return key the menu branches are left or parameter alterations aborted (old value is maintained).



With the start/enter key menu branches or parameters are called up or their changes stored.



5.3.3. LCD-DISPLAY

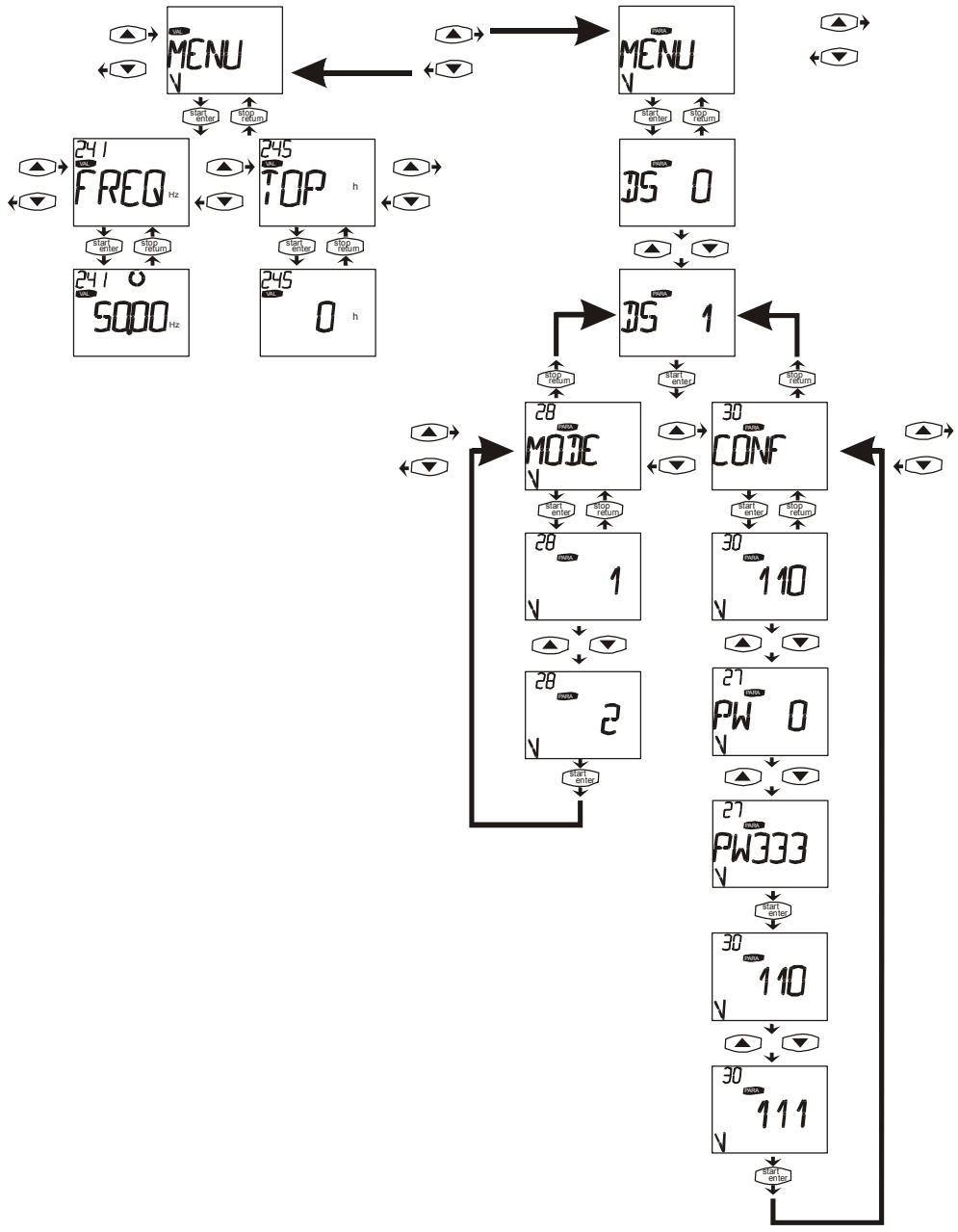


Display OF KP100		
Item	**Description**	**Function**
7	Anti-clockwise rotation	Control display for output rotation field, anti-clockwise field of rotation active
8	Clockwise rotation	Control display for output rotation field, clockwise field of rotation active
9	Acceleration ramp	Control display, active during acceleration
10	Brake ramp	Control display, active during braking
11	3-digit number display	7 segment display for actual values, parameter no.
12	VAL menu	Display actual values, for example frequency, voltage, current
13	PARA menu	Alter parameter setting
14	CTLR menu	Control motor via KP 100 control unit, device self-test and guided commissioning
15	Phys. unit for pos. 20	Displays %, V, A or VA with automatic assignment
16	Phys. unit for pos. 20	Displays h or rpm with automatic assignment
17	Phys. unit for pos. 20	Displays Hz, s or Hz/s with automatic assignment
18	5-digit figure display	15 segment display for parameter name and value
19	Bar graph description	Displays formula letters or physical unit for pos. 20
20	10-digit figure bar graph display	Displays parameter values, for example frequency, voltage, apparent current or real current

5.4. MENU STRUCTURE

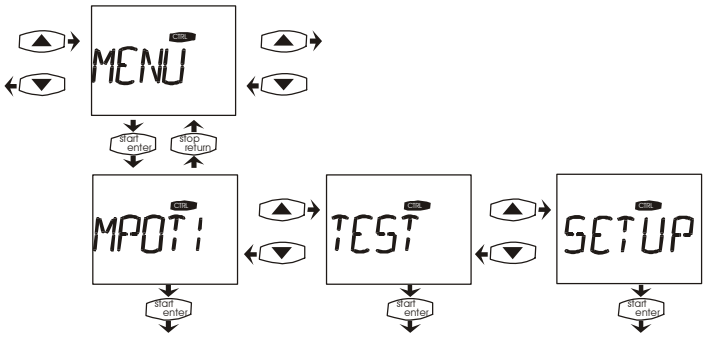
5.4.1. OVERVIEW (PART 1)

Menu **VAL** (actual values)	Menu **PARA** (parameter) no password entry	Menu **PARA** (parameter) with password entry



5.4.2. OVERVIEW (PART 2)

Menu **CTRL**



See control motor with KP 100 (Chapter 5.5)

See device test (Chapter 5.6)

See guided commissioning of the frequency inverter (Chapter 6.2)

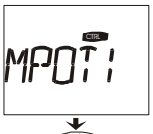
Note: The set-up routine for commissioning the frequency inverter is normally called after setting the factory settings or a new device. Guided commissioning of the frequency inverter appears until successful completion of set-up. The actual value selected from the menu VAL then appears the next time the device is switched on. Release of the frequency inverter with a start command leads to a display of the factory setting for the *Actual frequency* **241 (FREQ)** until it is switched on again.

5.5. CONTROL MOTOR WITH KP 100

The menu **CTRL** is selected in the main menu with the arrow keys.

If the message **NOCTR** appears after the start/enter key is pressed the control inputs **S2IND (STR)**, **S3IND (STL)** and the release signal **(FUF)** are already activated. Deactivate the signals STR and STL to enable the CTRL menu of the frequency inverter's control.

The first command in the CTRL menu is the function **MPOTI** (motor potentiometer). This enables a reference value setting independent of further possibilities of the reference value channel.

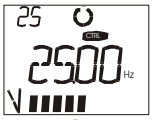


After pressing the start/enter key again the display **FUF** flashes if the control input **S1IND (FUF)** is not yet connected. For safety reasons the control input **S1IND (FUF)** must be connected in addition to starting.

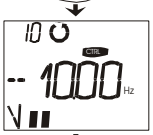
If the control input **S1IND (FUF)** is connected the set *Minimum Frequency* **418 (FMIN)** is displayed as a reference frequency value. The reference frequency value can be altered with the arrow keys.

After the start/enter key is pressed the motor accelerates with the set acceleration ramp to the pre-set reference frequency. The actual frequency, the output voltage (as a bar display) and the direction of rotation are then also displayed.

With the arrow up key the reference frequency value in a clockwise field of rotation (plus sign) can be increased up to the set *Maximum frequency* **419 (FMAX)**. The output frequency then rises with the set *Acceleration clockwise* **420 (RACCR)**.

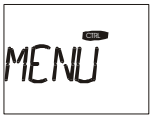


With the arrow down key the reference frequency value in a clockwise rotary field can be reduced. If the minimum frequency is 0 Hz, then the reference frequency value can become negative (minus sign). With the arrow up key the reference frequency value can be increased until the direction of rotation of the motor changes again (0 Hz and up).



If the stop/return key is pressed during operation, then the motor brakes to 0 Hz with the set deceleration ramp.

After pressing the stop/return key again, the main menu appears.



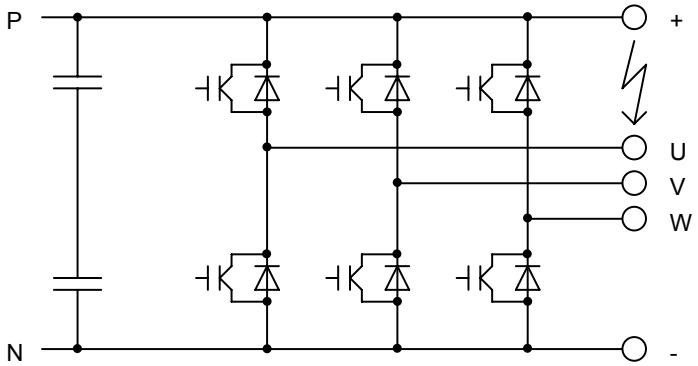
Caution: If the *Minimum Frequency* **418 (FMIN)** is set to 0 Hz, the motor will change its direction of rotation when the sign for the reference frequency value changes.
The reference line value which is transmitted via a communication card will be added to the value shown on the control unit.

5.6. DEVICE TEST

The inverter software contains various test routines to test internal and external hardware to facilitate troubleshooting in both the inverter as well as in a complete installation. These tests are used to discover errors in the inverter, in external sensors and the load (motor) and to discover wiring errors.
The device test has been divided into individual tests which can be activated separately as required to enable a separate testing of individual components. These individual tests are described in the following chapters.

5.6.1. TEST 1 (EARTH ERROR / SHORT-CIRCUIT TEST)

This test checks if an earth error is present in the load or inverter or if there is a conductive connection in the DC-link potential (DC+ or P and DC- or N). This test can be carried out either with or without a connected load.
During this test all 6 transistors (motor phases U, V and W) are switched on separately for approximately 1s each. No current may flow even when the load is connected.



If, for example, there is a conductive connection between the positive DC-link potential (DC+ or P) and the phase U (see diagram) the test would be aborted with the error "T0104 EARTH/P-U ERROR".

If an error is signalled during a test with connected load, the test should be repeated without a connected load to determine whether the error is in the inverter or in the load.

If an error is only signalled when the load is connected, one can assume an earth error in the load or alternatively, if the DC-link terminals are occupied, an error between a motor phase and a DC-link potential (DC+ or DC-).

If an error is signalled even if the motor connection terminals are not occupied, one can assume an error in the inverter or a defective transistor. If there is a defective transistor or a conductive connection in the unit, this is signalled in several phases when the load is connected since the current can also flow over the load. In this case only those messages which are produced without the connected load, are relevant.

A transistor which does not switch or a current measurement which does not function are not recognised by this test (but are by test 2) or result in existing errors which this test normally shows not being recognised.

5.6.2. TEST 2 (LOAD TEST)

This test checks whether a direct current can be impressed into the connected load in each direction. It only produces useful results if test 1 has been completed without any error message. A motor or a three-phase choke must be connected as a load for this test. The load may be connected both in a star as well as in a delta.

In this test a positive and a negative direct current are impressed in succession in each phase. This should be possible without any problem. If no current can be impressed in one direction then a corresponding error will be signalled. This test checks both the transistors and the load as well as the current transformers fitted in the frequency inverter.

If an error is signalled both for positive and negative current in one phase, then an open circuit of the relevant phase is present (e.g. cable break) or the corresponding current transformer is defective. If an error is signalled for only one polarity in one phase, one can assume that a transistor or a driver is defective or a connection in the unit is interrupted.

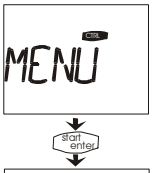
The impressed current is half the rated motor current which can be set with parameter *Rated Current* **371 (MIR)** in **data set 1**.

In order to avoid any damage to the unit or the load, the output voltage is limited to approximately 30V. If the direct current can not be achieved with this voltage, since the ohmic resistance of the load is too high, no load will be established as an error then in each phase. In this case the current to be impressed must be reduced by altering the parameter *Rated Current* **371 (MIR)**.

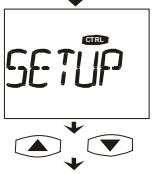
If test 2 signals an earth error after test 1 has signalled no earth error then one can assume that a shunt resistor or current transformer or one of the corresponding connections is defective.

5.6.3. PERFORMING THE DEVICE TEST WITH THE CONTROL UNIT KP 100

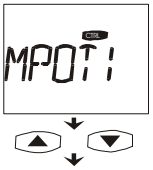
Select the menu **CTRL** in the main menu with the arrow keys.



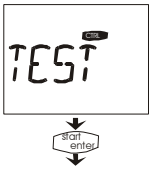
The menu **SETUP** (guided commissioning) appears after pressing the start/enter key.



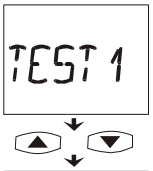
Select the functions in the CTRL menu with the arrow keys. Operation of the control unit KP100 (MPOTI) has been described in the previous chapter.



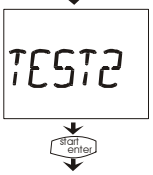
Select the menu **TEST** with the arrow keys.



TEST1 appears after the start/enter key is pressed.

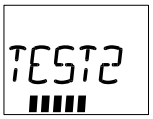


Select the required test **(TEST1 or TEST2)** with the arrow keys. You should start the device test with **TEST1**.



The abbreviation **FUF** appears after the start/enter key is pressed again if the control input **S1IND (FUF)** has not yet been connected.
For safety reasons the control input **S1IND (FUF)** must also be connected to start the test.

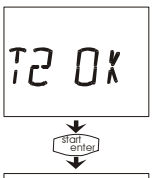
If the control input **S1IND (FUF)** is connected then test 1 or test 2 will start. The duration of the test is then shown with the bar display. A running test can be interrupted at any time with the stop/return key. The error "T001 STOP" will then be signalled. If an error occurs during a test this will be signalled (see error messages for the individual tests).
After an error the test can be continued with the start/enter key or finished with the stop/return key.



T1 OK appears in the display if the test is completed with no errors.

The menu **TEST2** appears after completing test 1 and pressing the start/enter key so that you can continue with test 2.

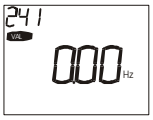
The second part of the device starts after start/enter key is pressed again. **T2 OK** will appear in the display at the end of a successful test.



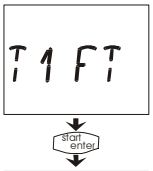
READY appears after carrying out test 2 and pressing the start/enter key.

The test menu can be quit by pressing the stop/return key. The inverter then performs a reset, indicated by **WAIT**.

The actual value display of the calculated *Actual Frequency* **241 (FREQ)** appears after the reset.



If an error message has occurred during a test, the message **T1FT** or **T2FT** appears (FT = fault / error) in place of **T1 OK** or **T2 OK** on completion of the test



READY will be shown on completion of a device test where an error has been signalled during the test and after the start/enter key is pressed.

The test menu can be quit by pressing the stop/return key. The inverter then performs a reset, indicated by **WAIT**.

The actual value display of the calculated *Actual Frequency* **241 (FREQ)** appears after the reset.

5.6.4. ERROR MESSAGES DURING TEST 1

The following error messages will be shown in the KP 100 control unit with code and text in moving script after an error has occurred. The first part of the device test checks the frequency inverter and can be performed with no connected load. In the event of an error, the device has to be disconnected from the load during trouble-shooting so that the exact cause can be determined.

Error messages during Test 1

KP 100 Display		Meaning
Code	**Text**	**Measures / Remedy**
T0001	STOP	Test interrupted by user.
T0002	PERMANENT ERROR	An unacknowledgeable error has occurred, no (further) test possible.
T0003	FUF VANISHED	No release, connect S1IND
T0101	ERD-/N-U	A conductive connection has been found between the phase U and DC- or PE.
T0102	EARTH/N-U ERROR	A conductive connection has been found between the phase V and DC- or PE.
T0103	EARTH/N-V ERROR	A conductive connection has been found between the phase W and DC- or PE.
T0104	EARTH/N-W ERROR	A conductive connection has been found between the phase U and DC+ or PE.
T0105	EARTH/P-U ERROR	A conductive connection has been found between the phase V and DC+ or PE.
T0106	EARTH/P-V ERROR	A conductive connection has been found between the phase W and DC+ or PE.
T0111	EARTH/P-W ERROR	A conductive connection has been found between the phase U and DC- or PE.
T0112	WEAK EARTH/N-U ERROR	A conductive connection has been found between the phase U and DC- or PE.
T0113	WEAK EARTH/N-V ERROR	A conductive connection has been found between the phase V and DC- or PE.
T0114	WEAK EARTH/N-W ERROR	A conductive connection has been found between the phase W and DC- or PE.
T0115	WEAK EARTH/P-U ERROR	A conductive connection has been found between the phase U and DC+ or PE.
T0116	WEAK EARTH/P-V ERROR	A conductive connection has been found between the phase V and DC+ or PE.

The detection and reporting of a device malfunction is split into two types of error to enable a better diagnosis. The conductive connection in the respective phase, between a phase and the DC-link or PE, is reported in the event of an excess current. The error message "weak earth" is shown if a lower current is measured in one of the phases in the first test.

5.6.5. ERROR MESSAGES DURING TEST 2

The second device test should be performed on completion of the first test. The lines and connected loads are checked during this test. The following error messages will be shown in the KP 100 control unit with code and text in moving script after an error has occurred.

Error messages during Test 2

KP 100 display		Meaning
Code	**Text**	**Measures / Remedy**
T0001	STOP	Test interrupted by user.
T0002	PERMANENT ERROR	An unacknowledgeable error has occurred, no (further) test possible.
T0003	FUF VANISHED	No release. Connect S1IND
T0200	EARTH/DC ERROR	A conductive connection has been found between the phases DC or PE. The cause of the error is shown in more detail by Test 1.
T0201	U FAILURE	Positive current could not be impressed in the phase U. Check motor cable and connection.
T0202	V FAILURE	Positive current could not be impressed in the phase V. Check motor cable and connection.
T0203	W FAILURE	Positive current could not be impressed in the phase W. Check motor cable and connection.
T0204	-U FAILURE	Negative current could not be impressed in the phase U. Check motor cable and connection.
T0205	-V FAILURE	Negative current could not be impressed in the phase V. Check motor cable and connection.
T0206	-W FAILURE	Negative current could not be impressed in the phase W. Check motor cable and connection.
T0301	IU SENSE FAILURE	The current impressed in direction (+/-) U was measured with the wrong sign or in a different phase. Check current transformer and transistor connections.
T0302	IV SENSE FAILURE	The current impressed in direction (+/-) V was measured with the wrong sign or in a different phase. Check current transformer and transistor connections.
T0303	IW SENSE FAILURE	The current impressed in direction (+/-) W was measured with the wrong sign or in a different phase. Check current transformer and transistor connections.
T0401	EARTH FAULT	The sum of the phase currents is more than 20% of the hardware cut-off current.

6. COMMISSIONING THE FREQUENCY INVERTER

6.1. SWITCH ON MAINS VOLTAGE

On completion of the installation work and before switching on the mains voltage you should check all the control and power connections again. If all the electrical connections are in order you must **switch off** terminal X210-3) the release of the inverter (control input FUF (S1IND). You can then switch on the mains voltage. The inverter carries out a self-test. During this test the two light-emitting diodes (LED H1 (green) as well as LED H2 (red)) on the front of the unit come on and the relay output (X209) signals "error".
The inverter completes the self-test after some few secounds, the background of the control unit KP 100's display is green, the LED H1(green) flashes and thus signals "ready for operation", the relay (X209) attracts and signals "no error".
Guided commissioning is initially called in the condition on delivery of the frequency inverter. The control unit KP100 shows the menu item “SETUP“ from the CTRL menu.

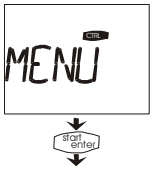
Note: The sequential control of the guided commissioning assumes a knowledge of chapter 5 "Handling the control unit KP100".

6.2. SETUP

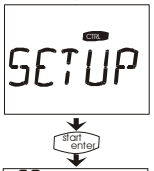
Guided commissioning of the frequency inverter determines all parameter settings relevant for the desired application. The choice of available parameters is derived from known standard applications in drive technology. This facilitates the choice of the most important parameters but cannot replace a subsequent check by the user. Guided commissioning is automatically called in the condition on delivery and after setting of the factory setting. On successful completion of the SETUP – routine the desired actual value from the VAL – menu will be shown in the control unit in future.
Guided commissioning also supports you during the parameterisation of various drive variants and modifications to the application.

Note: Guided commissioning contains the parameter identification function. The parameters are determined and set accordingly through a measurement. The motor should not be run before the start of the measurement since some of the machine data depend on the operating temperature.

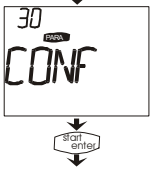
Guided commissioning automatically appears in the condition on delivery. Following successful commissioning you can select the sub-menu CTRL in the main menu to start the function again.



Press the start/enter key to change to the CTRL – sub-menu. Select the "SETUP" command in this sub-menu with the arrow keys and confirm with the start/enter – key.



Select the parameter *Configuration* **30 (CONF)** with the start/enter – key and enter the number 110 or 111 using the arrow keys. Conclude the input with the start/enter – key and change to the next parameter. (see following Chapter)



6.2.1. SELECT CONFIGURATION

The configuration of the inverter determines the assignment and basic function of the control inputs and outputs and the software functions. The frequency inverter software offers several configurations with V/f-characteristic control. The configurations mainly differ in the way the drive is controlled.
These operating instructions describe the V/f-characteristic control in the **configuration 110** and **configuration 111.**

Configuration 110, V/f – Characteristic control
Configuration 110 contains the functions for the speed control of an asynchronous machine in a variety of standard applications. The current motor speed is determined from the momentary ratio between the reference frequency and necessary voltage. The speed is specified as a further reference frequency through various adjustable reference value sources. Analog and digital inputs can be combined and supplemented as a further reference value source through linking to an optional communication protocol. When the set limits are reached the drive speed is regulated so that these are not exceeded.

Configuration 111, V/f – Characteristic control with technology controller
The standard V/f – characteristic control is extended with another controller by selecting configuration 111. The PI-controller which must be parameterised, facilitates the integration into an application with reference and actual value. The process values are represented as a percentage value and transmitted into an operational behaviour of the drive which has to be selected.

Commissioning of the frequency inverter requires the configurations according to these operating instructions. The following description of the parameters are analogous to the setting made with parameter *Configuration* **30 (CONF)**.

Note: Further information on the function overview, the connection plans and the explanations of the connection plans for the aforementioned configuration can be found in chapter 3.

6.2.2. CONTROL LEVEL

The three available control levels allow a graduated commissioning of the drive depending on the scope of the application. The set-up - routine on the first control level contains the most important parameters. The two subsequent control levels extend inquiries by special and control functions, which can remain unchanged in the factory settings for a number of applications.
Commissioning of the frequency inverter on the first *Control Level* **28 (MODE)** can be supplemented through subsequent parameterisation on the further control levels. All parameters are provided identically after guided commissioning in the PARA – menu.

Setting		
Parameter 28 (MODE)	**Customer setting**	**Function**
1 **(Factory setting)**		Control level 1
2		Control level 2
3		Control level 3

Note: The commissioning documented in this chapter describes the displayed parameters independent of the selected control level. You may have to refer to the corresponding chapter in the operating instructions for the extended parameter selection.

6.2.3. DATA SET

The parameter *Data Set* **(DS)** allows the selective storage of parameter settings in four separate data sets. The data set change-over parameters are identified in the operating instructions by a pictogram (see Chapter A Important information on these operating instructions). Data sets 1 to 4 are saved in data set 0 with the same parameter values. The standard application of the frequency inverter, without using data set change-over, uses data set 1.

Setting		
Parameter (DS)	**Customer setting**	**Function**
0 **(Factory setting)**		All data sets (DS0)
1		Data set 1 (DS1)
2		Data set 2 (DS2)
3		Data set 3 (DS3)
4		Data set 4 (DS4)

If guided commissioning is carried out in data set 0 although different settings for data set change-over parameters have been entered the value will not be shown. The parameter number, unit and menu branch will be shown in the familiar form. The parameters set in the factory will be set to zero in the defined value range. Press the arrow keys to set the desired value.

Note: The parameters shown during guided commissioning can be set in each of the 4 data sets according to the application. This allows a number of different configuration variants which are to be taken into account in the structured commissioning. Contact inputs S4IND (DSS1) and S5IND (DSS2) permit a change between data sets 1 to 4.

6.2.4. MOTOR TYPE

The properties of the control methods to be set vary with the connected motor. The parameter *Motor Type* **369 (MTYP)** offers a choice of motor variants with the corresponding tabular values. The check of the entered rated values and the guided commissioning take the parameterised motor type into account. The choice of motor types varies depending on the applications of the different control methods. The V/f-characteristic control is described in these operating instructions for motor type 1.

Setting			
Parameter 369 (MTYP)	**Abbr.**	**Description**	**Control level**
0	UNKNOWN	Unknown machine type	2
1 **(Factory setting)**	ASYNCHRON	Asynchronous machine, squirrel-cage rotor machine	2
2	SYNCHRONUS	Synchronous motor	2
3	RELUCTANCE	Reluctance motor	2
10	TRANSFORMER	Transformer	2

Note: The motor type setting leads to different results in the inquiry and presetting of the relevant parameters. Incorrect entries can lead to damage of the drive.

You should then enter the machine data described in the following chapter in the sequence in which they appear in the table. Confirm the parameter input and choice by pressing the start/enter key. Move between the parameters and change the corresponding values with the arrow keys. After the machine data has been entered the parameters are automatically calculated and checked. The display switches briefly to CALC before continuing the guided commissioning with parameter identification after a successful test of the machine data.

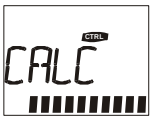
6.2.5. MACHINE DATA

The machine data which should be entered in the next stage of guided commissioning can be found on the motor's ratings plate and data sheet. The factory settings of the machine data are related to the nominal data of the frequency inverter and corresponding asynchronous machine. The machine data necessary for the V/f - characteristic control method are calculated from the settings which have been checked for plausibility in the commissioning sequence. The pre-set rated values in the factory should be checked by the user.

Setting						
Para. No.	**Abbr.**	**Unit**	**Factory setting**	**Customer setting**	**Name / Function**	**Control level**
370	MUR	V	400.0		Rated voltage	1
371	MIR	A	I_{FIN}		Rated current	1
372	MNR	min^{-1}	1490		Rated Speed	1
373	MPP	-	2		No. of pole pairs	1
374	MCOPR	-	0.85		Rated - cos(φ) [1)]	1
375	MFR	Hz	50.00		Rated frequency	1
376	MPR	kW	P_{FIN}		Mech. Rated power	1

[1)] Parameter for slip- and IxR - compensation

6.2.6. CHECKING THE MACHINE DATA



The machine data check is implemented in the V/f -characteristic control for the motor type asynchronous machine. This function is skipped if the parameter *Motor type* **369 (MTYP)** is set with one of the other values. The machine data check should only be omitted by experienced users. The configurations contain a complex control method which essentially depends on correctly entered machine parameters. The warning and error messages shown during the check sequence should thus be observed. If a critical status is detected in the guided commissioning sequence this will be shown in the display of the control unit KP100 with code and moving script. The messages are shown after checking and calculating the rated data. A warning or error message is shown depending on the deviation from the expected parameter value.
The warning message can be acknowledged with the start/enter key and guided commissioning is continued. The entered parameter values can be corrected by subsequently pressing the stop/return key.

Warning messages		
KP 100 display		**Meaning**
Code	**Text**	**Measures / Remedy**
SW0000	NO WARNING	No warning message is present. This message can be read out via an optional communication card.
SW0001	NOM. VOLTAGE	The *Rated Voltage* **370 (MUR)** is outside the FI– nominal voltage range. The maximum nominal voltage is shown on the frequency inverter's ratings plate.

Warning messages		
KP 100 display		**Meaning**
Code	**Text**	**Measures / Remedy**
SW0002	NOM. CURRENT	Check the *Rated Current* **371 (MIR)**, *Rated Mech. Power* **376 (MPR)** and *Rated Voltage* **370 (MUR)**. The calculated efficiency reaches the limits for an asynchronous motor.
SW0003	COS-PHI	The *Rated – Cos Phi* **374 (MCOPR)** is outside the standard range (0.7 to 0.95).
SW0004	SLIP FREQ	Check the *Rated Speed* **372 (MNR)**, *Rated Frequency* **375 (MFR)** and *No. of Pole Pairs* **373 (MPP)**. The slip reaches the limits for an asynchronous motor.

Note: Guided commissioning points out a deviation from the standard values through a warning message. If a standard motor is used you should check the entered rated values for safety's sake.

If an error message appears check and re-enter the parameterised rated data. Guided commissioning is repeated until the rated values have been entered with no errors. Premature termination of guided commissioning with the stop/return key should only be carried out by experienced users since some of the entered rated data is incorrect.

Error messages		
KP 100 display		**Meaning**
Code	**Text**	**Measure / Remedy**
SF0000	NO ERROR	No error message present
SF0001	NOM. CURRENT 1	The entered *Rated Current* **371 (MIR)** is too low
SF0002	NOM. CURRENT 2	The *Rated Current* **371 (MIR)** is too high relative to the *Rated Mech. Power* **376 (MPR)** and *Rated Voltage* **370 (MUR)**.
SF0003	COS-PHI	The *Rated - Cos Phi* **374 (MCOPR)** is incorrect (larger than 1 or smaller than 0.5).
SF0004	SLIP FRQ 1	The slip frequency calculated from the rated data is negative. Check the *Rated Speed* **372 (MNR)**, *Rated Frequency* **375 (MFR)** and *No. of Pole Pairs* **373 (MPP)**.
SF0005	SLIP FRQ 2	Check the entered *Rated Speed* **372 (MNR)**, *Rated Frequency* **375 (MFR)** and *No. of Pole Pairs* **373 (MPP)** because the calculated slip frequency is to high.
SF0006	POWER BALANCE	The overall power of the drive calculated from the rated data is lower than the entered rated power.
SF0007	NO TABLE FOR CONFIG	The pre-set configuration is not supported by guided commissioning. These operating instructions describe configuration 110 or 111 which should be set accordingly.

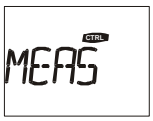
6.2.7. PARAMETER IDENTIFICATION

The V/f - characteristic control method requires further machine data which cannot be found on the ratings plate of the asynchronous machine. Guided commissioning can measure the necessary machine data, supplemental or alternative to the manufacturer's data sheet. The variables measured at a drive standstill are entered directly or subsequent to a calculation of the parameter. Following parameter identification the altered parameters are shown in the sequence listed in the table according to the selected control level.

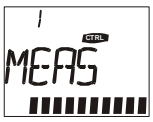
Caution: Guided commissioning of the frequency inverter requires a release of the power unit during parameter identification. Only qualified personnel may work with the machine so as to avoid serious injury or material damage. These include persons who are familiar with the erection, assembly, commissioning and operation of inverters and who are appropriately qualified for this work. These persons must have read the operating instructions carefully and must pay attention to the safety instructions before installation and commissioning.

The sequence and duration of the parameter identification varies depending on the connected machine and device output. Measurements are split into separate sections and can be aborted at any time through digital input S1IND (FUF) or the stop/return key. Guided commissioning shows the status of the individual measurements in a bar chart display. The 3-digit number in the top of the display shows the current stage of the measurement.

Guided commissioning switches to the parameter identification functions after checking the entered machine data. The safety functions of the frequency inverter prevent a release of the power unit without a switching of digital input S1IND (FUF). This also applies if error messages are pending. If a signal was applied at the beginning of guided commissioning the message will not be shown.



Confirm the MEAS display by pressing the start/enter – key. The connected load will be measured with various signals in the following parameter identification sequence.



The further stages of parameter identification comprise complex measuring and calculation algorithms which are shown by the message MEAS with a serial number. An abort by pressing the stop/return key or cancelling release lead to incomplete values in memory.

Caution: Measurement of the various motor parameters can lead to rotation of the drive shaft, particularly if there is no load on the drive.

6.2.8. OPERATION AND MACHINE DATA

The extended machine data are calculated from the parameterised and measured rated values. These parameters are shown for checking and can be altered by the user. The parameters documented in the following table are shown depending on the chosen control level but should only be modified by experienced users. The further stages of guided commissioning can be performed with no release of the power unit.

Setting					
Para. No.	**Abbr.**	**Unit**	**Setting**	**Name / Function**	**Control level**
377	RS	mΩ		Guided commissioning determines the stator resistance through a corresponding measurement in the three machine phases.	2

Guided commissioning is completed for the drive with the parameterised and calculated rated data. The further parameters in the set-up routine define the operating behaviour of the application.

Note: Guided commissioning comprises the parameter identification and the controller optimisation function. The V/f - Characteristic, the current limit value controller, the starting and stopping behaviour is at present optimised.

6.2.9. APPLICATION DATA

The various drive applications and resulting parameter settings call for a check of further parameters. The parameters inquired during guided commissioning are selected from known applications and should be supplemented by further settings in the PARA menu as required. The following parameter selection is shown depending on the chosen control level. Explanations to the parameters can be found in the following chapters of the operating instructions.

Error and warning behaviour						
Para. No.	**Abbr.**	**Unit**	**Setting**	**Customer setting**	**Name / Function**	**Control level**
417	FOFF	Hz	999.99		Frequency switch-off limit	2
Frequency limits						
418	FMIN	Hz	3.50		Minimum frequency, determines the minimum permissible drive speed.	1
419	FMAX	Hz	50.00		Maximum frequency, determines the maximum permissible drive speed.	1
Frequency ramps						
420	RACCR	Hz/s	1.00		Acceleration clockwise	1
421	RDECR	Hz/s	1.00		Deceleration clockwise	1
422	RACCL	Hz/s	1.00		Acceleration anti-clockwise	1
423	RDECL	Hz/s	1.00		Deceleration anti-clockwise	1
430	RRTR	ms	100		Ramp rise time clockwise	1
431	RFTR	ms	100		Ramp fall time clockwise	1
432	RRTL	ms	100		Ramp rise time anti-clockwise	1
433	RFTL	ms	100		Ramp fall time anti-clockwise	1

Guided commissioning of the frequency inverter is terminated by a device reset. The control unit KP100 shows the message WAIT.

The parameter *Actual Frequency* **241 (FREQ)** defined in the factory settings is shown following a faultless initialisation of the frequency inverter.

Guided commissioning facilitates the choice of the correct parameters and determines further rated data for the motor. If the parameters have been set via the optional control software or in the PARA – menu of the control unit KP100, the display of the chosen actual value should be activated manually. When the frequency inverter is switched on the Set-up – Function appears and should be quit by pressing the stop/return key. Change to the VAL menu and select the desired actual value to be shown in future. Press the start/enter key to show the value of the parameter and press the start/enter key again to select this as the actual value for a new start.

6.3. CHECK DIRECTION OF ROTATION

Check the relationship between reference value and actual direction of rotation of the drive. This can be tested as follows. Enter a reference value of approximately 10% and switch on the release switch of the inverter for a short time (connect control inputs FUF (S1IND) and STR (S2IND) for clockwise or FUF (S1IND) and STL (S3IND) for anticlockwise). During acceleration of the drive check if the motor shaft turns in the right direction. In addition to a check of the drive, corresponding actual values can be read out using the control unit KP100. If the direction of rotation is incorrect swap two motor phases, e. g. U and V, on the power connections of the frequency inverter. The mains connections (terminal L1, L2, L3) of the frequency inverter do not affect the direction of rotation of the drive but should be taken into account for devices with a 3-phase current fan.

Note: Guided commissioning of the frequency inverter is now completed and can be supplemented by further settings in the menu PARA. The set parameters have been selected so that they are suitable for commissioning in most application cases. Further settings relevant for the application should be checked on the basis of the operating instructions.

6.4. V/F – CHARACTERISTIC

The voltage frequency characteristic defines the behaviour of the 3-phase machine in the different operating points. The various applications within the drive engineering can be realised by adapting the V/f-characteristic to the load characteristic. The parameters *Starting voltage* **600 (US)**, *Cut-off voltage* **603 (UC)** and the *Cut-off frequency* **604 (FC)** were set by the guided commissioning in accordance with the machine data. It is important that there is an excess moment in the whole working range from standstill to the rated point. The brake-away torque or starting torque must be provided by parameterisation of the V/f – characteristic, starting current impression and selection of further parameters.

V/f - characteristic						
Para. No.	**Abbr.**	**Unit**	**Factory setting**	**Customer setting**	**Name / Function**	**Control level**
600	US	V	5.0		*Starting voltage* (Boost), determines the voltage (the brake-away torque) with output frequency = 0 Hz, when the starting current impression is switched off	1
601	UK	%	10		*Voltage rise* determines the size of the voltage rise of the V/f-characteristic.	1
602	FK	%	20		*Rise frequency* where the voltage rise is indicated.	1
603	UC	V	400.0		*Cut-off voltage*, determines the output voltage with set cut-off frequency 604 (FC). In most cases the set value corresponds to the rated motor voltage.	1
604	FC	Hz	50.00		*Cut-off frequency*, determines the output frequency where the cut-off voltage 603 (UC) is reached. In most cases the value to be set the motor rated frequency.	1

The V/f - Characteristic is explained in chapter 7.8 in detail.

Note: The operating points within the lower speed range should be operated rapidly wherever possible. Forced ventilation of the 3-phase motor requires the use of the drive within the range of the rated speed.

6.5. SPECIAL APPLICATION DATA

The frequency inverters contain a variety of functions, but only some of them are used in certain applications. The operating behaviour of the drive system contains the functions starting and stopping behaviour as well as autostart, search run and direct current brake. The following parameters were set by the controlled commissioning in accordance with the machine data or at the factory.

The parameters *Limit current* **613 (ILIMX)** and *Limit frequency* **614 (ILFMN)** of the current limit value controller.
The parameters *Start current* **623 (STI)** and *Limit frequency* **624 (STFMX)** of the drive's starting behaviour.
The parameter *Braking current* **631 (DC IB)** of the drive system's operating behaviour when stopping.

Setting						
Para. No.	**Abbr.**	**Unit**	**Factory setting**	**Customer setting**	**Name / Function**	**Control level**
610	ILSEL	-	1 (On)		*Current limit controller*, set on in factory setting.	1
613	ILIMX	A	o · I_{FIN}		*Limit current*, defines the maximum permissible current. The value to be set is the same as the motor nominal current.	1
614	ILFMN	Hz	0.00		*Limit frequency*, approximately 4% of the nominal frequency for current limitation.	3
620	STSEL	-	14		*Starting behaviour*, with the factory setting on the operation mode with demagnetising, starting current impression, ramp stop and IxR - compensation.	1
623	STI	A	I_{FIN}		*Starting current*, the current for starting the motor. In most cases the set value corresponds to the rated motor current.	1
624	STFMX	Hz	2.60		*Limit frequency*, speed limit for changing to the V/f - characteristic.	2
630	DISEL	-	11		*Stopping behaviour*, configured by stopping and switching off on the operation mode in the factory.	1
631	DC IB	A	$\sqrt{2}$ · I_{FIN}		*Braking current*, current for the direct current brake and stoppage.	
645	SYSEL	-	0 (Off)		*Search Run,* for synchronisation on a rotating drive and control on the reference speed.	1
651	AUTO	-	0 (Off)		*Autostart*, defines the automatic start after applying the mains voltage and applied starting command.	1

6.6. CARRY OUT FUNCTION TEST

The drive can now be operated in all operation states. Further parameters e. g. to adjust the analog inputs or set the signals at the control outputs, may have to be set on the basis of the **PARAMETER LISTS** (see chapter 9) and the **FUNCTION DESCRIPTION AND PARAMETERISATION** (see chapter 7).
You should then check various operating points of the drive and carry out an acceleration and braking test. The different monitoring functions of the frequency inverter ensure a safe operation of the drive system. The load behaviour of the connected machine must depend on the speed for useful employment of the monitoring functions.
The following controllers are set in the factory and limit the load of the drive system by altering the drive speed:

- Current limit controller
  Limitation of the output currents in the acceleration phase and during varying load moment. (see chapter 7.16.2)

- Intelligent current limits
  Monitoring of the drive load and reduction by power reduction. The operation mode for monitoring of the device load, heat sink and motor temperature is set in the factory. (see chapter 7.16.1)

- DC-link voltage controller
  Activated in the factory in the operating mode for limitation of the DC-link voltage and power failure regulation. (see chapter 7.16.3)

Note: The intervention of the different controllers is carried out instead of a fault switch-off of the frequency inverter by altering the motor speed. The competent user has to select the relevant setting out of the manifold configuration variations.
The controllers can be deactivated on request.

6.7. COMPLETE COMMISSIONING

The installation or machine description, the frequency inverter type with the serial number and all altered parameter settings, should be made note of for documentation purposes. For this purpose, the installation or machine description and the frequency inverter type with serial number can be entered on the first page of these operating instructions. The parameter settings can be entered in the table in chapter 6 or chapter 9.

Note: The optionally available control software allows a clear parameterisation and archiving of the settings. The saved configuration can be printed out for documentation purposes and can be loaded to the frequency inverter for commissioning. The selected control level defines the scope of the displayed and saved parameters.

7. DESCRIPTION OF FUNCTIONS AND PARAMETERS

7.1. SETTING THE CONFIGURATION

The *Configuration* **30 (CONF)** of the inverter specifies the basic function of the control inputs and control outputs and determines the software functions which are available. Configuration 110 contains the V/f-characteristic and in configuration 111 extended by the technology controller.

Setting			
Parameter 30 (CONF)	**Configuration**	**Description of the configuration**	**Control level**
110	V/f – characteristic	chapter 3 and 6.2.1	1
111	V/f – characteristic with technology controller	chapter 3 and 6.2.1	1

Caution: Other configurations can be set, but are not described in these operating instructions. They may only function in connection with certain extension cards to be built in by the manufacturer.

If the configuration is changed a **NEW START** is carried out automatically, at which time the fault message output is active for a short time.

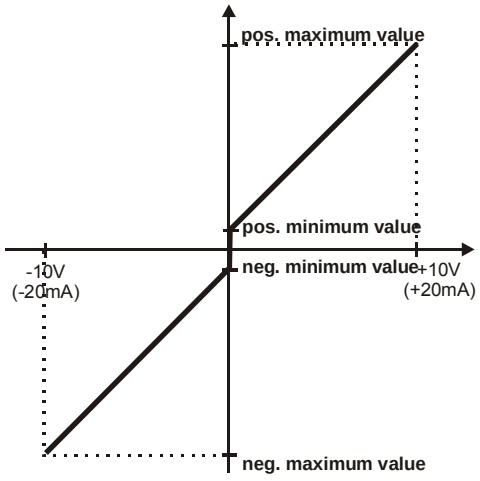
7.2. ANALOG INPUTS S1INA, S2INA AND S3INA

Reference value signals can be specified as actual value signals or limits via the analog inputs. Analog input 1 and analog input 2 are implemented as voltage inputs and analog input 3 as a current input (see chapter 3).

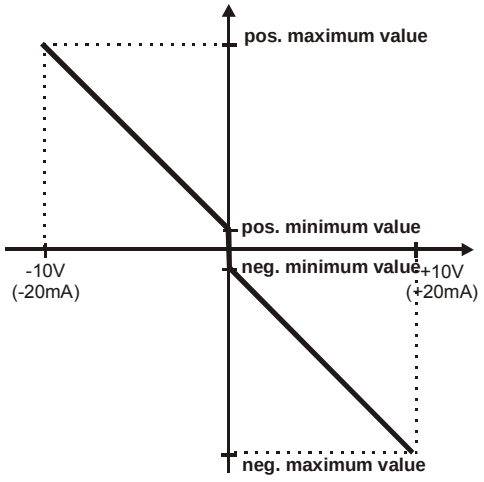
7.2.1. CHARACTERISTICS OF THE ANALOG INPUTS

The analog inputs to specify reference speed values are parameterised in the factory in configuration 110 and in configuration 111 to specify percentage values.
The inputs can be scaled for the range between positive minimum value and positive maximum value or for the range between negative maximum value and negative minimum value for various applications.
Four different characteristics and the corresponding inverted characteristics are available for signal adaptation.

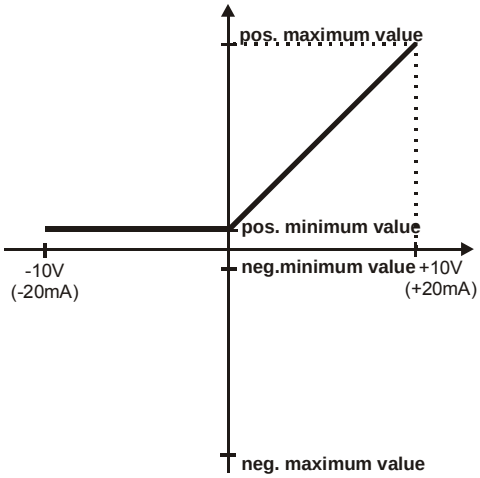
Bipolar (factory setting):



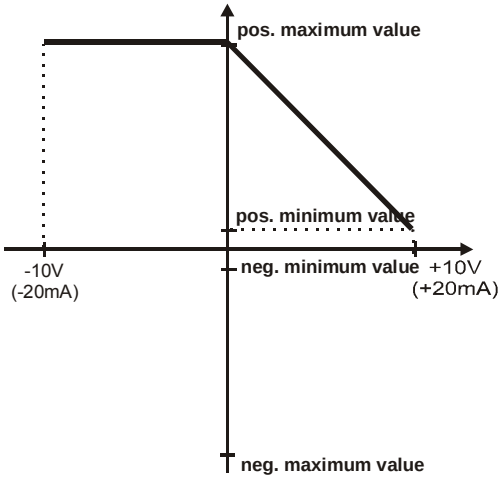
Bipolar inverted:



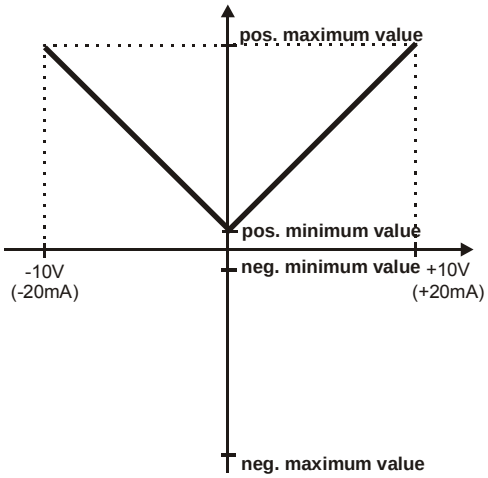
Unipolar:



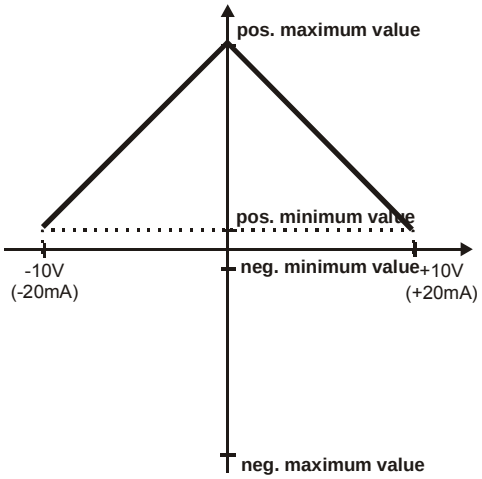
Unipolar inverted:



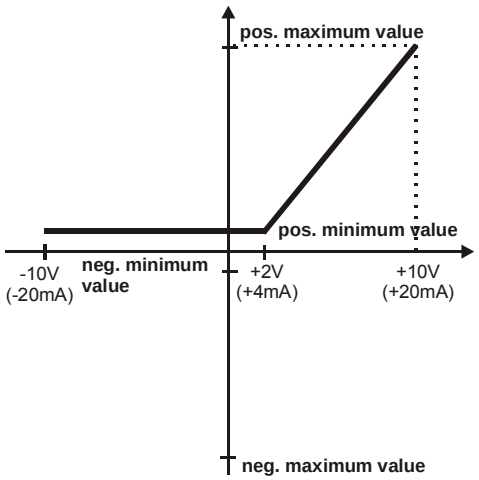
Absolute value function:



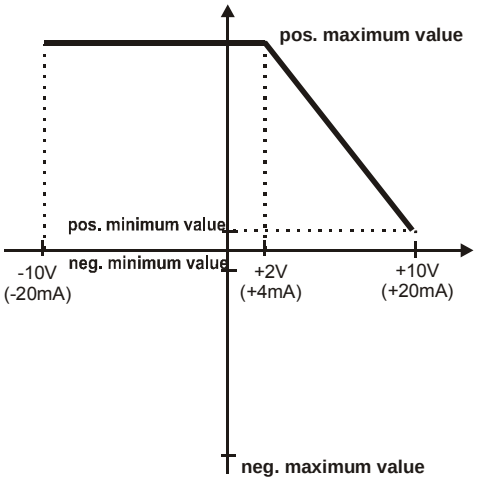
Absolute value function inverted:



Unipolar 2 - 10 V or 4 - 20 mA:



Unipolar inv. 2 - 10 V or 4 - 20 mA:



With the parameters *Operation mode analog input 1* **452 (A1SEL),** *Operation mode analog input 2* **460 (A2SEL)** and *Operation mode analog input 3* **470 (A3SEL)** the characteristics described above can be set as follows:

Setting		
Operation mode analog input 452 (A1SEL) 460 (A2SEL) 470 (A3SEL)	**Characteristic**	**Special features**
1 **(factory setting)**	Bipolar characteristic	-
2	Unipolar characteristic	-
3	Absolute value function	-
11	Bipolar characteristic inverted	-
12	Unipolar characteristic inverted	-
13	Absolute value function inverted	-
102	Unipolar characteristic 2 – 10V for analog input 1 and 2 4 - 20mA for analog input 3	If the input signal is lower than 1V or 2mA a warning message occurs.
112	Unipolar characteristic inverted 2 – 10V for analog input 1 and 2 4 - 20mA for analog input 3	If the input signal is lower than 1V or 2mA a warning message occurs.
202	Unipolar characteristic 2 – 10V for analog input 1 and 2 4 - 20mA for analog input 3	If the input signal is lower than 1V or 2mA a warning message and a error message occurs.
212	Unipolar characteristic inverted 2 – 10V for analog input 1 and 2 4 - 20mA for analog input 3	If the input signal is lower than 1V or 2mA a warning message and a error message occurs.
302	Unipolar characteristic 2 – 10V for analog input 1 and 2 4 - 20mA for analog input 3	If the input signal is lower than 1V or 2mA a warning message occurs, the drive is stopped and an error message occurs.
312	Unipolar Characteristic inverted 2 – 10V for analog input 1 and 2 4 - 20mA for analog input 3	If the input signal is lower than 1V or 2mA a warning message occurs, the drive is stopped and a error message occurs.

Notes:

If the operation mode of the analog input is selected with the values **102** to **312** then a warning message always occurs even in the case of an unreleased frequency inverter when the input voltage is lower than 1 V (analog input 1 and 2) or the input current is lower than 2 mA (analog input 3). A wire break monitoring can be implemented with these operation modes.

The operation mode **202** or **212** also defines the free run-down of the drive, irrespective of the stopping behaviour specified with the parameter *Stop Function* **630 (DISEL)** (chapter 7.10).

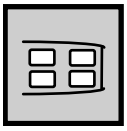
In the operation mode **302** or **312** the drive is stopped according to stopping behaviour 2 (stop and hold) (chapter 7.10), irrespective of the stopping behaviour.

When the set holding time has elapsed a fault message occurs. A new start is possible by switching on and off the start signal.

7.2.2. SCALING THE CHARACTERISTICS

The characteristics of the analog inputs are assigned positive and negative minimum and maximum values during scaling (see chapter 7.2.1). The frequency and percentage value range is to be defined according to the selected configuration.

7.2.2.1. FREQUENCY RANGE



The analog inputs to process frequency values as reference speed values, with the control process V/f-characteristic, are defined in the configurations described in these operating instructions.
The *Maximum frequency*, which can be set with parameter **419 (FMAX),** is assigned to the positive and negative maximum value of the respective analog input characteristic.
The *Minimum frequency*, which can be set with parameter **418 (FMIN),** is assigned to the positive and negative minimum value of the respective analog input characteristic.
At the same time the range of the output frequency or drive is determined with the minimum and maximum frequency (see chapter 7.8).

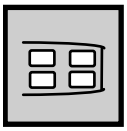
Settings						
Parameter			Setting range		Factory setting	Control level
Nr.	Abbr.	Meaning	Min	Max		
418	FMIN	Minimum frequency	0.00 Hz	999.99 Hz	3.50 Hz	1
419	FMAX	Maximum frequency	0.00 Hz	999.99 Hz	50.00 Hz	1

The output frequency limit should be set separately in each of the four data sets. The control uses the maximum value of the output frequency, calculated from the *Maximum Frequency* **419 (FMAX)** and the *Slip Frequency* **719 (MSLMX)**.

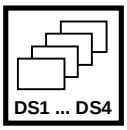
Notes: In a mode of operation of the frequency reference value channel with the direction of rotation specification depending on the sign with a positive reference value a clockwise field of rotation is specified and with a negative reference value an anti-clockwise field of rotation is specified. The limiting values are considered regardless the direction of rotation.

Caution: When setting the frequency range the data set change-over and maximum permissible speed range must be observed. Wrong settings can lead to injury or damage. A suitable maximum frequency is also determined by the switching frequency (see chapter 7.17.9.1).

7.2.2.2. PERCENTAGE VALUE RANGE



In configuration *V/f – characteristic with technology controller* **30 (CONF) = 111** the analog inputs are defined for processing of percentage values.
The *Maximum percentage value,* which can be set with parameter **519 (PRMAX),** is assigned to the positive and negative maximum value of the respective analog input characteristic.
The *Minimum reference percentage*, which can be set with parameter **518 (PRMIN),** is assigned to the positive and negative minimum value of the respective analog input characteristic.



Settings

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
518	PRMIN	Minimum percentage	0.00 %	300.00 %	0.00 %	1
519	PRMAX	Maximum percentage	0.00 %	300.00 %	100.00 %	1

Note: The range of the *Stator Frequency* **210 (FS)** and speed is set with the parameters *Minimum Frequency* **418 (FMIN)** and *Maximum Frequency* **419 (FMAX)**.

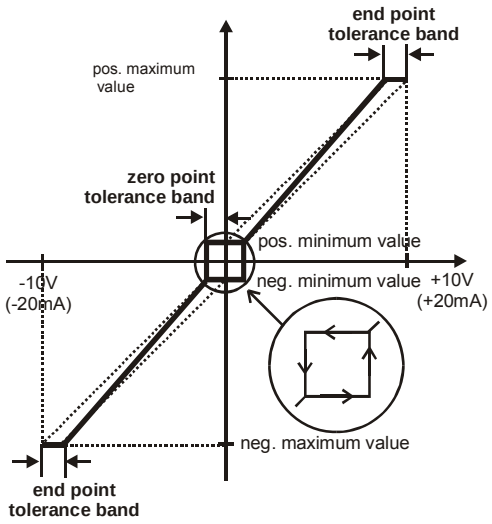
Example 1: A reference value source provides an analog voltage 0V – 8V according to a pressure range of 0mbar – 50mbar. This means that at 100% pressure (= 50mbar) the sensor supplies 8V.
The parameter *Minimum percentage value* **518 (PRMIN)** must be set to 0 % and for parameter *Maximum percentage value* **519 (PRMAX)** to 125 %. Thus the representation of the measuring signal on the chacteristic is enlarged.

Example 2: A further reference value source provides an analog voltage 0V – 10V. With that a reference value of 0% - 80% of the pressure range is supposed to be set. I. e. at 10V only 80% of the pressure range is supposed to be reached.
The parameter *Minimum percentage value* **518 (PRMIN)** must be set to 0% and for parameter *Maximum percentage value* **519 (PRMAX)** to 80%.

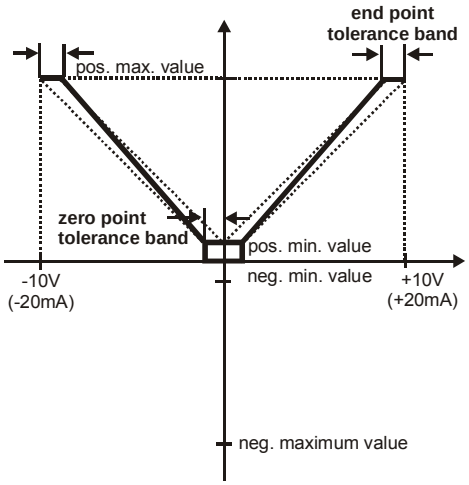
7.2.3. TOLERANCE RANGES AT THE ENDS OF THE CHARACTERISTICS

The analog inputs are adjusted in the factory. For special applications the tolerance ranges can be set at the range ends. This is useful, for example, if zero shifts from pre-located analog outputs must be compensated or when the input voltage, which perhaps does not reach its maximum value, must be adapted.
The tolerance bands are found at the upper and lower end point of the characteristic as well as at its zero point and are set identically for all analog inputs.

Bipolar (with hysterisis):



Absolute value function:



There is a hysteresis for the lower tolerance band, i.e. at the zero point, for the bipolar characteristic. Thus for example, coming from positive input signals, the output value is held at the positive minimum value until the input signal is lower than the value for the negative lower tolerance band. Only then we can continue on the set characteristic.

Settings

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
450	TBLOW	Zero point tolerance band	0.00 %	25.00 %	2.00 %	2
451	TBUPP	End point tolerance band	0.0 %	25.0 %	2.00 %	2

Example 1: An analog output card of a PLC supplies a positive offset voltage of 0.4 V.

$$\text{TBLOW} = \frac{0.4\text{V}}{10\text{V}} \cdot 100 = 4\%$$

Example 2: A potentiometer only achieves an output voltage of 9.8 V because of its final impact.

$$\text{TBUPP} = \left(1 - \frac{9.8\text{V}}{10\text{V}}\right) \cdot 100 = 2\%$$

Note: The tolerance band setting is effective for all analog inputs.

Important note for critical drives:
The gradient of the characteristic may change, as indicated in diagram above, depending on the width of the tolerance band.

7.2.4. ADAPTATION OF THE ANALOG INPUT CHARACTERISTICS

The characteristics can be adapted to any range for analog values which can not be mapped in the range between 0 to 10 V and 0 to 20 mA or in the range between –10 V to +10 V and –20 mA to +20 mA onto the frequency range or the percentage range. The upper end point and the zero point can be defined for this purpose. The lower end point results from the linear connection of the characteristic.

DS1 ... DS4

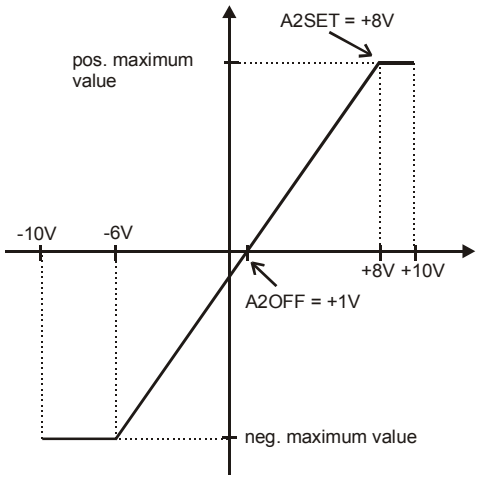
Settings						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
453	A1SET	Upper end point analog input 1	-6.00 V	10.00 V	10.00 V	2
454	A1OFF	Zero point analog input 1	-8.00 V	8.00 V	0.00 V	2
461	A2SET	Upper end point analog input 2	-6.00 V	10.00 V	10.00 V	2
462	A2OFF	Zero point analog input 2	-8.00 V	8.00 V	0.00 V	2
471	A3SET	Upper end point analog input 3	-12.00 mA	20.00 mA	20.00 mA	2
472	A3OFF	Zero point analog input 3	-16.00 mA	16.00 mA	0.00 mA	2

Example: A reference value source provides a signal of 1V – 8V at analog input 2. The values thus known can be used directly to adapt the characteristic:
Upper end point analog input 2 **461 (A2SET)** = 8 V
Zero point analog input 2 **462 (A2OFF)** = 1 V

The lower end point, which would theoretically appear at a negative reference value, is therefore calculated as:

$$\text{Lower end point} = 2 \cdot (\text{A2OFF}) - (\text{A2SET})$$
$$= 2 \cdot (1\,\text{V}) - (8\,\text{V}) = \underline{\underline{-6\,\text{V}}}$$

Adapting the end point and shifting the zero point results in the following course of the bipolar characteristic:



Note: The aforementioned parameters are **not** taken into consideration for operation modes of the analog characteristics which map the range 2 V to 10 V or 4 mA to 20 mA onto the frequency range or the percentage range.
The zero point should be at least 2 V or 4 mA below the end point, otherwise correct processing cannot be guaranteed.

7.3. DIGITAL CONTROL INPUTS S1IND TO S8IND

The control inputs can be switched on with switch contacts or directly activated with a voltage of 24 V DC (max 30 V), e. g. from a PCL. The ground (GND) of the PCL may have to be connected to the terminal X210.2 (GND).

Note: The wiring of the control terminals described in chapter 3 uses the 24V voltage supply of the frequency inverter. The connection to an external voltage source resets the potential isolation.

7.3.1. RELEASE OF THE INVERTER

The digital input release of the frequency inverter and the control inputs S2IND, S3IND are occupied by the following functions in the configuration V/f – characteristic control:

Functions		
Control input	**Function**	**Meaning**
S1IND	FUF	Release frequency inverter
S2IND	STR	Start clockwise rotation
S3IND	STL	Start anti-clockwise rotation [1)]

[1)] To use in configuration 110 only.

Note: The frequency inverter release affects certain software parameters. Part of the parameter should not be changed with a signal at control input S1IND. For safety reasons the inverter does not start if the start command has been received before the mains power is switched on, this means that the start command may only be sent after connection to the mains and the self-test. The safety function can be deactivated with the Autostart function (see chapter 7.17.1).

The following control possibilities arise depending on the logical state of the control inputs:

Activation			
FUF	**STR**	**STL** [1)]	**Function**
0	X	X	The converter of the frequency inverter is blocked. The drive runs out without control.
1	0	0	The drive is stopped. The stopping behaviour is determined by the setting of parameter *Stop function* **630 (DISEL)**. (see chapter 7.10 stopping behaviour)
1	1	0	The drive is released with a clockwise field of rotation. The behaviour during starting is defined with the aid of parameter *Start function* **620 (STSEL)**. (see chapter 7.9 starting behaviour)
1	0	1	The drive is released with an anti-clockwise field of rotation. The behaviour during starting is defined with the aid of the *Start function* **620 (STSEL)**. (see chapter 7.9 starting behaviour)
1	1	1	The drive is stopped. The stopping behaviour is determined by the setting of parameter *Stop function* **630 (DISEL)**. (see chapter 7.10 stopping behaviour)

To use in configuration 111.

0 = Contact open
1 = Contact closed
X = Any contact

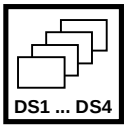
7.3.2. DATA SET CHANGE-OVER

The digital control inputs S4IND and S5IND are occupied with the data set change-over function (see chapter 3 Control connections). This permits a controlled adaptation of the parameters to the respective operating point of the application. The data set change-over can be made by the frequency inverter itself, irrespective of the status of the further control contacts, through connection with the digital control outputs. Parameterisation of the digital control outputs is described in chapter 7.5. The *Active Data Set* **249 (DSET)** can be read out via the control unit in the menu branch VAL.

Activation		
DSS1	**DSS2**	**active data set**
0	0	Data set 1 (DS1)
1	0	Data set 2 (DS2)
1	1	Data set 3 (DS3)
0	1	Data set 4 (DS4)

0 = contact open
1 = contact closed

Note: Please refer to the parameter list in chapter 9 which parameters can be switched over in the data set. In these operating instructions parameters which can be switched over in the data set are marked with the symbol



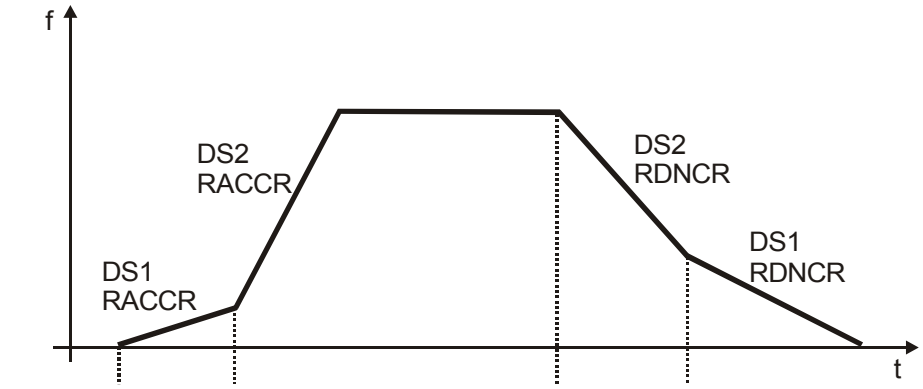
.

The parameters marked in this way have the same parameter number and the same parameter abbreviation in each of the four data sets.

Note: If you want to change parameters that offer a data record switching possibility, the respective data set (DS0 ... DS4) must be selected when you enter the menu PARA. The changes in the data record 0 are transferred to all four data sets and thereby simplify configuration of the frequency inverter. Parameterisation via an optional communications board, controlled commissioning and the PC program incorporate the same functions.

The following examples show possible applications of changing the data sets:

Example: Data set change-over at the acceleration and emergency stop ramp



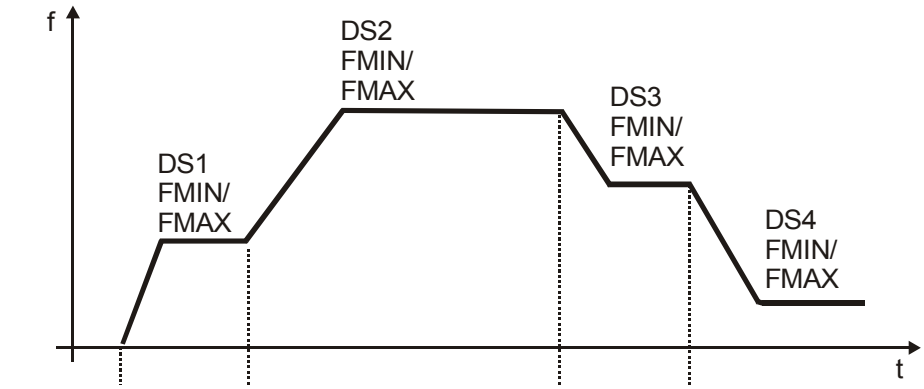
FUF	1		1		1		1
STR	1		1		1		1
STL	0		0		1		1
DSS1	0		1		1		0

Acceleration Emergency stop

0 = contact open 1 = contact closed

The parameter *Acceleration clockwise* **420 (RACCR)** is set differently in data set 1 and 2. The data set change-over is carried out via the digital input DSS1. According to the selected operation mode of the *Stop function* **630 (DISEL)** the drive is stopped with a simultaneous signal at the digital inputs STR and STL. The change-over between the settings of the parameter *Emergency stop clockwise* **424 (RDNCR)** is carried out via the digital input DSS1.

Example: Data set change-over with the frequency limits



FUF	1		1		1		1
STR	1		1		1		1
DSS1	0		1		1		0
DSS2	0		0		1		1

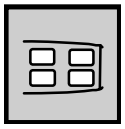
0 = contact open 1 = contact closed

The use of all four data sets shows an example of speed control via the *Maximum frequency* **419 (FMAX)** and *Minimum frequency* **418 (FMIN)**. The limit values and the accelerations can be changed in the data set. Transition between the frequency limits takes place according to the set rounding times and ramps. The ramps for reaching the new set point are adjusted via other parameters. (see chapter 7.11)

7.3.3. FIXED FREQUENCY CHANGE-OVER / MOTOR POTENTIOMETER FUNCTION

The control inputs **S6IND** and **S7IND** can be used in the two configurations of the V/f characteristic control in the operation modes fixed reference value or motor potentiometer. You can change between the functions via the data set change-over of the frequency or percentage reference value channel. The functions are described in the following chapters.

7.3.3.1. FIXED REFERENCE VALUE



The control inputs S6IND and S7IND can be occupied in **configuration 110** with the fixed frequency change-over FFS1 and FFS2. **Configuration 111** facilitates the connection of the control inputs with the function fixed percentage value change-over FPS1 and FPS2. Thus the reference value change-over can be realised with four fixed values. The reference value specification is either possible via the standard values or the function motor potentiometer. In the factory this control function is not active. The fixed frequencies FF1 to FF4 and the fixed percentage values FP1 to FP4 can be activated at the contact inputs as follows:

Activation		
FFS1 / FPS1	**FFS2 / FPS2**	**Active fixed frequency**
0	0	Fixed value 1 (FF1 / FP1)
1	0	Fixed value 2 (FF2 / FP2)
1	1	Fixed value 3 (FF3 / FP3)
0	1	Fixed value 4 (FF4 / FP4)

0 = Contact open 1 = Contact closed

Notes: The 4 fixed frequencies to be set can be parameterised in the four data sets. The use of the data set change-over thus makes it possible to set 16 fixed frequencies.

V/f – Characteristic control (Configuration 110):
For activation the parameter *Reference frequency source* **475 (RFSEL)** of the frequency reference value channel has to be set on fixed frequencies (see chapter 7.11). The fixed frequencies can be set with the parameters *Fixed frequency 1* **480 (FF1)**, *Fixed frequency 2* **481 (FF2)**, *Fixed frequency 3* **482 (FF3)** and *Fixed frequency 4* **483 (FF4).**

Setting						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
480	FF1	Fixed frequency 1	-999.99 Hz	999.99 Hz	5.00 Hz	1
481	FF2	Fixed frequency 2	-999.99 Hz	999.99 Hz	10.00 Hz	1
482	FF3	Fixed frequency 3	-999.99 Hz	999.99 Hz	25.00 Hz	1
483	FF4	Fixed frequency 4	-999.99 Hz	999.99 Hz	50.00 Hz	1

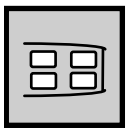
Caution: The direction of rotation is determined by the sign. A plus sign means a clockwise field of rotation and minus means an anti-clockwise field of rotation. The direction of rotation can also be specified with the control inputs S2IND **(STR)** and S3IND **(STL)**.
The direction of rotation can only be changed with the sign when the operation mode of the *Reference Frequency Source* **475 (RFSEL)** has been parameterised to an operation mode with **sign** +/-.
(see chapter 7.11).

V/f – Characteristic with technology controller (Configuration 111):
To activate the fixed percentage value change-over the parameter *Reference percentage source* **476 (RPSEL)** of the reference percentage channel must be set on fixed values (chapter 7.12). The fixed percentage values can be parameterised with the parameters *Fixed percentage value 1* **520 (FP1)**, *Fixed percentage value 2* **521 (FP2)**, *Fixed percentage value 3* **522 (FP3)** and *Fixed percentage value 4* **523 (FP4)**.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
520	FP1	Fixed percentage value 1	-300.00%	300.00%	10.00%	1
521	FP2	Fixed percentage value 2	-300.00%	300.00%	20.00%	1
522	FP3	Fixed percentage value 3	-300.00%	300.00%	50.00%	1
523	FP4	Fixed percentage value 4	-300.00%	300.00%	100.00%	1

Caution: The direction of rotation is determined via the sign. A plus sign means a clockwise field of rotation and minus means an anti-clockwise field of rotation. The direction of rotation can also be specified with the control input S2IND **(STR)**.
The direction of rotation can only be changed via the sign when the operation mode of the reference percentage value channel has been parameterised with the parameter *Reference percentage source* **476 (RPSEL)** to an operation mode with **sign** +/- (see chapter 7.12).

7.3.3.2. MOTOR POTENTIOMETER FUNCTION



The digital control inputs S6IND, S7IND can be used in the configuration of the V/f – characteristic control alternatively to the change-over of the fixed reference value. In the factory this control function is not active. In the configuration V/f – characteristics **(CONF=110)** the parameter *Reference frequency source* **475 (RFSEL)** of the reference frequency channel must be set to motor potentiometer function.
The configuration V/f–characteristics control with technology controller **(CONF=111)** must be set accordingly with the parameter *Reference percentage value source* **476 (RPSEL)**. With the motor potentiometer function the output signal of the frequency inverter can be altered via the digital control inputs as follows:

Activation		
MPS1 / MPPS1	MPS2 / MPPS2	Function CONF 110 / 111
0	0	Output frequency does not change
1	0	Output frequency and motor speed rises with set acceleration ramp
0	1	Output frequency and motor speed falls with set deceleration ramp
1	1	Output frequency is reset to initial value

0 = Contact open
1 = Contact closed

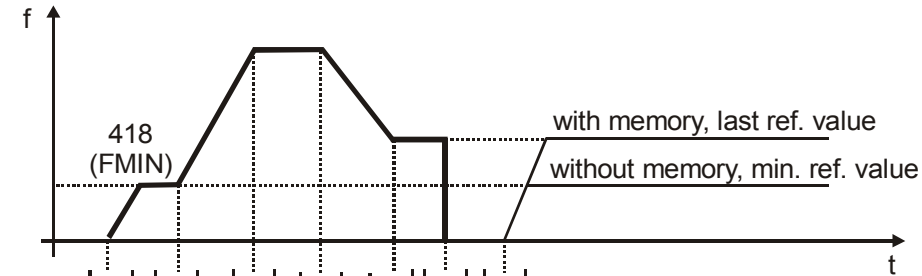
Note: The limitation of the reference values via the motor potentiometer function is carried out via the particular permitted level values.
In the configuration 110 the frequency range reaches from the *Minimum frequency* **418 (FMIN)** to the *Maximum frequency* **419 (FMAX)**.
The configuration 111 additionally restricts the operating range with the parameters *Minimum reference percentage* **518 (PRMIN)** and *Maximum reference percentage* **519 (PRMAX)**.

The operation modes of the motor potentiometer function define the behaviour of the function on various operating points of the frequency inverter.

Setting		
Operation mode 474 (MPOTI)	**Function**	**Control level**
0 **(Fact. setting)**	In the operation mode motor potentiometer **without memory** the motor runs at the frequency set with the parameter *Minimum frequency* **418 (FMIN)** at each start.	2
1	In the operation mode **with memory** the motor runs at the last reference value selected before switching off at each start. The reference value is stored when the unit is switched off.	2
2	The operation mode motor potentiometer **acceptance** should be used for the data set change-over of the reference value channel. The current reference frequency value is used when changing to the motor potentiometer function.	2

Note: The stopping behaviour with a set hold time (see chapter 7.10) permits behaviour in accordance with operating mode 1. Within the defined hold time, the motor runs up to the setpoint when started. After the hold time or after switching off, the operating behaviour conforms to the above table.

Example: Motor potentiometer with and without memory



FUF	1	1	1	1	1	1	1	
STR	1	1	1	1	1	0	1	
S6IND	0	1	0	0	0	0	0	
S7IND	0	0	0	1	0	0	0	

0 = contact open 1 = contact closed

Note: The acceleration of the drive is carried out with the set ramps (see chapter 7.15) according to the reference value specification via the motor potentiometer function.

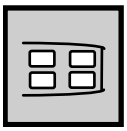
7.3.4. ACKNOWLEDGE ERROR MESSAGE

The control input S8IND is occupied by the RESET function. An error message is acknowledged by activating the contact input RESET. The function corresponds to the parameter *Program(ing)* **34 (PROG)** with the value 123..

Note: A fault message can only be acknowledged after its cause has been removed. The acknowledgement is then effected with the positive edge.
The red LED flashes during an error message. As soon as the error has been eliminated and the delay time of 15s has expired, the red LED comes on permanently. The error can now be acknowledged.

7.4. ANALOG OUTPUT S1OUTA

7.4.1. SETTING THE OUTPUT VALUE



The analog output SOUTA(I) provides a direct current which is proportional to an actual value. With parameter *Operation mode analog output 1* **550 (O1SEL)** the desired actual value size is set. The output of the actual value can be set in the following way:

Settings						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
550	01SEL	Operation mode analog output 1	0	252	1	1

Note: Further analog outputs are available as optional parameters with the extension module EAL-1. The extension module EAL-1 facilitates the output of the current and voltage signal.

OUTPUT SWITCHED OFF	
Operation mode analog output 1 550 (O1SEL)	**Function**
0	Analog output switched off

Note: The configurable analog output S1OUTA(I) is a current output. The selected output size is mapped in the current range of 0mA to 20mA.This is only possible until a maximum load resistance of 500Ohm.

FREQUENCY VALUES		
Operation mode analog output 1 550 (O1SEL)	**Output value**	**Range**
1 **(factory setting)**	Stator frequency	0 mA ≙ 0 Hz 20 mA ≙ Maximum frequency
2	Stator frequency	0 mA ≙ Minimum frequency 20 mA ≙ Maximum frequency
7	Actual frequency	0 mA ≙ 0 Hz 20 mA ≙ Maximum frequency
CURRENT VALUES		
20	Real current I_{active}	0 mA ≙ 0 A 20 mA ≙ FI nominal current
MECHANICAL VALUES		
30	Real power P_{active}	0 mA ≙ 0 kW 20 mA ≙ Rated power
31	Torque T	0 mA ≙ 0 Nm 20 mA ≙ Rated torque
32	Inside temperature	0 mA ≙ 0 °C 20 mA ≙ 100 °C
33	Heat sink temperature	0 mA ≙ 0 °C 20 mA ≙ 100 °C

ANALOG INPUT VALUES		
Operation mode analog output 1 550 (O1SEL)	**Output value**	**Range**
40	Analog input 1	0 mA ≙ 0 V 20 mA ≙ 10 V
41	Analog input 2	0 mA ≙ 0 V 20 mA ≙ 10 V
42	Analog input 3	0 mA ≙ 0 mA 20 mA ≙ 20 mA

VALUES WITHOUT SIGN		
50	Absolute current value	0 mA ≙ 0 A 20 mA ≙ FI nominal current
51	DC-link voltage U_d	0 mA ≙ 0 V 20 mA ≙ 1000 V
52	Output voltage U	0 mA ≙ 0 V 20 mA ≙ 1000 V
53	Volume flow	0 mA ≙ 0 m^3/h 20 mA ≙ Rated volume flow
54	Pressure	0 mA ≙ 0 kPa 20 mA ≙ Rated pressure

SIGNED FREQUENCIES			
101	Stator frequency	- 20 mA ≙ fmax (anticlockw.) 0 mA ≙ 0 Hz + 20 mA ≙ fmax (clockwise)	
102	Stator frequency	- 20 mA ≙ fmax (anticlockw.)	
		0 mA ≙	fmin (anticlockw.) < f < fmin (clockwise)
		+ 20 mA ≙ fmax (clockwise)	
107	Actual frequency	- 20 mA ≙ fmax (anticlockw.) 0 mA ≙ 0 Hz + 20 mA ≙ fmax (clockwise)	

SIGNED CURRENTS		
120	Real current I_{active}	- 20 mA ≙ - Nominal current 0 mA ≙ 0 A + 20 mA ≙ + Nominal current

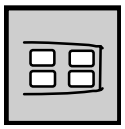
SIGNED MECHANICAL VALUES		
Operation mode analog output 1 550 (O1SEL)	**Output value**	**Range**
130	Real power P_{active}	- 20 mA ≙ - Rated power 0 mA ≙ 0 kW + 20 mA ≙ + Rated power
131	Torque T	- 20 mA ≙ - Rated moment 0 mA ≙ 0 Nm + 20 mA ≙ + Rated moment
132	Inside temperature	- 20 mA ≙ - 100 °C 0 mA ≙ 0 °C + 20 mA ≙ + 100 °C
133	Heat sink temperature	- 20 mA ≙ - 100 °C 0 mA ≙ 0 °C + 20 mA ≙ + 100 °C
SIGNED ANALOG INPUTS		
140	Analog input 1	- 20 mA ≙ - 10 V 0 mA ≙ 0 V + 20 mA ≙ + 10 V
141	Analog input 2	- 20 mA ≙ - 10 V 0 mA ≙ 0 V + 20 mA ≙ + 10 V
142	Analog input 3	- 20 mA ≙ - 20 mA 0 mA ≙ 0 mA + 20 mA ≙ + 20 mA
FREQUENCY VALUES		
201	Stator frequency	4 mA ≙ 0 Hz 20 mA ≙ Maximum frequency
202	Stator frequency	4 mA ≙ Minimum frequency 20 mA ≙ Maximum frequency
207	Actual frequency	4 mA ≙ 0 Hz 20 mA ≙ Maximum frequency
CURRENT VALUES		
220	Real current	4 mA ≙ 0 A 20 mA ≙ FI nominal current
MECHANICAL VALUES		
230	Real power P_{active}	4 mA ≙ 0 kW 20 mA ≙ Rated power
231	Torque T	4 mA ≙ 0 Nm 20 mA ≙ Rated moment
232	Inside temperature	4 mA ≙ 0 °C 20 mA ≙ 100 °C
233	Heat sink temperature	4 mA ≙ 0 °C 20 mA ≙ 100 °C

ANALOG INPUT VALUES		
Operation mode analog output 1 550 (O1SEL)	**Output value**	**Range**
240	Analog input 1	4 mA ≙ 0 V 20 mA ≙ 10 V
241	Analog input 2	4 mA ≙ 0 V 20 mA ≙ 10 V
242	Analog input 3	4 mA ≙ 0 V 20 mA ≙ 10 V

VALUES WITHOUT SIGN		
250	Absolute current value	4 mA ≙ 0 A 20 mA ≙ FI nominal current
251	DC-link voltage	4 mA ≙ 0 V 20 mA ≙ 1000 V
252	Output voltage	4 mA ≙ 0 V 20 mA ≙ 1000 V
253	Volume flow	4 mA ≙ 0 m^3/h 20 mA ≙ Rated volume flow
254	Pressure	4 mA ≙ 0 kPa 20 mA ≙ Rated pressure

Note: If option modules with further analog outputs are installed, the above mentioned actual values can also be output to these analog outputs.

7.4.2. ADJUSTMENT OF ANALOG OUTPUT 1



Electronic components have tolerances which become noticeable in the form of a distortion of the output amplification and a zero point shift. For this reason the analog output is balanced in the factory. In order to facilitate the adaptation of the analog output S1OUTA(I) to the very varied operational conditions, both the zero point as well as the amplification can be set.

7.4.2.1. ZERO SHIFT

The zero point of analog output S1OUTA(I) can be adjusted with parameter *Zero Adjustment A1* **551 (01OFF).**

SETTING						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
551	01OFF	Zero point adjustment analog output 1	- 100.0 %	100.0 %	0.0 %	1

Example: The operation mode of the analog output has been set in the factory to the output frequency. The zero point was accidentally shifted and should now be adjusted again.
For this purpose, the release of the frequency inverter must be taken away and the current at the analog output measured. The measured current is put in a percentage ratio to the maximum output current S1OUTA(I).
For example if a current of 1 mA was measured the following setting value results:

$$\text{O1OFF} = \frac{1\text{mA}}{20\text{mA}} \cdot 100 = 5\%$$

7.4.2.2. AMPLIFICATION SETTING

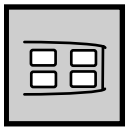
The amplification factor of analog output S1OUTA(I) is corrected with parameter *Amplification A1* **552 (01SC)**.

SETTING						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
552	01SC	Amplification Analog output 1	5.0 %	1000.0 %	100.0 %	1

Example: The mode of operation of the analog output has been set in the factory to the output frequency. The amplification was accidentally shifted and should now be adjusted again.
The drive is run in an operation point at maximum frequency. The output current is measured at the analog output after release of the frequency inverter and when the output frequency is reached. This value is put in the inverted percentage ratio to the maximum output current of the analog output S1OUTA(I).
For example, if a current of 18 mA was measured at maximum frequency the following setting value results:

$$\text{O1SC} = \frac{20\text{mA}}{18\text{mA}} \cdot 100 = 111\%$$

7.5. CONTROL DIGITAL OUTPUTS S1OUT, S2OUT AND S3OUT



Various monitoring functions can be set with the digital outputs **S1OUT, S2OUT** as well as the relay output **S3OUT**.
These monitoring functions can be set via the operation mode parameter *Operation mode digital output 1* **530 (D1SEL)** for **S1OUT,** *Operation mode digital output 2* **531 (D2SEL)** for **S2OUT** and *Operation mode relay* **532 (D3SEL)** for **S3OUT**.
If the message to be monitored is present at the outputs S1OUT or S2OUT the digital output becomes high active. The various events which can be assigned via the operation mode are described in the corresponding chapters of the operating instructions.

Setting		
Oper. mode 530 (D1SEL) 531 (D2SEL) 532 (D3SEL)	**Function**	**Contr. level**
0	Control output switched off	2
1	Message if the inverter is ready for operation or in operation	2
2	Message if the inverter is switched on **Factory setting of D2SEL**	2
3	Fault message	2
4	Message when the *Stator frequency* **210 (FS)** is higher than the *Setting frequency* **510 (FTRIG)** (from the factory setting 3.00 Hz). **Factory setting of D1SEL**	2
5 **1)**	Message when the calculated output frequency has reached the reference frequency	2
6 **2)**	Message when the actual percentage value has reached the reference value	2
7	Message in case of an IxT – or IxT-DC-warning	2
8	Message for heat sink overtemperature warning (T_C)	2
9	Message for inside temperature warning (T_i)	2
10	Message for motor temperature warning (T_{PTC})	2
11	Message for general warning	2
12	Message for overheat (T_c, T_i, T_{PTC})	2
13	Message for power failure (power failure regulation active)	2
14	Message for warning motor protective switch	2
15	Message for current limitation warning	2
16	Message for current limitation, since IxT reached	2
17	Message for current limitation, since IxT-DC reached	2
18	Message for current limitation, since T_c reached	2
19	Message for current limitation, since T_{PTC} reached	2
20	Comparator 1	2
21	Comparator 2	2
22	Warning V-belt monitoring	2
30	Flux formation complete	2
40	Activate brake	2
43	External van control, when the *Switch-On Temperature* **39 (TVENT)** has reached	2
100	Control output active	2
101 to 140	Operation modes 1 to 40 inverted (LOW active) **Factory setting for D3SEL = 103**	2

1) Operation mode 5 is only available in configuration 110.
2) Operation mode 6 is only available in configuration 111.

Note: The voltage supply for the digital outputs S1OUT and S2OUT can be carried out via the terminal X210-1 (+24 V). Alternatively, an external supply voltage of, for example, +24 V(max +30 V) can be connected. Pay attention to the potential isolation. If a relay is connected to the digital outputs S1OUT and S2OUT this must be suitable for the relevant supply voltage and may have a maximum nominal current of 50 mA.

7.5.1. OPERATION MODE SETTING FREQUENCY REACHED

If the **operation mode 4** is selected the respective output becomes active when the *Stator frequency* **210 (FS)** exceeds the set nominal value of parameter *Setting frequency* **510 (FTRIG)**.
The respective output is switched over again as soon as the *Stator frequency* **210 (FS)** falls below the refernce value.

DS1 ... DS4

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
510	FTRIG	Setting frequency	0.00 Hz	999.99 Hz	3.00 Hz	2

7.5.2. OPERATION MODE REFERENCE VALUE REACHED

In the **operation mode 5 resp. 6** a message is generated at the relevant output when the calculated actual value reaches the reference value.
The maximum deviation in percent of the adjustable range (max – min) can be set with the parameter *Max. Control Deviation* **549 (DEVMX)**.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
549	DEVMX	Max. control deviation	0.01 %	20.00 %	5.00 %	2

7.5.3. OPERATION MODE FLUX FORMATION

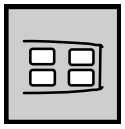
If the **operation mode 30** is selected, the relevant output becomes active when the flux formation has been completed. The time for the flux formation results from the operating status of the machine and the pre-set parameters for remagnitization. The remagnitization has to be defined via the starting behaviour and is effected by the intensity of the set starting current. (see chapter 7.9 starting behaviour)

7.5.4. OPERATION MODE BRAKE

The brake function in **operation mode 40** enables the control of a corresponding unit via the digital control output. The function uses not only the control commands but also the starting and stopping behaviour set in the contact inputs to control the digital output.
The output is activated with the standby message (green flashing LED) of the frequency inverter. The output is switched off on completion of the motor remagnetization according to the configurated starting behaviour (see chapter 7.9). The brake is released and the drive accelerated according to the selected setting.
The stopping behaviour of the drive depends on the configuration of the parameter *Operation Mode Stop Function* **630 (DISEL)** (see chapter 7.10). If the stopping behaviour is selected with the stop function, the drive is run down to zero speed and the digital output is not switched. The brake can be controlled in the further operation modes of the stop function. The digital output is set at the beginning of a free run-down of the drive. The behaviour is comparable to that to a run-down behaviour with stop. The drive is run down and held for the pre-set holding time. The control output is set and thus the brake activated within the pre-set holding time.

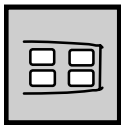
Note: The brake function in the **operation mode 140** should be given preference for a safe operation since in this operation mode the brake is activated even if the frequency inverter's mains protection is deactivated and in the event of a wire beak.

7.5.5. OPERATION MODES CURRENT LIMITATION



The **operation modes 15 to 19** link the two digital outputs as well as the relay output with the functions of the intelligent current limits (see chapter 7.16.1). The power reduction by the pre-set value, as a percentage of the rated current, depends on the selected operation mode. Accordingly, current limit intervention even can be output with the operation modes of the digital outputs. If the intelligent current limits function is deactivated, the corresponding operation modes are similarly deactivated.

7.5.6. OPERATION COMPARATOR 1 AND COMPARATOR 2



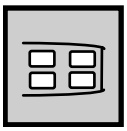
Various comparisons of certain actual values with fixed values which can be set can be carried out with the aid of the comparators 1 and 2.
The actual values to be compared can be selected according to the following table with the parameters *Operation Mode Comparator 1* **540 (C1SEL)** and *Operation Mode Comparator 2* **543 (C2SEL)**.

Setting			
Operation mode 540 (C1SEL) 543 (C2SEL)	**Function**	**Reference value**	**Control level**
0	Switched off	-	2
1 **(Fact. setting)**	Message when current amount > limit	Rated current **371 (MIR)**	2
2	Message when real current amount > limit	Rated current **371 (MIR)**	2
3	Message when stator frequency amount > limit	Maximum frequency **419 (FMAX)**	2
7	Message when actual frequency amount > limit	Maximum frequency **419 (FMAX)**	2
102	Message when real current > limit	Rated current **371 (MIR)**	2
103	Message when stator frequency > limit	Maximum frequency **419 (FMAX)**	2
107	Message when actual frequency > limit	Maximum frequency **419 (FMAX)**	2

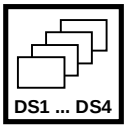
The switch-on and switch-off thresholds for the comparator 1 are set with the parameter *Comparator On Above* **541 (C1ON)** and the parameter *Comparator Off Below* **542 (C1OFF)**.
Comparator 2 is set with the parameter *Comparator On Above* **544 (C2ON)** and *Comparator Off Below* **545 (C2OFF)**.
The limits are specified as a percentage of the relevant reference values (see table above).

Setting						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
541	C1ON	Comparator on above	- 300.00 %	300.00 %	100.00 %	2
542	C1OFF	Comparator off below	- 300.00 %	300.00 %	50.00 %	2
544	C2ON	Comparator on above	- 300.00 %	300.00 %	100.00 %	2
545	C2OFF	Comparator off below	- 300.00 %	300.00 %	50.00 %	2

7.6. SETTING THE MOTOR DATA



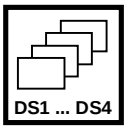
The guided commissioning of the frequency inverter determines all parameter settings for the required application. The selection of the available parameters is derived from known standard applications of drive technology. This simplifies selection of the important parameters, but can also be parameterised by you in the menu branch PARA in the same way. Only skilled users should change the extended machine data that is not given on the rating plate of the asynchronous machine. The guided commissioning determines this extended motor data by way of a measurement and sets the parameter.



Setting the motor rated data

Parameter			Setting range		Factory setting	Contr. level
No.	Abbr.	Meaning	Min	Max		
370	MUR	Rated voltage	60.0 V	800.0 V	400.0 V	1
371	MIR	Rated current	0.1 · I_{FIN}	10 · o · I_{FIN}	I_{FIN}	1
372	MNR	Rated speed	96 min^{-1}	60000 min^{-1}	1490 min^{-1}	1
373	MPP	No. of pool pairs	1	24	2	1
374	MCOPR	Rated cosinus Phi	0.01	1.00	0.85	1
375	MFR	Rated frequency	10.00 Hz	1000.00 Hz	50.00 Hz	1
376	MPR	Mech. rated power	0.1 · P_{FIN}	10 · P_{FIN}	P_{FIN}	1

The optional functions of the V/f characteristic control require the input of the extended motor data. The controlled commissioning supports you in determining the parameter *Stator Resistance* **377 (RS)**. Because the stator resistance is temperature-dependent, there should be an adjustment at a winding temperature that is reached during normal operation of the motor.
The parameter *Stator Resistance* **377 (RS)** is entered as a phase parameter and measured accordingly during guided commissioning. If the machine is operated in a star circuit the stator resistance corresponds to the resistance of a winding. In a delta circuit the stator resistance is the smaller than the winding resistance by the factor √3.



Further motor data

Parameter			Setting range		Factory setting	Contr. level
No.	Abbr.	Meaning	Min	Max		
377	RS	Stator resistance [1)]	0 mΩ	6000 mΩ	Dependent on type	2

[1)] Parameters have been set via the guided commissioning

The following table is represented in the frequency inverter software and includes the alternative stator resistances of the standard motors, matching the nominal output of the device. This rated value is measured via guided commissioning and stored in the parameter *Stator Resistance* **377 (RS)**.

Alternative stator resistances		
VCB 400-	**Motor output**	**Altern. stator resistance**
010	4 kW	1650 mΩ
014	5.5 kW	1200 mΩ
018	7.5 kW	885 mΩ
025	11 kW	530 mΩ
034	15 kW	360 mΩ
045	22 kW	165 mΩ
060	30 kW	144 mΩ
075	37 kW	102 mΩ
090	45 kW	84 mΩ
115	55 kW	57 mΩ

Alternative stator resistances		
VCB 400-	**Motor output**	**Altern. stator resistance**
135	65 kW	45 mΩ
150	75 kW	33 mΩ
180	90 kW	27 mΩ
210	110 kW	24 mΩ
250	132 kW	18 mΩ
300	160 kW	15 mΩ
370	200 kW	12 mΩ
460	250 kW	8 mΩ
570	315 kW	1 mΩ
610	355 kW	1 mΩ

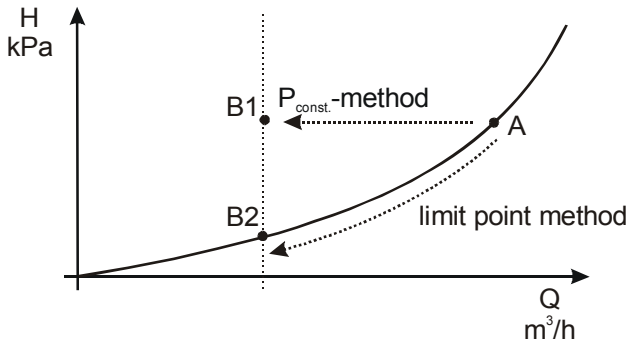
7.7. SETTING THE SYSTEM DATA

The system data must only be entered if you are using the additional actual values volumetric flow and pressure. Conversion of the control variable into a value that is dependent on the application occurs on the basis of the limit point method. In the limit point method, the operating point moves as a result of the motor speed changing on the characteristic.

DS1 ... DS4

Setting						
Parameter			**Setting range**		**Factory setting**	**Contr. level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
397	QR	Nominal volumetric flow	1 m^3/h	99999 m^3/h	10 m^3/h	1
398	HR	Nominal pressure	0.1 kPa	999.9 kPa	100.0 kPa	1

Pipe network or channel characteristic:

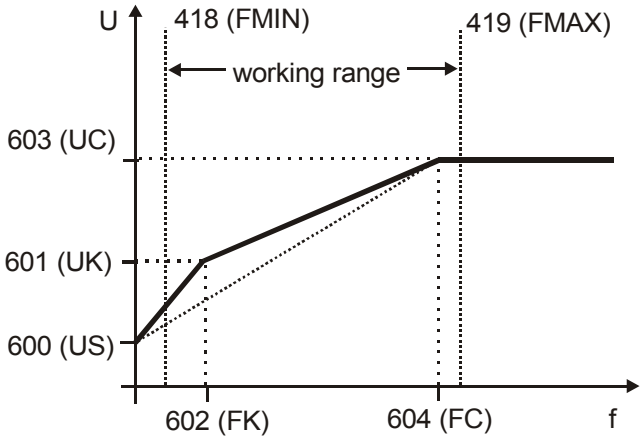


The established methods for controlled operation of heating pumps and fans use a characteristic for describing the application.
Point A in the figure describes the operation point of a pump. The transition to part-load operation can occur with constant pressure (change to delivery flow, pressure remains constant) or on the basis of the limit point method (change to pressure and delivery flow). Both methods can be realised with the integrated technology controller. (see chapter 7.16.5)
The displayed actual values are calculated on the basis of the limit point method irrespective of the selected operating mode of the technology controller.

7.8. V/F- CHARACTERISTIC

Loss-free control of the asynchronous-motor speed can be achieved by adjusting the V/f-characteristic. The motor speed changes in accordance with the frequency change. The torque which has to be applied at the prevailing operating point of the motor, requires the output voltage to be controlled in proportion to the frequency. With a constant ratio between the output voltage and the frequency-converter frequency, the magnetisation is held constant within the nominal range of the asynchronous motor. The measurement point of the motor or vertex of the V/f characteristic is defined via guided commissioning using the parameters *Cut-off voltage* **603 (UC)** and *Cut-off frequency* **604 (FC)**.

The lower frequency range is critical where an increased voltage is necessary for starting the drive. The voltage at the output frequency = zero is set using the parameter *Starting voltage* **600 (US)**. A voltage rise deviating from the U/f-characteristic curve can be defined by the parameters *Rise of voltage* **601 (UK)** and *Rise frequency* **602 (FK)**. The percentage parameter value is calculated from the linear V/f characteristic. The operating range of the machine or V/f characteristic is established by using the parameters *Minimum frequency* **418 (FMIN)** and *Maximum frequency* **419 (FMAX)**.



DS1 ... DS4

Setting

Parameter			Setting range		Factory setting
No.	**Abbr.**	**Meaning**	**Min**	**Max**	
600	US	Starting voltage [1)]	0.0 V	100.0 V	5.0 V
601	UK	Rise of voltage	-100 %	200 %	10 %
602	FK	Rise frequency	0 %	100 %	20 %
603	UC	Cut-off voltage [1)]	60.0 V	530.0 V	400.0 V
604	FC	Cut-off frequency [1)]	0.00 Hz	999.99 Hz	50.00 Hz

[1)] Parameters have been set via the guided commissioning

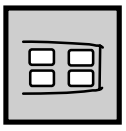
The *Cut-off voltage* **603 (UC)** and *Cut-off frequency* **604 (FC)** set in the factory has been derived from the motor data *Rated voltage* **370 (MUR)** and *Rated frequency* **375 (MFR)**. With the parameterised *Starting voltage* **600 (US)** results the line equation of the V/f-characteristic.

$$U = \left(\frac{UC - US}{FC - 0}\right) \cdot f + US = \left(\frac{400V - 5V}{50Hz - 0Hz}\right) \cdot f + 5V$$

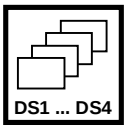
The *Rise frequency* **602 (FK)** is entered in percent to the *Cut-off frequency* **604 (FC)** and amounts to f=10Hz in the factory. The *Rise of voltage* **601 (UK)** is calculated with U=92.4V for the factory setting.

$$U = \left[\left(\frac{UC - US}{FC - 0}\right) \cdot (FK \cdot FC) + US\right] \cdot (1 + UK) = \left[\left(\frac{400V - 5V}{50Hz - 0Hz}\right) \cdot (0.2 \cdot 50Hz) + 5V\right] \cdot 1.1 = \underline{\underline{92.4V}}$$

7.8.1. DYNAMIC VOLTAGE PRE-CONTROL

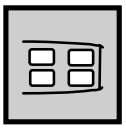


The *Dynamic voltage pre-control* **605 (UDYN)** accelerates the control behaviour of the current limit value and voltage controller. The value of the output voltage resulting from the V/f–characteristic is altered by addition of the calculated voltage pre-control. The pre-control reference value is valued in percent.

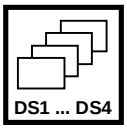


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
605	UDYN	Dyn. voltage pre-control	0 %	200 %	100 %	3

7.9. STARTING BEHAVIOUR



The start-up of the 3-phase machine must be configured by the user. Following release of the frequency inverter (see chapter 7.3.1) the machine is initially excited or a starting current supplied according to the operating mode selected using the parameter *Starting function* **620 (STSEL).** The voltage drop at the alternate stator resistance, reducing the torque in the lower frequency range can be balanced by the IxR – compensation. The parameter *Starting function* **620 (STSEL)** can be changed in the data set. This has to be taken into consideration if the data set change-over is used when starting the drive.



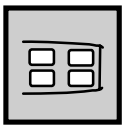
Setting		
Oper. mode 620 (STSEL)	Starting function	Control level
0	No starting function, only V/f – characteristic control	1
1	Remagnetizing	1
2	Remagnetizing + starting current impression	1
3	Remagnetizing + IxR - compensation	1
4	Remagnetizing + IxR – compensation + starting current impression	1
12	Remagnetizing + starting current impression with ramp stop	1
14 **(fact. setting)**	Remagnetizing + IxR – compensation + starting current impression with ramp stop	1

Depending on the setting of parameter *Starting function* **620 (STSEL)** the following starting behaviour will result:

Starting behaviour	
Starting behaviour 0 **pure V/f characteristic**	With this operation mode the *Starting voltage* **600 (US)** is output at an output frequency of 0 Hz when starting the inverter. Then the output voltage and the output frequency are altered according to the set V/f characteristic. The break-away torque or the current at the start is determined by the set starting voltage. The starting behaviour may be optimised with the parameter *Starting voltage* **600 (US)**.
Starting behaviour 1 **remagnetizing**	In this operation mode 30 % of the current which has been set with parameter *Starting current* **623 (STI)** after release, are remagnetized into the motor. At the same time the output frequency is held at the value zero Hz for 300 ms. Following this the drive is continued with the set V/f-characteristic (see starting behaviour 0).

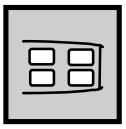
Starting behaviour (Cont.)	
Operation mode 2 **remagnetizing** **+** **start current impression**	Operation mode 2 includes operation mode 1. After 300ms the output frequency is raised according to the set acceleration. When the output frequency reaches the value which was set with the parameter *Frequency limit* **624 (STFMX)** the starting current is taken back. A phased transition until a 1.4-fold frequency limit on the set V/f characteristic is carried out. The output current depends on the load from this operation point.
Operation mode 3 **remagnetizing** **+** **IxR–compensation**	Operation mode 3 includes the operation mode 1 of the start function. When the output frequency reaches the value set with parameter *Frequency limit* **624 (STFMX)**, the output voltage increases with the IxR – compensation. The V/f – characteristic is shifted by the voltage component which depends on the stator resistance.
Operation mode 4 **remagnetizing** **+** **IxR–compensation** **+** **start current impression**	In this operation mode the current which was set with the parameter *Starting current* **623 (STI)** is impressed into the motor for remagnetization after release. At this time the output frequency is held on zero Hz for 300 ms. Afterwards the output frequency is raised according to the set acceleration. When the output frequency reaches the value which was set with parameter *Frequency limit* **624 (STFMX),** the starting current is taken back. There is a smooth change-over on the V/f-characteristic and an output current, independent from the load, is ensued. Simultaneously, with this output frequency the output voltage is raised by the IxR-compensation. The V/f-characteristic is shifted by the voltage component which depends on the stator resistance.
Operation mode 12 **remagnetizing** **+** **start current impression** **with ramp stop**	The operation mode 12 includes an additional function to guarantee a starting behaviour under more difficult conditions. Remagnetizing and impression of the starting current is carried out according to operation mode 2. The ramp stop considers the current consumption of the motor in the particular operation point and controls the frequency and voltage modification by stopping the ramp. The *Controller status* **275 (CTRST)** reports the intervention of the controller with the message **"RSTP".** (see chapter 7.20.4.6)
Operation mode 14 **remagnetizing** **+** **IxR–compensation** **+** **start current impression** **with ramp stop**	In this operation mode the functions of operation mode 12 are extended by the compensation of the voltage drop at the stator resistance. When the output frequency reaches the value set with parameter *Frequency limit* **624 (STFMX)** the output voltage raises by the IxR – compensation. The V/f – characteristic is shifted by the voltage component which depends on the stator resistance.

7.9.1. IXR-COMPENSATION



With parameter *Starting function* **620 (STSEL)** the IxR - compensation can be activated by selection of starting behaviour 3 or 4. The IxR - compensation levels the voltage drop which was caused by the stator resistance of the motor by raising the V/f-characteristic.
The stator resistance can be set with parameter *Stator resistance* **377 (RS)** (see chapter 7.6).

7.9.2. STARTING CURRENT IMPRESSION



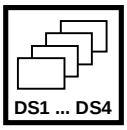
With parameter *Starting function* **620 (STSEL)** a current to magnetise and/or to break-away can be impressed into the machine by selection of starting behaviour 1, 2 and 3. The level of the current to be impressed can be set with parameter *Starting current* **623 (STI).**

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
623	STI	Starting current [1]	0.0	o · I_{FIN}	I_{FIN}	1

[1] Parameters have been set via the guided commissioning

Note: For magnetising 30 % of the starting current is impressed for the duration of 300 ms.

With parameter *Frequency limit* **624 (STFMX)** you can determine up to which output frequency the starting current impression must be active when starting (behaviour 2 and 4).

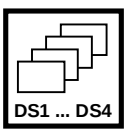


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
624	STFMX	Frequency limit [1]	0.00 Hz	100.00 Hz	2.60 Hz	2

[1] Parameters have been set via the guided commissioning

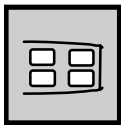
Note: If the current limit value controller is additionally activated, this is only active when the output frequency has exceeded the set value of the parameter *Frequency limit* **614 (ILFMX)** and the 1.4-fold value of the parameter *Frequency limit* **624 (STFMX)**.

To impress the starting current a PI controller is used which can be optimised with the parameters *Amplification* **621 (STV)** and *Integral time* **622 (STTI).**

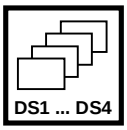


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
621	STV	Amplification	0.01	10.00	1.00	3
622	STTI	Integral time	1 ms	30000 ms	50 ms	3

7.10. STOPPING BEHAVIOUR



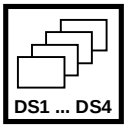
The stopping behaviour of the drive (see chapter 7.3.1) must be adapted in the various operation modes of the *Stopping function* **630 (DISEL)**. The stopping behaviour as well as the starting behaviour must be configured in the four data sets according to the requirements of the application. Configuration 111 includes the operation modes via the control input S2IND **X210.4 (STR)** and thus the combinations with the control input S3IND **X210.5 (STL)** are cancelled. In configuration 110 all operation modes of the matrix below can be selected.



Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
630	DISEL	Stop function	00	55	11	1

Stopping behaviour	
Stopping behaviour 0 **Free run down**	The converter is immediately blocked. The drive is immediately voltage-free and runs down freely.
Stopping behaviour 1 **Stop + Switch off**	The drive is led to a standstill with the set deceleration. When the standstill is reached the converter is blocked after a holding time. The holding time can be set with the parameter *Holding time* **638 (DI T)**. Depending on the setting of the parameter *Start function* **620 (STSEL)** the starting current is impressed for the duration of the holding time or the starting voltage is output.
Stopping behaviour 2 **Stop + hold**	The drive is led to a standstill with the set deceleration and stays permanently supplied with current. Depending on the setting of the parameter *Start function* **620 (STSEL)** the starting current **623 (STI)** is impressed from the standstill or the starting voltage is output.
Stopping behaviour 3 **Stop + brake**	The drive is led to a standstill with the set deceleration. From standstill the direct current is impressed which was set with the parameter *Braking current* **631 (DC IB)**.
Stopping behaviour 4 **Emergency hold + switch off**	The drive is led to a standstill with the emergency stop deceleration. When the standstill is reached the converter is blocked after a holding time. The holding time can be set with the parameter *Holding time* **638 (DI T)**. Depending on the setting of the parameter *Start function* **620 (STSEL)** the starting current is impressed from the standstill or the starting voltage is output.
Stopping behaviour 5 **Emergency hold + hold**	The drive is led to a standstill with the set emergency deceleration and stays permanently supplied with current. Depending on the setting of the parameter *Start function* **620 (STSEL)** the starting current is impressed from the standstill or the starting voltage is output.
Stopping behaviour 6 **Emergency hold + brake**	The drive is led to a standstill with the set emergency deceleration. From standstill the direct current is impressed which was set with the parameter *Braking current* **631 (DC IB)**.
Stopping behaviour 7 **Direct Current Brake**	The DC braking is activated immediately. At this time the direct current is impressed which was set with the parameter *Braking current* **631 (DC IB)**.

The stopping behaviour is allocated to the signal at the control inputs S2IND X210.4 (STR) and S3IND X210.5 (STL) via the operation mode of the stop function. In configuration 111 the marked operation modes for the stop function are available.



Stopping behaviour

Operation mode *Stop function* **630** (**DISEL**)		**STR = 0 and STL = 0**							
		stopping behaviour 0	stopping behaviour 1	stopping behaviour 2	stopping behaviour 3	stopping behaviour 4	stopping behaviour 5	stopping behaviour 6	stopping behaviour 7
STR = 1 and STL = 1	stopping behaviour 0	0	1	2	3	4	5	6	7
	stopping behaviour 1	10	11	12	13	14	15	16	17
	stopping behaviour 2	20	21	22	23	24	25	26	27
	stopping behaviour 3	30	31	32	33	34	35	36	37
	stopping behaviour 4	40	41	42	43	44	45	46	47
	stopping behaviour 5	50	51	52	53	54	55	56	57
	stopping behaviour 6	60	61	62	63	64	65	66	67
	stopping behaviour 7	70	71	72	73	74	75	76	77

Operation modes of the stop function in the configuration 111

Note: The parameter *Stop function* **630 (DISEL)** can be switched over in the data set. The parameterisation of the starting behaviour and stopping behaviour is possible in the four data sets. Please make note of the equipment output during acceleration and braking time which is required from the drive system.

Example: A drive should be brought to a standstill with the combination of the control inputs STR = 1 and STL = 1 according to the stopping behaviour 2.

For safety aspects the drive should be brought to a standstill with the combination of the control inputs STR = 0 and STL = 0 according to the stopping behaviour 5. This facilitates a wire-backage-monotoring of the connected components.

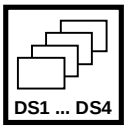
The setting for parameter *Stop function* **630 (DISEL)** is determinated with the value 25 at the intersection of the column “stopping behaviour 2” for (STR = 0 and STL = 0) and the line “stopping behaviour 5” for (STR = 1 and STL = 0).

The holding time which is required in the stopping behaviours 1 and 4 can be set with the parameter *Holding time* **638 (DI T)** in operation level 3.

Setting

Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
638	DI T	Holding time Stop function	0.0 s	200.0 s	1.0 s	2

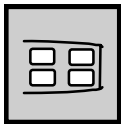
The stopping of the drive is acknowledged when the *Stator frequency* **210 (FS)** falls below the frequency value which can be set with the parameter *Switch-Off Threshold* **637 (DIOFF)**. The value entered in percent, refers to the *Maximum Frequency* **419 (FMAX)**.



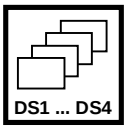
SETTING						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
637	DIOFF	Switch-off threshold	0.0 %	100.0 %	1.0 %	2

Note: The frequency inverter can only provide the power required for control down to speed zero with sufficient dimensioning according to the load behaviour of the drive. Utilisation of the equipment output is supported by the intelligent current limits.

7.10.1. DIRECT CURRENT BRAKE



The direct current brake is activated by the selection of stopping behaviour 3, 6 or 7 with the parameter *Stop function* **630 (DISEL)**. Depending on the set stop function the motor is either impressed immediately with DC current or not until the standstill. The DC current can be set with the parameter *Braking current* **631 (DC IB)**.



SETTING						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
631	DC IB	Braking current [1)]	0.00 A	$\sqrt{2} \cdot I_{FIN}$	$\sqrt{2} \cdot I_{FIN}$	2

[1)] Parameters have been set via the guided commissioning

Depending on the setting of the parameter *Braking time* **632 (DC TB)** the DC brake can function contact-controlled or time-controlled.

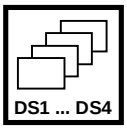
Note: The level and duration of the output DC current depends on the set *Switching frequency* **400 (FT)** of the frequency inverter. The maximum heating of the motor has to be considered.

Time-controlled:
The DC brake is activated with the control contacts regular release X210.3 (FUF), start - clockwise X210.4 (STR) and start - anti-clockwise X210.5 (STL). The *Braking current* **631 (DC IB)** flows until the set *Braking time* **632 (DC TB)** has expired or one of the named control contacts is opened. In configuration 111 the control contact X210.4 (STR) for the DC brake has to be used.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
632	DC TB	Braking time	0.0 s	200.0 s	10.0 s	2

Contact-controlled:
If the parameter *Braking time* **632 (DC TB)** is set at 0s, the DC brake is controlled only by the control contacts regulator release (FUF), start - clockwise STR and start - anti-clockwise STL. The time monitoring no longer takes place.

In order to avoid current rushes that can cause the inverter to switch off, the motor must not be impressed with DC until it has been demagnetised. The demagnetisation time depends on the size of the motor and so can be set with the parameter *Demagnetising time* **633 (DC TD)**. The demagnetising time should be parameterised in the range of the motor time constant.

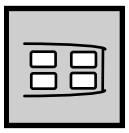


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
633	DC TD	Demagnetising-time	0.1 s	30.0 s	5.0 s	2

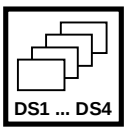
To impress the braking current a PI controller is used which can be optimised with the parameters *Amplification* **634 (DC V)** and *Integral time* **635 (DC TI)**.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
634	DC V	Amplification	0.00	10.00	1.00	3
635	DC TI	Integral time	0 ms	1000 ms	50 ms	3

7.11. SETTING OF THE REFERENCE FREQUENCY CHANNEL



In **configuration** 110 the various possibilities of the reference frequency specification with the parameter *Reference frequency source* **475 (RFSEL)** can be selected and set with special operational behaviour. In this case settings according to the following table can be selected which combine several reference value sources additively.



Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
475	RFSEL	Reference frequency source	1	130	5	1

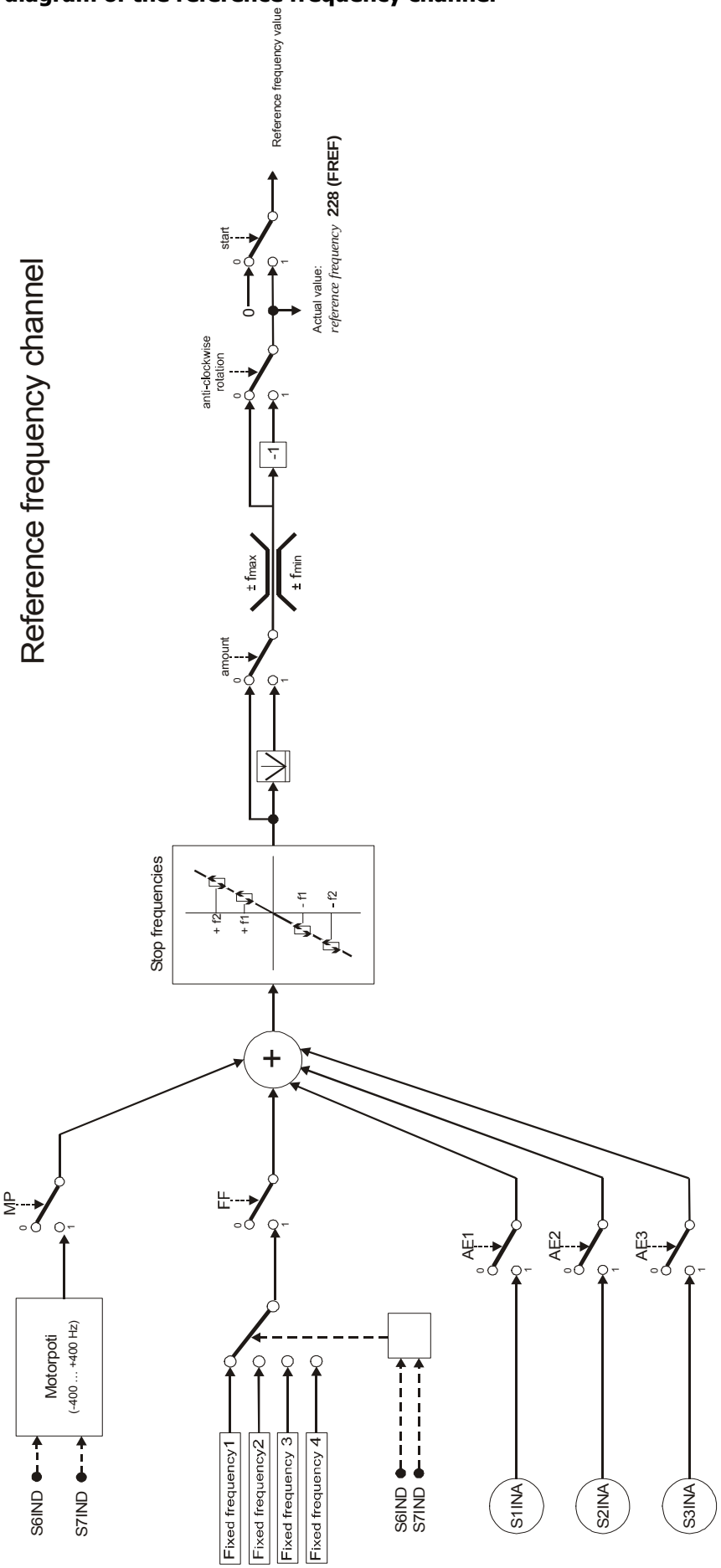
The following table shows the selection of operation modes of the reference frequency channel for the various reference frequency sources (speed reference value).

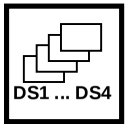
Reference Frequency Sources		
Operation mode 475 (RFSEL)	**Selected Reference Frequency Sources**	**Sign**
1	Analog input S1INA	Amount
2	Analog input S2INA	Amount
3	Analog input S3INA	Amount
4	Analog input S1INA + S2INA	Amount
5 **(fact. setting)**	Analog input S1INA + S3INA	Amount
10	Fixed frequencies	Amount
11	Fixed frequencies + Analog input S1INA	Amount
12	Fixed frequencies + Analog input S2INA	Amount
13	Fixed frequencies + Analog input S3INA	Amount
14	Fixed frequencies + Analog input S1INA + S2INA	Amount
15	Fixed frequencies + Analog input S1INA + S3INA	Amount
20	Motor potentiometer	Amount
21	Motor potentiometer + Analog input S1INA	Amount
22	Motor potentiometer + Analog input S2INA	Amount
23	Motor potentiometer + Analog input S3INA	Amount
24	Motor potentiometer + Analog input S1INA + S2INA	Amount
25	Motor potentiometer + Analog input S1INA + S3INA	Amount
101	Analog input S1INA	±
102	Analog input S2INA	±
103	Analog input S3INA	±
104	Analog input S1INA + S2INA	±
105	Analog input S1INA + S3INA	±
110	Fixed frequencies	±
111	Fixed frequencies + Analog input S1INA	±
112	Fixed frequencies + Analog input S2INA	±
113	Fixed frequencies + Analog input S3INA	±
114	Fixed frequencies + Analog input S1INA + S2INA	±
115	Fixed frequencies + Analog input S1INA + S3INA	±
120	Motor potentiometer	±
121	Motor potentiometer + Analog input S1INA	±
122	Motor potentiometer + Analog input S2INA	±
123	Motor potentiometer + Analog input S3INA	±
124	Motor potentiometer + Analog input S1INA + S2INA	±
125	Motor potentiometer + Analog input S1INA + S3INA	±

The following block diagram shows all possibilities of the reference frequency specification and the software switches which are switched on or off in the various operation modes through parameter *Reference frequency source* **475 (RFSEL)**.

Note: In this context see also chapter fixed frequency change-over / Motor potentiometer function (chapter 7.3.3).

Block diagram of the reference frequency channel

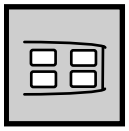




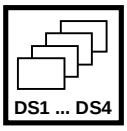
Switch position depending on the operation mode						
Oper. mode	Software switch					
475 (RFSEL)	S1INA	S2INA	S3INA	FF	MP	Sign
1	1					Amount
2		1				Amount
3			1			Amount
4	1	1				Amount
5	1		1			Amount
10				1		Amount
11	1			1		Amount
12		1		1		Amount
13			1	1		Amount
14	1	1		1		Amount
15	1		1	1		Amount
20					1	Amount
21	1				1	Amount
22		1			1	Amount
23			1		1	Amount
24	1	1			1	Amount
25	1		1		1	Amount

Switch position depending on the operation mode						
Oper. mode	Software switch					
475 (RFSEL)	S1INA	S2INA	S3INA	FF	MP	Sign
101	1					+ / -
102		1				+ / -
103			1			+ / -
104	1	1				+ / -
105	1		1			+ / -
110				1		+ / -
111	1			1		+ / -
112		1		1		+ / -
113			1	1		+ / -
114	1	1		1		+ / -
115	1		1	1		+ / -
120					1	+ / -
121	1				1	+ / -
122		1			1	+ / -
123			1		1	+ / -
124	1	1			1	+ / -
125	1		1		1	+ / -

7.12. SETTING THE REFERENCE PERCENTAGE CHANNEL



In configuration **30 CONF = 111** the various possibilities of the reference percentage specification can be selected with parameter *Reference percentage source* **476 (RPSEL)** and set with special operating behaviour. In this case settings can be selected which combine several reference value sources additively.



Setting

Parameter			Setting range		Factory setting	Control level
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
476	RPSEL	Reference percentage source	1	125	105	1

The following table shows the selection of operation modes of the reference percentage channel for the various reference percentage sources.

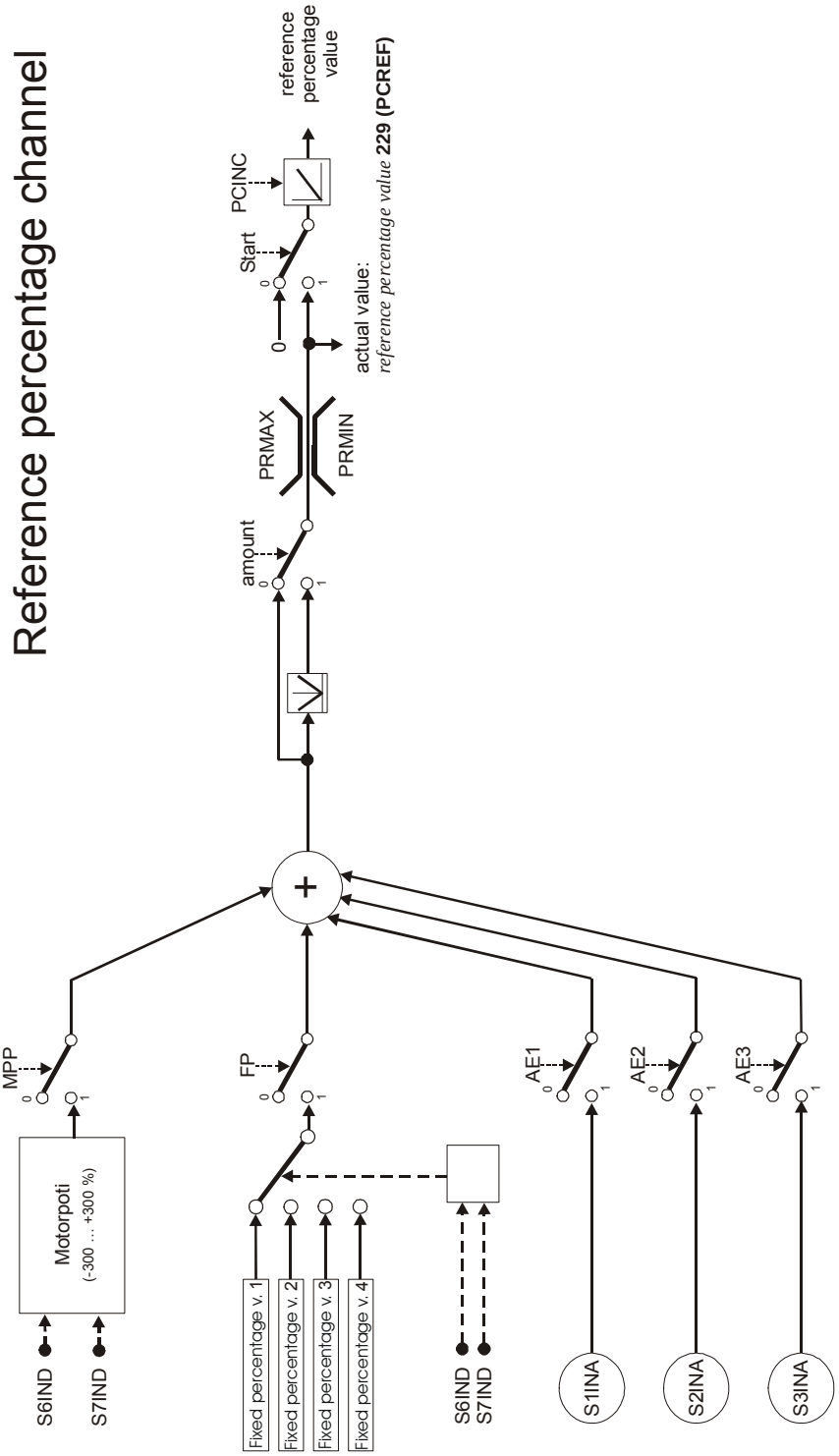
Reference Percentage Sources

Operation mode 476 (RPSEL)	Selected Reference Percentage Sources	Sign
1	Analog input S1INA	Amount
2	Analog input S2INA	Amount
3	Analog input S3INA	Amount
4	Analog input S1INA + S2INA	Amount
5	Analog input S1INA + S3INA	Amount
10	Fixed percentage v.	Amount
11	Fixed percentage value + Analog input S1INA	Amount
12	Fixed percentage value + Analog input S2INA	Amount
13	Fixed percentage value + Analog input S3INA	Amount
14	Fixed percentage value + Analog input S1INA + S2INA	Amount
15	Fixed percentage value + Analog input S1INA + S3INA	Amount
20	Motor potentiometer	Amount
21	Motor potentiometer + Analog input S1INA	Amount
22	Motor potentiometer + Analog input S2INA	Amount
23	Motor potentiometer + Analog input S3INA	Amount
24	Motor potentiometer + Analog input S1INA + S2INA	Amount
25	Motor potentiometer + Analog input S1INA + S3INA	Amount
101 **(fact. settg.)**	Analog input S1INA	±
102	Analog input S2INA	±
103	Analog input S3INA	±
104	Analog input S1INA + S2INA	±
105	Analog input S1INA + S3INA	±
110	Fixed percentage value	±
111	Fixed percentage value + Analog input S1INA	±
112	Fixed percentage value + Analog input S2INA	±
113	Fixed percentage value + Analog input S3INA	±
114	Fixed percentage value + Analog input S1INA + S2INA	±
115	Fixed percentage value + Analog input S1INA + S3INA	±
120	Motor potentiometer	±
121	Motor potentiometer + Analog input S1INA	±
122	Motor potentiometer + Analog input S2INA	±
123	Motor potentiometer + Analog input S3INA	±
124	Motor potentiometer + Analog input S1INA + S2INA	±
125	Motor potentiometer + Analog input S1INA + S3INA	±

The following block diagram shows all possibilities of the reference percentage specification and the software switches which are switched on or off with the various operation modes by the parameter *Reference percentage source* **476 (RPSEL)**.

Note: In this context see also chapter Fixed reference value change-over / motor potentiometer function (chapter 7.3.3).

Block diagram of the reference percentage channel



Software switch position depending on the operation mode

Oper. mode	Software switch					
476 (RPSEL)	S1INA	S2INA	S3INA	FF	MP	Sign
1	1					Amount
2		1				Amount
3			1			Amount
4	1	1				Amount
5	1		1			Amount
10				1		Amount
11	1			1		Amount
12		1		1		Amount
13			1	1		Amount
14	1	1		1		Amount
15	1		1	1		Amount
20					1	Amount
21	1				1	Amount
22		1			1	Amount
23			1		1	Amount
24	1	1			1	Amount
25	1		1		1	Amount

Software switch position depending on the operation

Oper. mode	Software switch					
476 (RPSEL)	S1INA	S2INA	S3INA	FF	MP	Sign
101	1					+ / -
102		1				+ / -
103			1			+ / -
104	1	1				+ / -
105	1		1			+ / -
110				1		+ / -
111	1			1		+ / -
112		1		1		+ / -
113			1	1		+ / -
114	1	1		1		+ / -
115	1		1	1		+ / -
120					1	+ / -
121	1				1	+ / -
122		1			1	+ / -
123			1		1	+ / -
124	1	1			1	+ / -
125	1		1		1	+ / -

7.13. SETTING OF THE PERCENTAGE VALUE RAMPS

The percentage value ramps determine how quickly a reference value change reaches the following technology controller. The behaviour corresponds to a low pass which considers the time behaviour of the drive system. The control deviation calculated from the actual percentage value and the reference percentage value, is controlled and filtered onto the frequency ramps.

DS1 ... DS4

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
477	PCINC	Ramp gradient percentage	0 %/s	60000 %/s	10 %/s	1

7.14. SETTING THE ACTUAL PERCENTAGE SOURCE

Configuration V/f – characteristic control with technology controller also requires the assignment of an analog application size with the parameter *Actual percentage source* **478 (APSEL)** for the reference value. The technology controller controls the drive system using the difference between the reference value and the actual value. The measured actual value is mapped on the analog input via an instrument transformer (0V .. ±10V or mA .. ±20mA). Assignment of the actual percentage source and the analog input should only be carried out using an input which is not used from the reference percentage channel.

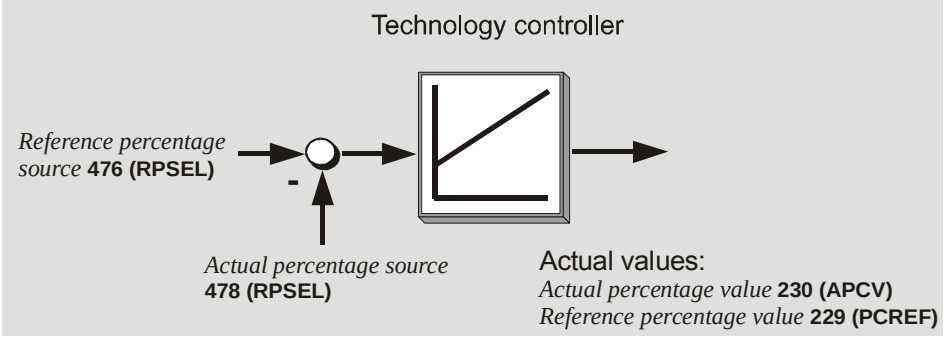
DS1 ... DS4

Setting		
Operation mode 478 (APSEL)	Selected Actual Percentage Source	Control level
1	Analog input 1 (S1INA) terminal X211.3, voltage range 0V ... ± 10V	1
2 Factory setting	Analog input 2 (S2INA) terminal X211.5, voltage range 0V ... ± 10V	1
3	Analog input 3 (S3INA) terminal X211.7, voltage range 0mA ... ± 20mA	1

Note: The analog inputs can be adapted according to the previous chapters. The steps for parameterisation and configuration do not depend on the assignment in configuration 111.

Technology controller:
The technology controller is a PI - controller for process engineering. Configuration 111 is applicable, for example, for pressure, temperature or flow control.

Structural layout:



7.15. SETTING THE RAMPS

The ramps determine how quickly the frequency value is changed at a reference value modification or after a start, stop or brake command. The maximum permissible ramp gradient should be selected depending on the application and the current consumption of the motor. If the acceleration is set to 0 Hz/s, the corresponding direction of rotation is blocked.
The parameter *Maximum Leading* **426 (RFMX)** limits the difference between the output of the ramp and the actual value of the drive. The pre-set maximum deviation is a dead time for the control behaviour which should be selected as small as possible.

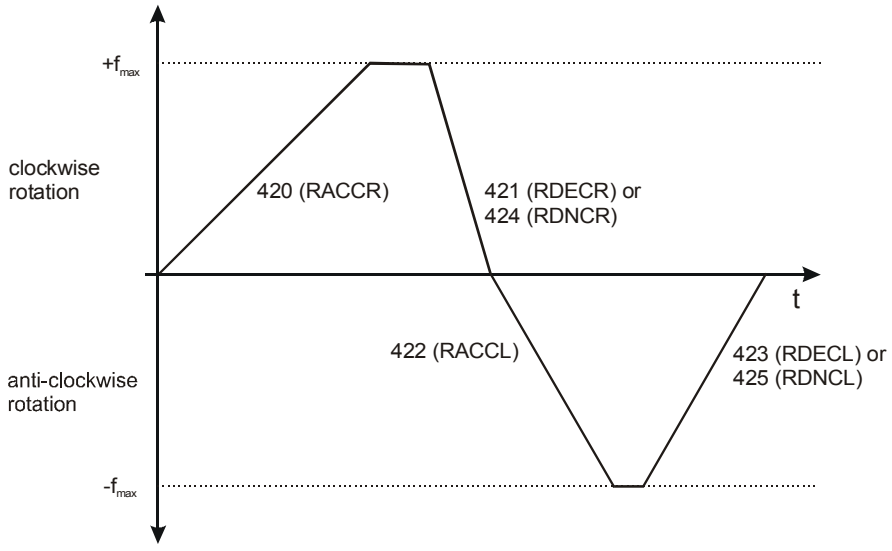
DS1 ... DS4

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
420	RACCR	Acceleration clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
421	RDECR	Deceleration clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
422	RACCL	Acceleration anti-clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
423	RDECL	Deceleration anti-clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
426	RFMX	Max. leading	0.01 Hz	999.99 Hz	5.00 Hz	3

The ramps for the emergency stop of the drive, which should be activated via the operation mode of the stop function, must be chosen according to the application. The non-linear course (S-shaped) of the ramps is not active during an emergency stop of the drive.

DS1 ... DS4

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
424	RDNCR	Emergency stop clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
425	RDNCL	Emergency stop anti-clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1



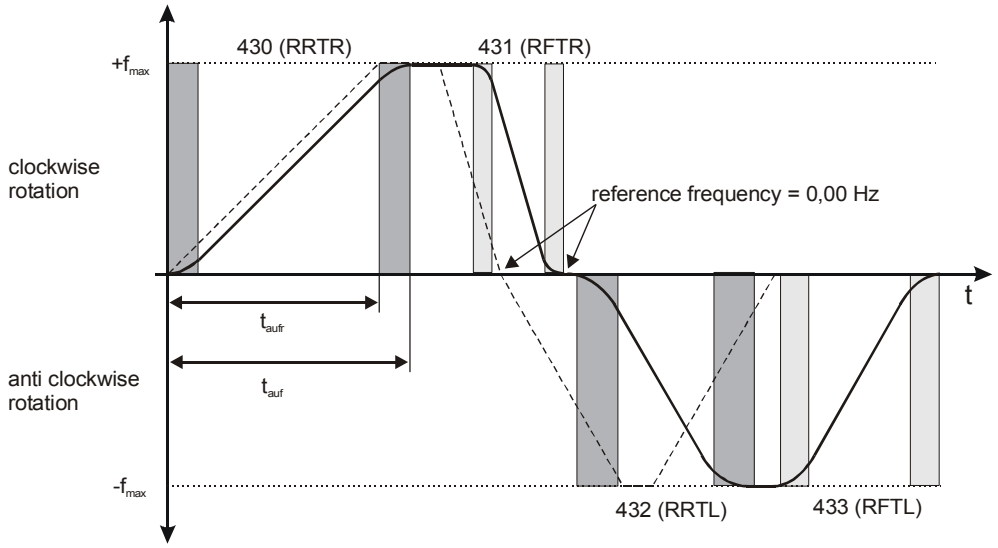
The load which occurs during a linear acceleration of the drive is reduced by the rates of increase which have to be set (S-curve). The non-linear frequency course is defined as a ramp fall or rise time and specifies over which time the frequency is to be brought to the pre-set ramp. The accelerations set with parameters 420 to 423 are retained, irrespective of the selected ramp fall or rise times.

Setting the ramp rise/fall times to zero deactivates this function and allows the use of linear ramps. The data set change-over of parameters in the acceleration phases of the drive requires a take-over of defined values. The control calculates the values needed to reach the reference values from the ratio of the acceleration to the ramp rise/fall time and uses these up to the end of the acceleration phase. The acceleration parameterised in the data set is taken over directly. This method avoids the crossing of reference values and enables the data set change-over between extremely deviant values.

DS1 ... DS4

Setting

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
430	RRTR	Ramp rise time clockwise	0 ms	65000 ms	100 ms	1
431	RFTR	Ramp fall time clockwise	0 ms	65000 ms	100 ms	1
432	RRTL	Ramp rise time anti-clockwise	0 ms	65000 ms	100 ms	1
433	RFTL	Ramp fall time anti-clockwise	0 ms	65000 ms	100 ms	1



Example: Calculation of the acceleration time with a clockwise field of rotation, an acceleration of 20 Hz to 50 Hz (fmax) and an acceleration ramp **420 (RACCR)** of 2 Hz/s. The ramp rise time **430 (RRTR)** is set at 100 ms.

$$t_{upr} = \frac{\Delta f}{RACCR}$$

$$t_{upr} = \frac{50Hz - 20Hz}{2Hz/s} = 15s$$

$$t_{up} = t_{upr} + RRTR$$

$$t_{up} = 15s + 100ms = 15.1s$$

$t_{up\,r}$ = Acceleration time clockwise rotation

Δf = Frequency change acceleration ramp

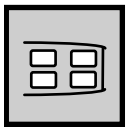
RACCR = Acceleration clockwise

RRTR = Ramp rise time clockwise

Note: The pre-set ramp rise/fall times are to be taken into consideration when calculating the time intervals. The data set change-over between the parameterised ramp rise/fall times can be delayed depending on the operating point of the drive.

7.16. CONTROL FUNCTIONS

7.16.1. INTELLIGENT CURRENT LIMITS

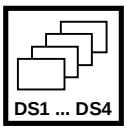


The current limits which should be set depending on the application prevent an inadmissible load on the connected motor and a fault switch-off of the frequency inverter. The specified overload reserve for the frequency inverter can be optimally used with the aid of intelligent current limits, particularly in applications with dynamic load changes. The criterion, which should be selected via the parameter *Operation Mode* **573 (LISEL),** defines the threshold for the activation of the intelligent current limit. The parameterised rated motor current and nominal current of the frequency inverter is synchronised as permitted level value of the intelligent current limits.

Intelligent current limits

Operation mode 573 (LISEL)	Function	Control level
0	Switched off	1
1	Limitation to the type-dependent current limit (IxT)	1
10	Limitation to the max. heat sink temperature (T_K)	1
11	Operation mode 1 and 10 (IxT + T_c)	1
20	Limitation to motor temperature (T_{PTC})	1
21	Operation mode 20 and 1 (T_{PTC} + IxT)	1
30	Operation mode 10 and 20 (T_c + T_{PTC})	1
31 **(Fact. setting)**	Operation mode 10, 20 and 1 (T_c + T_{PTC} + IxT)	1

The threshold set via parameter *Operation Mode* **573 (LISEL)** is monitored by the intelligent current limits. Once the limit is reached the power reduction set with the parameter *Power Limit* **574 (LIPR)** is carried out. This is achieved when the motors are in operation by reducing the output current and speed. The load behaviour of the connected machine must be speed-dependent if you wish to use the intelligent current limits. The overall time of power reduction due to an increased motor or heat sink temperature includes the necessary time needed for cooling. The subsequent *Limitation Time* **575 (LID)** defines the time after power reduction for monitoring. The defined overload reserve (IxT) of the frequency inverter is once again available after a 10 minute period of power reduction. The power limit should be defined as low as possible to give the drive enough time to cool down. The reference value is the nominal output of the frequency inverter or the set rated output of the motor.

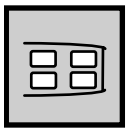


Setting

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
574	LIPR	Power limit	40.00 %	95.00 %	80.00 %	1
575	LID	Limitation time	5 min	300 min	15 min	1

Note: The control behaviour of the current limit controller described in the following chapter is extended by the intelligent current limits. The typical load characteristics of the machine must depend on the speed if you wish to use the intelligent current limits. Examples include pumps, fans and other variable-speed machines.

7.16.2. CURRENT LIMIT CONTROLLER

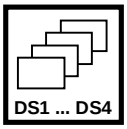


With the current limit controller, the inadmissible load of the drive system is avoided because drive control depends on the load. This is extended by the intelligent current limits described in the previous chapter. The current limit controller reduces e. g. the drive load during acceleration by stopping the acceleration ramp. The switching off of the inverter which occurs at acceleration ramps with too steep setting is thus avoided. With the parameter *Operation mode current limit controller* **610 (ILSEL)** the current limit controller is switched on and off.

Setting		
Operation mode 610 (ILSEL)	**Function**	**Control level**
0	Current limit controller and intelligent current limits switched off	1
1 **(Fact. setting)**	Current limit controller switched on	1

Behaviour with motor operation:
With the current limit value controller switched on, when the set *Current limit* **613 (ILIMX)** is exceeded, the output frequency is lowered until the limit current is not exceeded. The output frequency is lowered at a maximum of the set frequency until the parameter *Frequency limit* **614 (ILFMX)**. When the *Current limit* **613 (ILIMX)** is fallen below, the output frequency is raised to the reference value again.

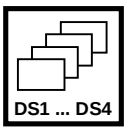
Behaviour with generating operation:
With the current limit value controller switched on, when the set *Current limit* **613 (ILIMX)** is exceeded, the output frequency is raised until the current limit is fallen below again. The output frequency is in this case raised at a maximum up to the set *Maximum frequency* **419 (FMAX**). When the *Current limit* **613 (ILIMX)** is fallen below again, the output frequency is lowered again to the required reference value.



Setting						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
613	ILIMX	Current limit [1)]	0.0 A	o · I_{FIN}	o · I_{FIN}	1
614	ILFMN	Current frequency [1)]	0.00 Hz	999.99 Hz	0.00 Hz	3

[1)] Parameters have been set via the guided commissioning

The control behaviour of the current limit controller has to be set via the proportional part, the parameter *Amplification* **611 (ILV**) and the integrating part, the parameter *Integral time* **612 (ILTI).** If, under exceptional circumstances, it should be necessary to optimise the controller parameters, a setting should be carried out by sharp modification of parameter *Current limit* **613 (ILIMX)**.



Setting of the controller parameters						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
611	ILV	Amplification	0.01	30.00	1.00	3
612	ILTI	Integral time	1 ms	10000 ms	24 ms	3

Note: The dynamic of the current limit controller and the voltage controller is influenced by the setting of parameter *Dyn. voltage pre-control* **605 UDYN)**. The function is described in chapter 7.8.1.

7.16.3. VOLTAGE CONTROLLER

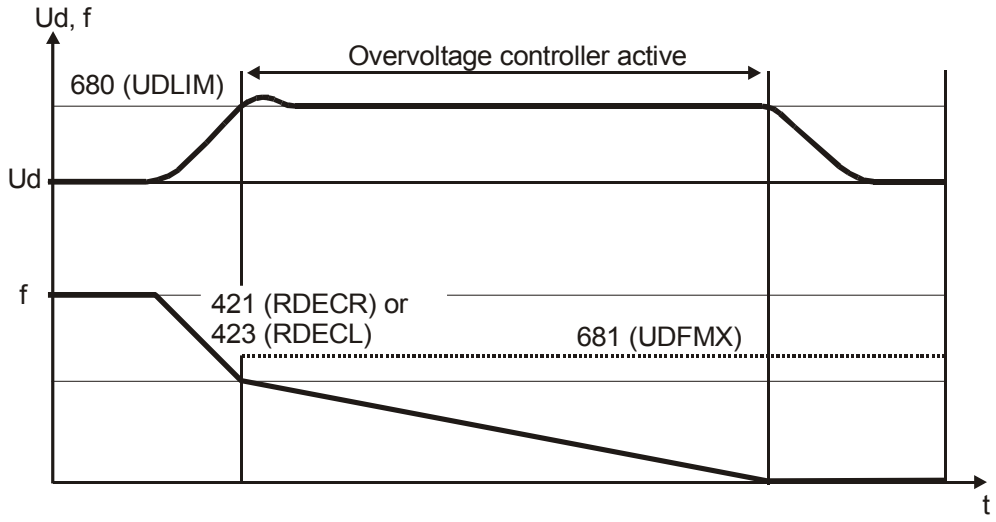
The voltage controller includes the functions necessary for monitoring of the DC-link voltage.
The rising DC-link voltage in regenerative operation or braking of the 3-phase machine is controlled on the set limiting value by the voltage controller.
The power failure regulation uses the kinetic rotation energy of the drive to link transient power failures.
The voltage controller is set with parameter *Operation mode* **670 (UDSEL)** according to the application.

DS1 ... DS4

Setting drive controller

Oper. mode 670 (UDSEL)	Function	Control level
0	Voltage controller switched off	2
1	Overvoltage controller switched on	2
2	Power failure regulation switched on	2
3 **(factory setting)**	Overvoltage controller and power failure regulation switched on	2

Operation mode Overvoltage control,
Parameter *Operation mode voltage controller* **670 (UDSEL) = 1**

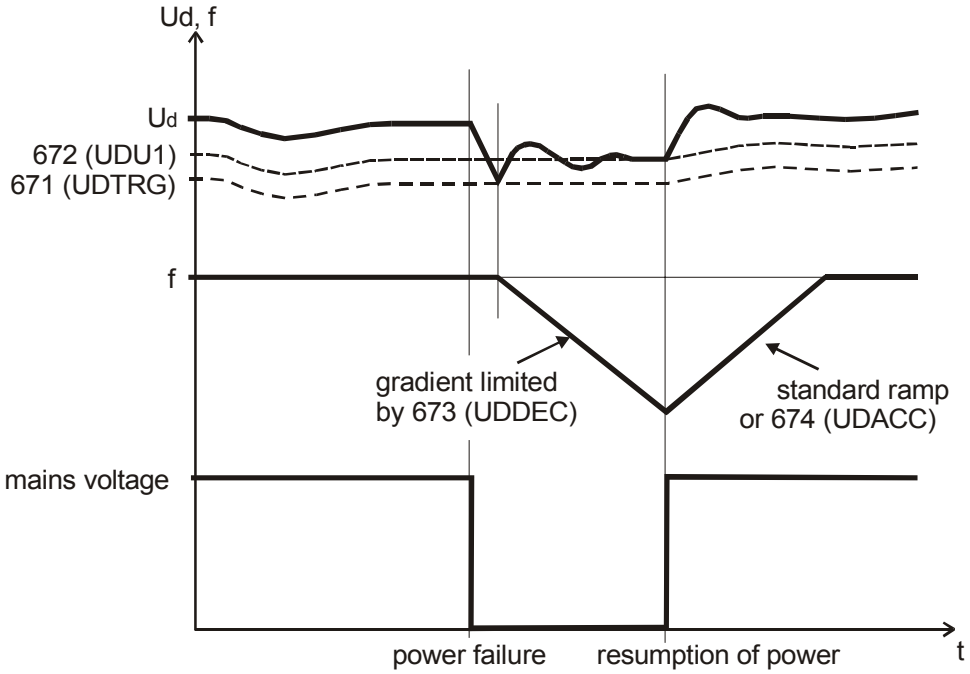


With the overvoltage control a switch-off of the inverter during regenerative operation is avoided. The reduction of the drive speed selected by a ramp gradient via the parameter *Deceleration clockwise* **421 (RDECR)** or *Deceleration anti-clockwise* **423 (RDCEL)** can result in an overvoltage within the DC-link. When the voltage exceeds the value set by parameter *Reference DC-link limitation* **680 (UDLIM)** the deceleration is reduced, so that the DC-link voltage is controlled on the set value. In case the DC-link voltage cannot be controlled on the set reference value by reduction of the deceleration, the deceleration is stopped and the output frequency is raised. The limiting value for the frequency rise is calculated by addition of parameter *Max. frequency rise* **681 (UDFMX)** with the operation point of the controller intervention.

Setting

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
680	UDLIM	Reference DC-link limitation	425.0 V	725.0 V	680.0 V	3
681	UDFMX	Max. frequency-increase	0.00 Hz	999.99 Hz	10.00 Hz	3

Operation mode power failure regulation,
Parameter *Operation mode voltage controller* **670 (UDSEL) = 2**

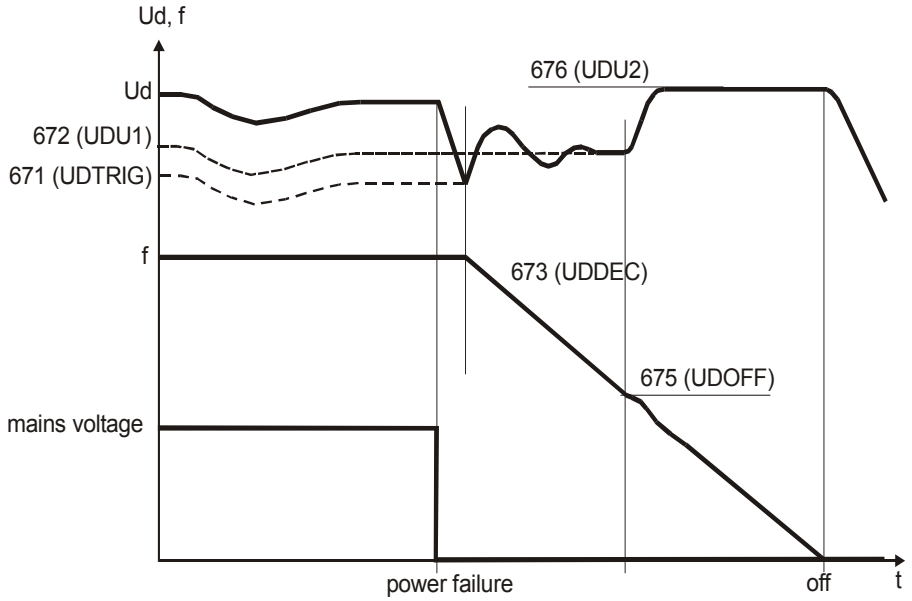


With power failure regulation, short-term power failures can be bridged. A power failure is recognised when the DC-link voltage has fallen below the set value of parameter *Power failure threshold* **671 (UDTRG).** When a power failure has been recognised, the controller tries to regulate the DC-link voltage to the value set on the parameter *Reference power support value* **672 (UDU1)**. For this purpose the output frequency is continuously reduced and the motor with its rotating grounds is put into generating operation mode. Reduction in the output frequency is carried out at maximum with the set ramp by parameter *Power support deceleration* **673 (UDDEC).**
The values are calculated towards the DC-link nominal voltage with the parameters *Power failure threshold* **671 (UDTRG)** and *Reference power support value* **672 (UDU1)**.
When mains voltage is resumed in time before the inverter is switched off by detection of mains undervoltage, the drive is accelerated, at maximum, to its reference frequency by parameter *Acceleration resumption of power* **674 (UDACC).** The switch-off limit must be configured via parameter *Reference shutdown value* **676 (UDU2)**.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
671	UDTRG	Power failure threshold	-200.0 V	-50.0 V	-100.0 V	3
672	UDU1	Reference power support value	-200.0 V	-10.0 V	-40.0 V	3
676	UDU2	Reference shut-down value	425.0 V	725.0 V	680.0 V	3

Note: During activated power failure regulation and during standard operation the frequency inverter reacts to signals at the control inputs. The protective circuit with externally supplied control signals is only possible when there is no interruption. Otherwise, supply using the frequency inverter has to be utilised.

Continuation to operation mode power failure regulation



The DC-link voltage which is available in the event of a power failure is provided by the motor. The output frequency is continuously reduced and the motor with its rotating masses is brought into generator mode. The maximum reduction in the output frequency is achieved using the ramps which are set by the parameter *Deceleration power support* **673 (UDDEC)** as far as the frequency limit *Shutdown threshold* **675 (UDOFF)**. If the energy in the system is not sufficient to get through periods of power failure, the drive is shut down. Slowing down takes place from the frequency limit with maximum ramping. The length of time until the motor shuts down is determined by the energy generated by the system which results in an increase in the DC-link voltage. The DC-link voltage set using the parameter *Reference shutdown value* **676 (UDU2)** is used as a closed-loop control parameter of the voltage regulator and is held constant. The rise in voltage makes it possible to optimise the brake behaviour and the length of time before shutdown. The behaviour of the regulator is comparable to Deceleration behaviour 2 (shutdown + hold), as the voltage regulator controls the drive using the maximum deceleration ramp and is supplied with the residual DC-link voltage.

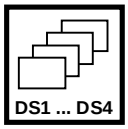
If mains power is resumed after the shut-down of the drive but the undervoltage switch-off is not deactivated yet, the inverter will signalise failure. The operating unit KP100 displays the fault message **"F0702 POWER FAILURE"**.

If the power failure without shut-down (*Shutdown threshold* **675 (UDOFF)** = 0 Hz) lasts until the frequency is lowered to 0 Hz, then on resumption of power the inverter will accelerate the drive to the reference frequency again.

If the power failure with or without shut-down lasts until the inverter has switched off completely (LEDs = OFF) then on resumption of power the inverter will be in the state “ready”. When the release comes again, will start the drive. If the release is permanently switched on, the *Auto-start* **651 (AUTO)** must be switched on.

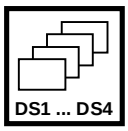
Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
672	UDU1	Reference power support value	-200.0 V	-10.0 V	-40.0 V	3
676	UDU2	Reference shutdown value	425.0 V	725.0 V	680.0 V	3

The voltage regulator uses the set DC-link voltage limits for closed-loop control. The changes in frequency necessary for this are parameterised by ramps which have to be set. The *Deceleration power support* **673 (UDDEC)** defines the maximum delay of the drive that is necessary to reach the voltage value *Reference power support value* **672 (UDU1)**. If the value set at the works is altered, the parameter *Acceleration resumption of power* **674 (UDACC)** replaces the set values of the ramp parameters *Acceleration clockwise* **420 (RACCR)** or *Acceleration anticlockwise* **422 (RACCL)**. The voltage control in the event of a power failure changes as from the frequency limit *Shutdown threshold* **675 (UDOFF)** from the *Reference power support value* **672 (UDU1)** to the *Reference shutdown value* **676 (UDU2)**.



Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
673	UDDEC	Deceleration power support	0.01 Hz/s	999.99 Hz/s	50.00 Hz/s	3
674	UDACC	Acceleration resumption of power	0.00 Hz/s	999.99 Hz/s	0.00 Hz/s	2
675	UDOFF	Shutdown threshold	0.00 Hz	999.99 Hz	0.00 Hz	2

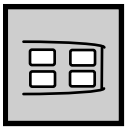
The proportional as well as the integrating part of the voltage controller must be set via parameter *Amplification* **677 (UDV)** and parameter *Integral time* **678 (UDTI).** The control functions must be de-activated via parameter value zero. In each setting a P – controller or I – controller is concerned.



Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
677	UDV	Amplification	0.00	30.00	1.00	3
678	UDTI	Integral time	0 ms	10000 ms	8 ms	3

Note: The dynamics of the current limit value controller and the voltage controller are influenced by the setting of parameter *Dyn. voltage pre-control* **605 (UDYN)**. The function is described in chapter 7.8.1.

7.16.4. SLIP COMPENSATION



The difference depending on the load between reference speed and the speed of the 3-phase motor is the slip. This dependence can completely be compensated by measuring the voltage in the output phases of the frequency inverter. In **configuration 110** the slip compensation facilitates a speed regulation without feed-back (tachometer generator or encoder). The stator frequency and thus the speed of the asynchronous motor is corrected depending on the active current.
With parameter *Operation mode slip compensation* **660 (SLSEL)** the slip compensation is switched on and off.

Setting		
Operation mode 660(SLSEL)	Function	Control level
0 **(Factory setting)**	Slip compensation switched off	2
1	Slip compensation switched on	2

The control response of the slip compensation can only be optimised in certain applications via the parameters. Parameter *Amplification* **661 (SLV)** determines the correction of the speed or the effect of the slip compensation proportional to the load change. The *Max. slip ramp* **662 (SLR)** defines the max. frequency change per second in order to avoid an overcurrent at the load change.
The parameter *Minimum frequency* **663 (SLFMN)** defines as from which frequency the slip compensation becomes active.

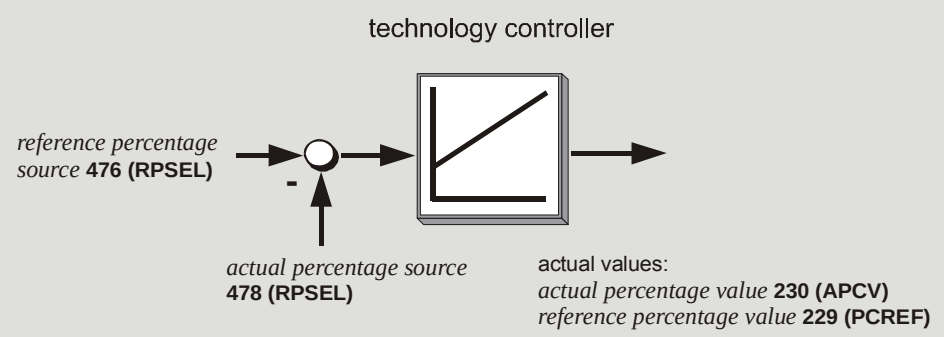
DS1 ... DS4

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
661	SLV	Amplification	0.0 %	300.0 %	100.0 %	3
662	SLR	Max. slip ramp	0.01 Hz/s	650.00 Hz/s	5.00 Hz/s	3
663	SLFMN	Minimum frequency	0.01 Hz	999.99 Hz	2.50 Hz	2

7.16.5. TECHNOLOGY CONTROLLER

The technology controller (PI controller) is available in **configuration 111**. The connection of reference value and actual value of the application with the functions of the frequency inverter facilitates the process control without further components. Applications such as pressure control, volume flow control or speed control thus can easily be realised.
The configuration of the reference percentage source (chapter 7.12) and the assignment of the actual percentage source (chapter 7.14) has to be considered.

Structural layout:



The function selected via parameter *Operation mode technology controller* **440 (TCSEL)** defines the behaviour of the technology controller.

Setting		
Operation mode 440 (TCSEL)	Function	Control level
0 **(Factory setting)**	Technology controller switched off	1
1	Standard	1
2	Level 1	1
3	Level 2	1
4	Speed control	1
5	indirect volumetric flow control	1

Operation mode standard

Parameter *Operation mode technology controller* **440 (TCSEL) = 1**

This operation mode is suitable for example for a pressure control or volumetric flow control with linear behaviour. When the actual value is missing (less than 0.5 %) the output frequency is led by the set parameter *Deceleration* **421 (RDECR)** to the frequency set with parameter *Minimum frequency* **418 (FMIN).** With this function an acceleration of the drive is avoided when the actual value is missing. When the actual value returns the controller continues to function automatically.
With parameter *Hysteresis* **443 (TCHYS)** an overshooting of the technology controller can be prevented by limitation of its output size with reference to the stator frequency. That means that the output size of the controller cannot become higher or lower than the positive and negative value limits of the set hysteresis.

Operation mode level control 1

Parameter *Operation mode technology controller* **440 (TCSEL) = 2**

This operation mode is suitable for example for level controlling. When the actual value is missing (less than 0.5 %) the output frequency is led by the set parameter *Deceleration* **421 (RDECR)** to the frequency, set with parameter *Fixed frequency* **441 (TCFF)**. The *Fixed frequency* **441 (TCFF)** has to be parameterised higher or equal to the set *Minimum frequency* **418 (FMIN),** otherwise the frequency is limited on **418 (FMIN)**.
With this function the drive with missing actual value is led on a set frequency which can be found in the control range *Minimum frequency* **418 (FMIN)** and *Maximum frequency* **419 (FMAX)**.
When the actual value returns the controller continues to function automatically.

Operation mode level control 2

Parameter *Operation mode technology controller* **440 (TCSEL) = 3**

This operation mode is suitable for example for level controlling. When the actual value is missing (less than 0.5 %) the output frequency is led on the *Fixed frequency* **441 (TCFF)** as at level control 1. When the control deviation becomes zero or negative the output frequency is led with the set *Deceleration* **421 (RDECR)** on the set *Minimum frequency* **418 (FMIN)**.
With this function an acceleration of the drive is avoided when the actual value is missing. In the case of a negative control deviation or a zero control deviation and a set *Minimum frequency* **418 (FMIN)** of 0 Hz the drive is brought to a standstill. The power component is then switched off, i. e. the motor is not supplied with current, until the actual value returns or the control deviation exceeds a **positive** *Hysteresis* **443 (TCHYS)**.

Operation mode speed control

Parameter *Operation mode technology controller* **440 (TCSEL) = 4**

This operation mode is suitable for example for speed controls with analog actual value transmitter (e. g. analog tachometer). When the actual value is missing (less than 0.5%) the output frequency is led to the set *Maximum frequency* **419 (FMAX)** with the set *Acceleration clockwise* **420 (RACCR)**. When the actual value returns, the controller continues to function automatically.

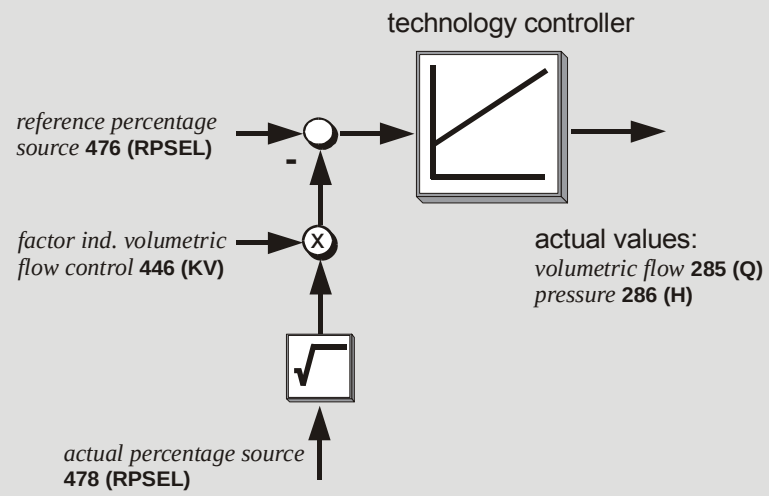
Operation mode indirect volumetric flow control

Parameter *Operating mode technology controller* **440 (TCSEL) = 5**

The pressure or volumetric flow control in operating mode 1 is extended by this operating mode in terms of functions. The actual value variable for which the square root is extracted in operating mode 5 of the technology controller allows, for example, direct measurement of the effective pressure in the system via the inflow nozzle of the fan. The effective pressure has a square ratio to the volumetric flow and thereby forms the control variable of the volumetric flow control. The calculation corresponds to the “law of proportionality” which is generally valid for centrifugal machines.

Adaptation to the respective application and measurement are performed via the *factor ind. volumetric flow control* **446 (KV)**. The actual values are calculated on the basis of the limit point method from the system data rated pressure and volumetric flow that must be parameterised (see Section 7.7)

Structural layout:



The control behaviour of the technology controller corresponds to a PI-controller. The proportional part is optimised with parameter *Amplification* **444 (TCV)** and the integral part with parameter *Integral time* **445 (TCTI)**. Here the control direction is determined by the sign of the amplification i. e. the output frequency is lowered with a rising actual value and plus sign of the amplification (e. g. with pressure control). The output frequency is raised with a rising actual value and minus sign of the amplification (e. g. with temperature control).

With parameter *Max. P component* **442 (TCPMX)** the frequency change at the controller output is limited. This prevents the system from oscillation in case of big acceleration ramps (chapter 7.15).

In the operation modes standard and level control 2 parameter *hysteresis* **443 (TCHYS)** restricts the deviation of the output size of the technology controller to the actual stator frequency of the motor.

Setting

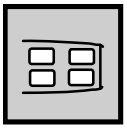
DS1 ... DS4

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
441	TCFF	Fixed frequency	-999.99 Hz	+999.99 Hz	0.00 Hz	1
442	TCPMX	Max. P component	0.01 Hz	999.99 Hz	50.00 Hz	1
443	TCHYS	Hysteresis	0.01 %	100.00 %	10.00 %	1
444	TCV	Amplification	-15.00	+15.00	1.00	1
445	TCTI	Integral time	0 ms	32767 ms	200 ms	1

Note: The parameterisation of the technology controller in the individual data sets facilitates the adaptation to different operation points of the application with the data set change-over via control contacts.

7.17. SPECIAL FUNCTIONS

7.17.1. AUTO-START



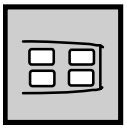
The auto-start function is suitable for example for pump and fan drives. By activating the auto-start function with parameter *Autostart* **651 (AUTO)** the frequency inverter supplies the drive after the mains voltage is connected. The change of the control signals at the digital inputs is not necessary after initialisation. The motor is accelerated according to parameterisation and reference value signals.

Note: The inverter may only be switched onto the mains power every 60 s. This means that a jog mode of a mains relay is not permissible. The equipment monitoring deactivates when the charging circuit is overloaded and reports this with the error "F09000 pre-load-relay".

Setting		
Oper. mode 651 (AUTO)	**Function**	**Control level**
0 **(fact. setting)**	Autostart switched off	1
1	Autostart switched on	1

Caution: At this point explicit reference is made to VDE regulation 0100 part 227 and regulation 0113, in particular sections 5.4 protection from automatic restarting after power failure and power resumption, and section 5.5 undervoltage protection.
Risk to persons, machinery and production goods must be excluded in the event of one of these cases.
Furthermore any special provisions and national regulations relevant for the particular application must be complied with.

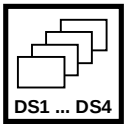
7.17.2. V-BELT MONITORING



Monitoring of the connection between the rotary current machine and the load is possible with the aid of the V-belt monitoring function. The parameter *Operating mode* **581 (BMSEL)** defines the function behaviour if the effective current falls below the set *trigger limit Iactive* **582 (BMTLI)** for a period longer than the parameterised *delay time* **583 (BMTD)**.

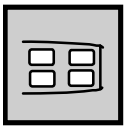
Setting		
Oper. mode 581 (BMSEL)	**Function**	**Control level**
0 **(fact. setting)**	OFF	1
1	Warning message "W8000 BELT" is displayed	1
2	Fault deactivation with the message "F0402 V-BELT MONITORING"	1

The fault and warning messages can be output with the aid of the digital outputs and can be forwarded to a higher-order controller.



Setting						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
582	BMTLI	Trigger limit Iactive	0.1%	100.0 %	10.0 %	1
583	BMTD	Delay time	0.1 s	600.0 s	10.0 s	1

7.17.3. SYNCHRONISATION



The synchronisation of a rotating drive is necessary in applications which drive the motor with the behaviour. With the aid of the synchronisation a rotating drive can be switched onto without producing a fault signal of the inverter. Afterwards the motor is led onto the reference speed with the set acceleration.
If the drive cannot be synchronised onto, the DC brake is activated whose duration can be set with parameter *Braking time after search run* **646 (SYTB)**. With parameter *Operation mode* **645 (SYSEL)** the operation mode of the synchronisation is set.

Setting		
Oper. mode 645 (SYSEL)	**Function**	**Control level**
0 **(fact. setting)**	Synchronisation switched off	1
1	Search direction according to the sign of the reference v.	1
2	Search direction first clockwise, then anti-clockwise	1
3	Search direction first anti-clockwise, then clockwise	1
4	Search direction clockwise only	1
5	Search direction anti-clockwise only	1

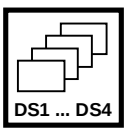
Parameter *Operation mode synchronisation* **645 (SYSEL) = 1,**
Search direction according to the sign of the reference value
In this operation mode the search direction is determined by the sign of the reference value. If a positive reference value (clockwise field of rotation) is specified as reference value, then the search direction is in a positive direction (clockwise field of rotation), with a negative reference value the search is in a negative direction (anti-clockwise field of rotation).

Parameter *Operation mode synchronisation* **645 (SYSEL) = 2,**
Search direction first clockwise, then anti-clockwise
In this operation mode it is first attempted to synchronise onto the drive in a positive direction (clockwise field of rotation). If this attempt is unsuccessful, it is attempted to synchronise onto the drive in a negative direction (anti-clockwise field of rotation).

Parameter *Operation mode synchronisation* **645 (SYSEL) = 3,**
Search direction first anti-clockwise, then clockwise
In this operation mode it is first attempted to synchronise onto the drive in a negative direction (anti-clockwise field of rotation). If this attempt is unsuccessful it is attempted to synchronise onto the drive in a positive direction (clockwise field of rotation).

Parameter *Operation mode synchronisation* **645 (SYSEL) = 4,**
Search direction only clockwise
In this operation mode it is only attempted to synchronise onto the drive in a positive direction (clockwise field of rotation).

Parameter *Operation mode synchronisation* **645 (SYSEL) = 5,**
Search direction anti-clockwise only
In this operation mode it is only attempted to synchronise onto the drive in a negative direction (anti-clockwise field of rotation).

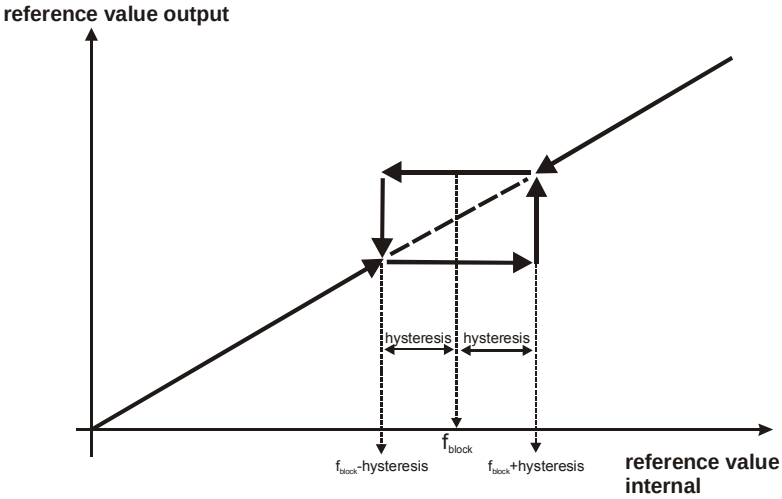


Setting						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
646	SYTB	Braking time after search run	0.0 s	200.0 s	10.0 s	2
647	SYIS	Current / motor rated current	1.00 %	100.00 %	70.00 %	2
648	SYV	Amplification	0.00	10.00	1.00	3
649	SYTI	Integral time	0 ms	1000 ms	20 ms	3

7.17.4. BLOCKING FREQUENCIES

For certain applications it is necessary to fade out reference frequencies so that installation resonance points as stationary operation points can be avoided. In configuration 110 two frequencies can be determined via parameter *1. Blocking frequency* **447 (FB1)** and parameter *2. Blocking frequency* **448 (FB2)** with a parameter *frequency hysteresis* **449 (FBHYS)**. This means that both frequencies have the same hysteresis band.

A blocking frequency is active when parameter *1. Blocking frequency* **447 (FB1)** or parameter *2. Blocking frequency* **448 (FB2)** and parameter *frequency hysteresis* **449 (FBHYS)** are unequal 0 Hz. Both blocking frequencies are valid for positive and negative reference values. The behaviour of the reference value can be determined from its direction of movement according to the following diagram.



DS1 ... DS4

Settings

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
447	FB1	1st block frequency	0.00 Hz	999.99 Hz	0.00 Hz	2
448	FB2	2nd block frequency	0.00 Hz	999.99 Hz	0.00 Hz	2
449	FBHYS	Frequency hysteresis	0.00 Hz	100.00 Hz	0.00 Hz	2

Note: The area faded out by hysteresis as a stationary operating point is passed through as fast as possible according to the set ramp. If there is a limitation of the output frequency due to the controller parameter settings, for example when the current limit is reached, hysteresis is passed through with a delay.

7.17.5. DYNAMIC PHASE CURRENT LIMITATION

In the case of dynamic load or current changes, which lead to a switch-off of the inverter with a fault message and which can not be removed with the current limit value regulator, the dynamic phase current limitation should be switched on with the parameter *Dyn. phase current limit* **403 (IDYN)**. If the current reaches the set limit within one motor phase, this phase is switched off for a short time. If a repeated switch-off does not result in a trouble shooting, a shut-down on faults occurs indicating F0502 dynamic phase current limitation.

Setting the parameter *Dyn. phase current limit* **403 (IDYN)** to value **0.0 A** means that the dynamic phase current limitation is switched off.

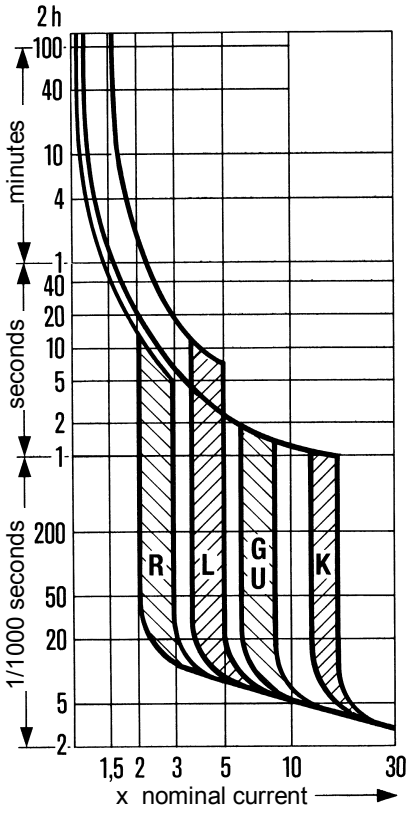
Setting

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
403	IDYN	Dynamic phase current limit	0.0 A	o · I_{FIN}	0.0 A	3

7.17.6. MOTOR PROTECTIVE SWITCH

Motor protective switches protect a motor and its lead from overheating due to overloading. Depending on the size of the overload they serve as short-circuit protection with their quick triggering and at the same time as overload protection with their slow switch-off.

Conventional motor protective switches for various applications with different trigger characteristics (L, G/U, R and K) according to the diagram on the right are available on the market. Since frequency inverters in most cases are used to feed motors, which in turn are classified as operating appliances with very high starting currents, the K characteristic is realised exclusively in this function.



Unlike the mode of a conventional motor protective switch, which immediately disconnects the operational appliance to be protected when the trigger threshold is reached, this function offers the possibility of issuing a warning message instead of an immediate switch-off.

The nominal current of the motor protective switch depends on the rated motor current which is specified with the parameter *Rated Current* **371 (MIR)** of each data set. In case of rating the application the nominal values of the frequency inverter must be considered correspondingly.

The function of the motor circuit breaker can be switched over in the data set. Different motors can thus be operated on one inverter. Each motor can thus have its own motor protective switch.

If a motor is being operated with the inverter, for which several settings, for example minimum and maximum frequency are changed via the data set change-over, only one motor protective switch may be present. A differentiation can be made between these functions by selecting the parameter *Operation mode motor circuit breaker* **571 (MSEL)** for single motor operation or multiple motor operation.

DS1 ... DS4

Setting	
Operation mode 571 (MSEL)	**Function**
0 **(Fact. setting)**	OFF
1	Motor protective switch for multiple motor operation with fault switch-off.
2	Motor protective switch for singe motor operation with fault switch-off.
11	Motor protective switch for multiple motor operation with warning message.
22	Motor protective switch for single motor operation with warning message.

7.17.6.1. MOTOR PROTECTIVE BREAKER FOR MULTIPLE MOTOR OPERATION

The function of the motor protective switch is set for multiple motor operation with the parameter *Operation mode motor protective switch* **571 (MSEL) = 1** or **571 (MSEL) = 11**.
In multiple motor operation it is assumed that one motor is used for each data set. For this purpose, each data set is assigned a motor and a motor protective switch. In this mode of operation all existing motor protective switches are monitored at the same time. The present output current of the frequency inverter is only taken into account for the motor protective switch activated by the data set. Zero current is calculated in the motor protective switches of the other data sets, so that the thermal decay function is taken into consideration. In connection with the data set change-over, the function of the motor protective switch acts like motors which are alternately switched to the mains with their own protective switches.

7.17.6.2. MOTOR PROTECTIVE SWITCH FOR SINGLE MOTOR OPERATION

The function of the motor protective switch is set for single motor operation with the parameter *Operation mode motor protective switch* **571 (MSEL) = 2** or **571 (MSEL) = 22**.
In single motor operation, only one motor protective switch is active which monitors the output current of the frequency inverter. In the case of a data set switch-over only the switch-off limits derived from the rated machine parameters are switched over. Accumulated thermal values are used further after the switch-over. During data set change-over it must be ensured that the machine data are specified for all data sets identically. In connection with the data set change-over, the function of the motor circuit breaker acts like motors which are alternately switched to the mains with one common protective switch.

7.17.6.3. MOTOR PROTECTIVE SWITCH WITH FAULT SWITCH OFF

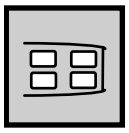
With parameter *Operation mode motor protective switch* **571 (MSEL) = 1** or **571 (MSEL) = 2** a fault switch-off is triggered when the motor protection is activated.
If the motor protective switch triggers, the frequency inverter is switched off with the fault message "**F0401 Motor protective switch**".

7.17.6.4. MOTOR PROTECTIVE SWITCH WITH WARNING MESSAGE

With parameter *Operation mode motor protective switch* **571 (MSEL) = 11** or **571 (MSEL) = 22** a warning message is triggered when the motor protection is activated. If the motor protective switch triggers, frequency inverter warning is sent with the warning message "**W0200 motor protective switch**".

Note: The warning message of the motor protective switch can be read out via the digital control outputs (see chapter 7.5).

7.17.7. BRAKE CHOPPER THRESHOLD



The frequency inverters are optionally fitted with a brake chopper. The external braking resistance is connected to terminals Rb2 and ZK+. Detailed information can be found in the corresponding operating instructions. The parameter *Trigger Threshold* **506 (UD BC)** defines the trigger threshold for the brake chopper. The regenerative power of the drive, leading to a rise of the DC-link voltage, is converted into heat by the external braking resistance above the trigger threshold. The temperature monitoring for the resistance should be integrated in the safety chain in accordance with the corresponding operating instructions.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
506	UD BC	Trigger threshold	425.0 V	1000.0 V	725.0 V	3

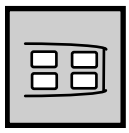
Set the parameter *Trigger Threshold* **506 (UD BC)** so that this is between the maximum DC-link voltage generated by the mains and the maximum permissible DC-link voltage of the frequency inverter of 750 V.

$$U_{main} \cdot 1{,}1 \cdot \sqrt{2} < UD\,BC < 750\,V$$

If the parameter *Trigger Threshold* **506 (UD BC)** is set above 750 V, the brake chopper cannot be activated and is switched off.

Note: The power of the external braking resistance and the maximum occurring current are to be taken into account during parameterisation, depending on the application. The trigger threshold must be above the voltage in the DC-link. The actual value *DC-link voltage* **222 (UDC)** can be read out in the menu VAL.

7.17.8. SETTING THE FAN SWITCH-ON TEMPERATURE



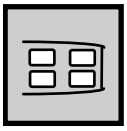
The switch-on temperature of the unit fans can be set with parameter *Switch-on temperature* **39 (TVENT)**. The unit fan is activated if the heat sink temperature exceeds the set temperature value.
If the heat sink temperature is 5°C lower than the set temperature value, the unit fan is switched off with a delay of one minute. The fan is also switched on while the warning messages TC or TI (see chapter 8.2.1) are active. For controlling an external fan, the function must be additionally connected to the digital control outputs.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
39	TVENT	Switch-on temperature	0 °C	75 °C	0 °C	2

Note: Frequency inverters of size 3, the device VCB400-570 and VCB400-610 are not fitted with a controllable unit fan in the factory. The optional extension is possible for devices of size 3.

7.17.9. PULSE WIDTH MODULATION

7.17.9.1. SETTING THE SWITCHING FREQUENCY



The motor noises can be reduced by switching over the parameter *Switching frequency* **400 (FT)**. The switching frequency should be reduced by a max. ratio of 1:10 of the frequency of the output signal for a sine-shaped output signal. The switching frequency that can be set, depends on the type of frequency inverter and differs from the following table for specially ordered device variants.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
400	FT	Switching frequency	1 kHz	see table	FI - type-dep.	1

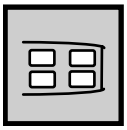
Note: The switching frequency affects the behaviour of the current controller. The scanning time is reduced with an increasing switching frequency, thus improving the dynamic behaviour of the control.

Setting Switching frequency	
Inverter type	**Switching frequency**
VCB400-010 to -115	1 ... 8 kHz
VCB400-135	1 ... 4 kHz
VCB400-150 to -180	1 ... 8 kHz
VCB400-210 to -250	1 ... 4 kHz
VCB400-300 to -370	1 ... 2 kHz [1)]
VCB400-460 to -610	1 kHz [1)]

[1)] The configurations for a frequency inverter with different control systems partly require a switching frequency of 4 kHz. The devices are available with a higher switching frequency on request.

Caution: Frequency inverters in the VCB family of devices require an adjustment of the switching frequency relative to the current load under certain operating conditions.
(see Operating instructions Part 1; General comments and power section)

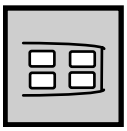
7.17.9.2. SETTING THE SWITCHING COMPENSATION



The concentricity characteristics at low speed can be optimised and the switching losses which depend on the switching frequency (voltage losses at the output) can be compensated with the parameter *Switching compensation* **402 (PWCOM)**.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
402	PWCOM	Switching compensation	0 %	200 %	50 %	2

7.17.10. COMMUNICATION INTERFACE



The frequency inverters can be extended for data communication with various options. Integration in an automation and control system is always possible. Parameterisation and commissioning can be carried out via the optional communication card, the control unit KP100 or the interface adapter. The PC – program supports the serial communication protocol and adapter. The baud rate set in control level 2 with the parameter *Baud Rate* **10 (BAUD)** should be set uniformly.

Setting		
Parameter 10 (BAUD)	**Baud rate**	**Control level**
1	2400 Bit/s	2
2	4800 Bit/s	2
3 **(Factory setting)**	9600 Bit/s	2
4	19200 Bit/s	2

If the frequency inverter is operated via the serial interface (RS232, RS485) it may be important to monitor the presence of the communication route. The inverter may be switched on/off in the remote mode or may only receive its reference values cyclically via the serial interface. If communication fails, no or incorrect data will be transferred. This status is detected by the communication watchdog. The watchdog function monitors the time during which incorrect communication takes place. This time can be set with the parameter *RS232/RS485 Watchdog Timer* **413 (WDOG)**. The set value is the time in seconds (range 0....10000 seconds). If the time is set to 0, the watchdog function is deactivated.

Settings						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
413	WDOG	RS232/RS485 Watchdog	0 s	10000 s	0	3

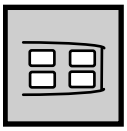
The remote mode is activated by setting the parameters *LocalRemote-Flag* **412 (REMOT)** on control level 3. This permits a change between control via contacts and the control unit and interface.

Setting		
Parameter 412 (REMOT)	**Function**	**Control level**
0 **(Factory setting)**	Control via contact	3
1	Control via interface	3

Note: If the remote mode is activated, the release can only be carried out through the communication channel. This is only possible if the hardware release S1IND (and start clockwise S2IND) is switched on!

7.18. SETTING THE ERROR AND WARNING BEHAVIOUR

7.18.1. SETTING THE WARNING LIMITS

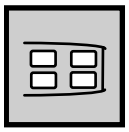


Limits can be set with the following parameters which lead to a warning message when reached. The warning message is displayed with the LED's and can be read out with the control unit KP 100 parameter *Warnings* **269 (WARN)**) or output via one of the digital control outputs.
If the limits are set below the switch-off limits of the inverter then a drive, for example, can be brought to a standstill prematurely or a fan can be switched on before the inverter breaks down in the event of a warning message.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
405	WIXTD	Warning limit IxT-DC	6 %	100 %	80 %	3
406	WIXT	Warning limit IxT	6 %	100 %	80 %	3
407	WTC	Warning limit Tc	-25 °C	0 °C	-5 °C	3
408	WTI	Warning limit Ti	-25 °C	0 °C	-5 °C	3

The *Warning Limit IxT-DC* **405 (WIXTD)** is a current limit for the frequency range with starting current impression and the *Warning Limit IxT* **406 (WIXT)** is an overload limit above a frequency of 2.5 Hz. A value is hereby set which indicates at which percentage of the switch-off limit the warning limit is located.
The *Warning Limit Tc* **407 (WTC)** is a heat sink temperature limit and the *Warning Limit Ti* **408 (WTI)** is an inside temperature limit. The temperature value calculated from the type-dependent limit minus the pre-set warning limit can be determined from the application data. The switch-off limit for the frequency inverter is 60°C – 70°C inside temperature and 80°C - 90°C heat sink temperature.

7.18.2. OVERFREQUENCY SWITCH-OFF

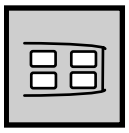


The maximum occurring output frequency of the frequency inverter has to be set with the parameter *Frequency switch-off limit* **417 (F OFF)**. If the *Stator frequency* **210 (FS)** exceeds this frequency limit, the inverter switches off with the error message ,"**F1100 OVERFREQUENCY"**.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
417	F OFF	Frequency switch-off limit	0.00 Hz	999.99 Hz	999.99 Hz	2

Note: The safety function of the switch-off at a high output frequency is deactivated with the value 999.99 Hz. If the application requires this function, the switch-off frequency is above the sum of the slip frequency and the *Maximum frequency* **419 (FMAX)**.

7.18.3. EARTH FAULT IDENTIFIER

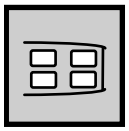


The limit of the resultant current can be set with the parameter *Earth fault switch-off limit* **416 (IEOFF)**. If there is an unbalance between the three motor phases, for example due to an earth fault, the inverter will be switched off after a triple check with the error message "F0505 Earth fault overload". Frequency inverters of size 1 do not currently offer this parameter in all device variants.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
416	IEOFF	Earth fault switch-off limit	0.0 A	o · I_{FIN}	0.25 · I_{FIN}	3

Note: If the parameter *Earth fault switch-off* **416 (IEOFF)** is set with the value zero amperes monitoring of the phase currents for unbalance is switched off.

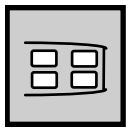
7.18.4. DC VOLTAGE COMPENSATION



At the inverter output a DC component can appear on the output voltage by asymmetries. This DC component can be compensated by the inverter. The maximum output voltage of the compensation is then set with parameter *IDC compensation limit* **415 (DCCMX)**. When there is a higher voltage required to manage the compensation of the DC component than the set limit, then the error "**F1301 IDC-Compensation**" is released. If this error appears, it will be necessary to check if the load is damaged. In this case the voltage limit may be increased.
Setting the parameter *IDC-compensation* **415 (DCCMX)** to zero, the DC compensation is deactivated.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
415	DCCMX	Limit IDC compensation	0.0 V	1.5 V	1.5 V	3

7.18.5. CONTROLLER STATUS



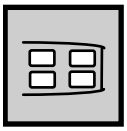
The intervention of the intelligent current limits and of the controller can be displayed by the status messages with the parameter *Controller status* **275 (CTRST)**. The limit values and events that lead to the intervention of the respective controller are described in the corresponding chapters. The behaviour when a controller intervenes is configured with the parameter *Controller status message* **409 (CTMSG)**.

Setting		
Parameter 409 (CTMSG)	Function	Control level
0	The controller status message function is switched off.	3
1 **(Fact. setting)**	Intervention of the speed controller or intelligent current limits is shown as a warning.	3
11	Display of the limitation is shown as a warning and by the flashing red LED.	3

The warning messages in the operating modes 1 and 11 can be read out via the parameter *Warnings* **269 (WARN)**.

7.19. GENERAL SETTINGS

7.19.1. SETTING THE CONTROL LEVEL



The parameters are divided into 3 control levels.

The most important parameters for commissioning can be found in **level 1**.

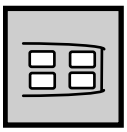
Level 2 includes all parameters from level 1. It also allows access to further parameters as well as special and control functions, e.g. controller parameters or control output settings.

Level 3 is reserved for special parameters. At the same time it enables access to parameters in control levels 1 and 2.

The parameter *Control Level* **28 (MODE)** determines the effective control level and can be set in control level 1.

Setting	
Parameter 28 (MODE)	**Function**
1 **(Factory setting)**	Control level 1
2	Control level 2
3	Control level 3

7.19.2. SETTING THE PASSWORD



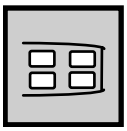
The parameter *Set password* **27 (PASSW)** can be set as protection against access from unauthorised persons. This password is then inquired in the case of a change of parameter. The parameter can only be changed with a correct entry.
If the password is entered correctly all changeable parameters can now be changed with no further password inquiry.

If there is no input via the keypad of the control unit KP 100 for approx. 10 minutes the password protection is automatically reactivated.
A new password is thus activated 10 minutes after the last keypad operation. If a RESET is conducted directly after a password change, the new password is active immediately after the RESET.

If the parameter *Set Password* **27 (PASSW)** is set with the value zero no password will be inquired when changing parameters. The previous password is then deleted.

Setting						
Parameter			**Setting range**		**Factory setting**	**Control level**
No.	**Abbr.**	**Meaning**	**Min**	**Max**		
27	PASSW	Set password	0	999	0	1

7.19.3. ACTIVATE FACTORY SETTING

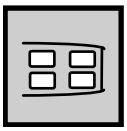


The factory setting can be activated or a RESET carried out with the parameter *Program* **34 (PROG)** in control level 1. The factory setting sets the parameters of the set configuration on the defined values. After initialisation of the frequency inverter the actual value set in the factory is displayed in the operation unit KP100.

Setting		
Parameter 34 (PROG)	**Function**	**Meaning**
123	RESET	Acknowledge error message
4444	Activate factory setting	Default values

Caution: Other parameter values are not permissible and may not be set. When the factory setting is activated, these will only be carried out in the set configuration.

7.19.4. SETTING THE LANGUAGE

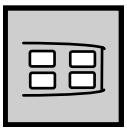


The language is set with the parameter *Language* **33 (LANG)** in control level 1. The error messages and parameters loaded when using a PC program will be shown in the chosen language. Further languages can be set via the PC program.

Setting	
Parameter 33 (LANG)	**Configuration**
0 **(Factory setting)**	German
1	English

Note: The parameter abbreviations shown by the control unit KP100 are independent of the chosen language. The setting with parameter *Language* **33 (LANG)** leads to a display of fault and warning signals in the particular language.

7.20. DISPLAY PARAMETERS



Amongst the parameters various actual values and states can be read out in the menu branch **PARA**.
The existing display parameters can be read out via the control unit or PC program. Writing access is only possible with parameter *User name* **29 (Name)**.

7.20.1. USER NAME

A plant or machine name entered with the PC can be read out with the parameter *User name* **29 (Name)**. The display appears as a moving script, e.g.:

Crane 5 Lifting gear

7.20.2. PRODUCTION DATA

The production data can only be read and are in control level 2 of the parameter structure.

7.20.2.1. INVERTER DATA

The inverter type and the serial number can be read out with parameter *Serial number* **0 (SN)**. The display appears as a moving script e. g.:

VCB 400 001 018	**0010261**
I	I
FI - Type	Serial - No.

7.20.2.2. BUILT IN OPTIONAL MODULES

You can read out which optional modules (cards) are installed in the inverter with the parameter *Optional modules* **1 (OPT)**. The display appears as a moving script e. g. for the extension module:

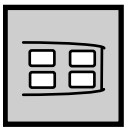
EAL-1

7.20.2.3. SOFTWARE VERSION

The inverter software version number can be read out with the parameter *Inverter software version* **12 (VERS)**. The display appears as a moving script e.g.:

V3-0

7.20.3. ACTUAL VALUES



The software for the frequency inverter shows a number of actual values depending on the chosen configuration and the installed extension cards.
The following chapters contain the parameters in the menu VAL with no installed extension cards. The actual value memory permits a selective monitoring of the application and the frequency inverter in a definable period. The saved mean and peak values of various parameters can be deleted separately.

7.20.3.1. ACTUAL VALUES OF THE FREQUENCY INVERTER

Actual values of the frequency inverter

Parameter			Control level	Contents
No.	Abbr.	Meaning		
222	UDC	DC-link voltage	1	Current voltage in DC-link
223	A	Modulation	2	Output voltage relative to the input voltage 100 % = mains input voltage
228	FREF	Reference frequency internal	2	Current reference frequency (configuration 110)
229	PCREF	Percentage reference value	2	Actual percentage value (configuration 111)
230	APCV	Percentage actual value	2	Actual percentage value (configuration 111)
244	TWORK	Working hours counter	1	Current working hours, active power part of the inverter
245	TOP	Operation hours counter	1	Actual operation hours, inverter with main supply
249	DSET	Active data set	2	Data set currently in use
250	IND	Digital inputs	1	Status of the eight digital inputs (decimal code)
251	INA1	Analog input 1	1	Voltage signal at analog input 1
252	INA2	Analog input 2	1	Voltage signal at analog input 2
253	INA3	Analog input 3	1	Current signal at analog input 3
254	OUTD	Digital outputs	1	Status of the three digital outputs (decimal code)
255	TC	Heat sink temperature	1	Current heat sink temperature
256	TI	Inside temperature	1	Current inside temperature
257	OUTA1	Analog output 1	1	Level of output current at analog output 1
259	ERROR	Current error	1	Error code and abbreviation in moving script
269	WARN	Warnings	1	Warning code and abbreviation in moving script
275	CTRST	Controller status	3	Controller code of active controller

Note: The actual values can only be read and are in the specified control levels. The parameter *Control level* **28 (MODE)** allows you to change the active control level (see chapter 7.19.1 Setting the control level).

7.20.3.2. ACTUAL VALUES OF THE MACHINE

Actual values of the machine				
Parameter			Control level	Contents
No.	Abbr.	Meaning		
210	FS	Stator frequency	1	Current output frequency
211	I RMS	Effective current	1	Current effective value of the output current (motor current)
212	U RMS	Machine voltage	1	Effective value of linked current output voltage
213	PW	Active power	1	Current calculated active power
214	IW	Active current	1	Actual active current – effective value
224	T	Torque	2	Current torque
238	FLUX	Flux value	2	Percentage magnetic flux
239	IB	Reactive current	1	Actual reactive current – effective value
240	SPEED	Actual Speed	1	Calculated or measured speed of the drive
241	FREQ	Actual Frequency	1	Calculated or measured frequency of the drive

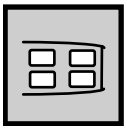
7.20.3.3. ACTUAL VALUES OF THE SYSTEM DATA

The correct display of the actual values is dependent on the system data to be parameterised, the selected configuration and the operating mode of the technology controller.

Actual values of the system				
Parameter			Control level	Contents
No.	Abbr.	Meaning		
285	Q	Volumetric flow	1	calculated volumetric flow in the dimension m^3/h
286	H	pressure	1	calculated pressure depending on the characteristic in the dimension kPa

Note: The actual values can only be read and are in the specified control levels. The parameter *Control level* **28 (MODE)** allows you to change the active control level (see chapter 7.19.1 Setting the control level).

7.20.3.4. ACTUAL VALUE MEMORY



The assessment and maintenance of the frequency inverter in the application is facilitated by the saving of various actual values. The actual value memory guarantees a monitoring of the individual parameters over a defined period. The parameter *Reset memory* **237 (PHCLR)** saved in the menu PARA permits a selective reset of the individual average and peak values.

Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
237	PHCLR	Reset memory	0	100	0	3

The following table shows the various possibilities of the actual value memory to reset certain values:

Parameter 237 (PHCLR)	Function	Description
0 **(Fact. setting)**	No deletion	The actual value memory remains unchanged
1	Peak value IxT	Delete the maximum measured utilisation of the inverter overload above the starting current impression
2	Peak value IxT-DC	Delete the maximum measured utilisation of the inverter overload within the starting current impression
3	Peak value Uzk	Delete the max. DC-link voltage which has occurred during operation of the frequency inverter.
4	Average value Uzk	Delete the average DC-link voltage calculated in the consideration period
5	Peak value Tk	Delete the highest heat sink temperature which has occurred
6	Average value Tk	Delete the average heat sink temperature calculated in the consideration period
7	Peak value Ti	Delete the highest inside temperature which has occurred
8	Average value Ti	Delete the average inside temperature calculated in the consideration period
9	Peak value I amount	Delete the largest measured current amount
10	Average value I amount	Delete the average current amount calculated in the consideration period
11	Peak value Pact. pos.	Delete the largest calculated active power in motor operation
12	Peak value Pact. neg.	Delete the largest calculated active power in generator operation
13	Average value Pact.	Delete the average active power calculated in the consideration period
16	Energy pos.	Delete the calculated energy in motor operation
17	Energy neg.	Delete the calculated energy in generator operation
100	All peak values	Delete the saved peak values
101	All average values	Delete the saved average values
102	All values	Delete all saved values

According to the previous table the different values of the actual value memory via parameter of the menu VAL in operation level 3 are to be read out.

Parameter			Unit	Contents
No.	Abbr.	Meaning		
231	PHIXT	Peak value IxT	%	The maximum measured utilisation of the frequency inverter overload above the starting current impression
232	PHIDC	Peak value IxT-DC	%	The maximum measured utilisation of the frequency inverter overload within the starting current impression
287	UDMAX	Peak value DC-link voltage	V	The max. DC-link voltage which has occurred during operation of the frequency inverter.
288	UDAVG	Average value DC-link voltage	V	The average DC-link voltage calculated in the consideration period
289	TCMAX	Peak value heat sink temp.	°C	The highest heat sink temperature which has occurred
290	TCAVG	Average value heat sink temp.	°C	The average heat sink temperature calculated in the consideration period
291	TIMAX	Peak value inside temp.	°C	The highest inside temperature which has occurred
292	TIAVG	Average value inside temp.	°C	The average inside temperature calculated in the consideration period
293	IMAX	Peak value current amount	A	The largest measured current amount
294	IAVG	Average value current amount	A	The average current amount calculated in the consideration period
295	PMAXP	Peak value active power pos.	kW	The largest calculated active power in motor operation
296	PMAXN	Peak value active power neg.	kW	The largest calculated active power in generator operation
297	PAVG	Average value active power	kW	The average active power calculated in the consideration period
301	ENRGP	Energy pos.	kWh	The calculated energy in motor operation
302	ENRGN	Energy neg.	kWh	The calculated energy in generator operation

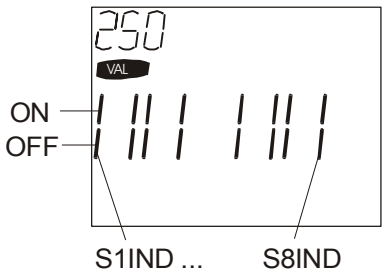
Note: The actual values can only be read and are in control level 3. Parameter *Control level* **28 (MODE)** allows you to change the active control level (see chapter 7.19.1 Setting the control level).

7.20.4. STATUS DISPLAY

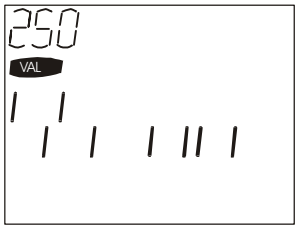
The status display of the digital and analog control signals as well as the software behaviour can be read out in operation level 1. This facilitates the test of the various control signals, especially during commissioning. During operation the intervention of a control function means the verification of the corresponding parameters.

7.20.4.1. STATUS OF THE DIGITAL INPUTS

The parameter *Digital inputs* **250 (IND)** displays the present status of the digital inputs. The following display is used for this purpose.



Example: S1IND and S3IND switched on and S2IND and S4IND to S8IND switched off



Note: The operational state of the digital inputs (parameter *Digital inputs* **254 (IND)**) to be read out via the optional PC program is coded as a decimal value. The operational state given in the example corresponds to the decimal value 5 to be read out.

7.20.4.2. INPUT SIGNALS AT THE ANALOG INPUTS

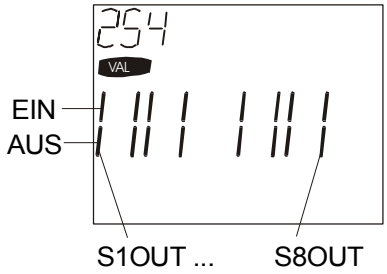
The input voltage at the analog inputs S1INA and S2INA can be read out with the parameters *Analog input 1* **251 (INA1)** and *Analog input 2* **252 (INA2)**.
The input current at analog input S3INA can be read out with parameter *Analog input 3* **253 (INA3)**.

7.20.4.3. READ OUT ACTIVE DATA SET

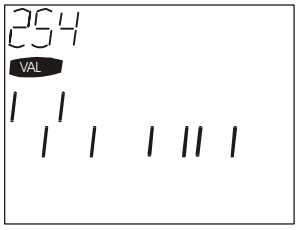
The currently active data set can be determined with the parameter *Active data set* **249 (DSET)**. This parameter is in control level 2.

7.20.4.4. STATUS OF THE DIGITAL OUTPUTS

The present status of the digital outputs can be read out with the parameter *Digital outputs* **254 (OUTD)**. This parameter is in control level 1.
The following display is used.



Example: S1OUT and S3OUT switched on and S2OUT and S4OUT to S8OUT switched off



Note: The operational state of the digital outputs (parameter *Digital outputs* **254 (OUTD)**) to be read out via the optional PC program is coded as a decimal value. The operational state given in the example corresponds to the decimal value 5 to be read out

7.20.4.5. OUTPUT SIGNAL OF THE ANALOG OUTPUT

The output current at the analog output S1OUTA can be read out with the parameter *Analog output 1* **257 (OUTA1)**.
This value depends on the configuration set with the parameter operation mode *Analog output 1* **550 (O1SEL)**. (see chapter 7.4.1)
The output signal at connection S1OUTA can be between -20mA and +20mA.

7.20.4.6. STATUS OF THE CONTROLLERS

The parameter *Controller status* **275 (CTRST**) can be used to determine which of the control functions limits the reference signals at the actual point of operation.
This parameter is in control level 1. The message appears as a moving script in the display of the control unit KP100.

CXXXX	**ABCDE**
I	I
Controller code	Controller abbr.

The following status displays are available:

Status displays		
Controller code	**Controller Abbr.**	**Meaning**
C0000	-	No controller active
C0001	UDDYN	Voltage controller in dynamic operation
C0002	UDSTOP	Stopping the machine
C0004	UDCTR	Power failure regulation via voltage controller
C0008	UDLIM	Overvoltage control
C0010	BOOST	Dynamic pilot voltage control accumulated
C0020	ILIM	Current limit controller active
C0100	RSTP	Reduction of current via the ramp stop, defined in the starting behaviour
C0200	IXTLIM	Utilisation limit of overload above the starting current impression (0 Hz – 2.5 Hz) reached (limit intelligent current limits)
C0400	IXTDCLIM	Utilisation limit of overload in the range of the starting current impression (0 Hz – 2.5 Hz) (limit intelligent current limits)
C0800	TCLIM	The pre-set warning limit of the heat sink temperature has been reached (limit intelligent current limits)
C1000	PTCLIM	The pre-set warning limit for the motor temperature has been reached (limit intelligent current limits)

If several controllers intervene simultaneously, a fault code is shown in the display as a hexadecimal value, which is composed of the sum of the individual codes. The relevant controller abbreviation then follows as a moving script.

Example: The following is displayed

C 0025 UDDYN UDCTR ILIM

Thus a dynamic operation of the Ud - controller occured. Simultaneously, the power failure regulation as well as the current limit controller were in operation.
The controller code results in the sum of the single codes
(0001 + 0004 + 0020) = 0025.

7.20.5. ERROR AND WARNING MESSAGES

7.20.5.1. CURRENT ERROR

The parameter *Current error* **259 (ERROR)** displays the current error. The error messages and their meanings can be found in chapter 8.2.2.

7.20.5.2. WARNING MESSAGE

Pending warning messages can be read out with the parameter *Warnings* **269 (WARN)**. The warning messages and their meanings can be found in chapter 8.2.1.

7.20.5.3. ERROR SUM

The number of error faults which have appeared since delivery of the inverter can be read out with the parameter *No. of errors* **362 (ESUM)**.

Note: Each error increments the error sum. This is also valid when the same error occurs several times in succession.
In the error memory and error environment the same errors which appear several times in succession are not taken into consideration. This means that only the first error and its environment are stored in the error memory.

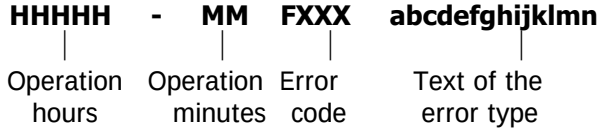
7.20.5.4. ERROR MEMORY

The inverter has an error memory in which the last 16 error messages are stored in chronological order. The stored error messages can be read out according to the following table:

Error messages	
Parameter number	**Parameter abbr.**
310	ERR1
311	ERR2
312	ERR3
313	ERR4
314	ERR5
315	ERR6
316	ERR7
317	ERR8

Error messages	
Parameter number	**Parameter abbr.**
318	ERR9
319	ERR10
320	ERR11
321	ERR12
322	ERR13
323	ERR14
324	ERR15
325	ERR16

The error which appeared last can be read out with parameter *Last error* **310 (ERR1)**, the last but one fault with parameter *Last error but one* **311 (ERR2)** etc. The position of the operation hours counter at which the fault appeared is also displayed for each error.



Example: 0012 56 F0500 OVERCURRENT
An overcurrent has occured after 12 hours and 56 minutes of operation.

Note: The last four error messages can be reached via the control level 1. If you also wish to read out the remaining 12 error messages the control level 2 must be set. The meaning of the error codes can be found in chapter 8.2.2.

7.20.6. ERROR ENVIRONMENT

Additional actual values and status values which were stored at the same time as the error appeared can be read out with the control unit KP 100 together with the last error which can be read out with the parameter *Last error* **310 (ERR1)** (error environment). This facilitates troubleshooting for the causes of the error.

Note: The relevant error environment can only be read out with the PC program, available as an accessory, for the parameters *Last error but one* **311 (ERR2)**, *Error 3* **312 (ERR3)** and *Error 4* **313 (ERR4)**. The error environment of these errors cannot be read out with the control unit KP 100.
If you wish to read out the error environment of the last error you must set control level 3.

7.20.6.1. ERROR MEMORY STATUS

You can check whether the error environment has been stored without mistakes after a fault has appeared with the parameter *Checksum* **361 (CHSUM)**.
If the error environment could be saved in the memory without mistake the message **OK** appears in the display of the control unit KP 100.
If the error environment could not be saved in the memory without mistakes then the message **NOK** appears in the display of the control unit KP 100. In this case, the correctness of the values (parameters 330 to 360) which may have been saved in the memory of the error environment is questionable.
If no error has occurred the message **C0000** appears in the display of the control unit KP 100**.** The message is preceded by the value of the operation hours counter at the time of the error, separated by a semicolon.

7.20.6.2. ACTUAL ERROR VALUES AND ERROR STATUS

The following actual values are stored at the same time as an error occurs:

Actual error values

Parameter			Contents
No.	**Abbr.**	**Meaning**	
330	EUDC	DC-link voltage	DC-link voltage of the inverter
331	EURMS	Output voltage	Output voltage to motor
332	EFS	Stator frequency	Stator frequency of the motor
333	EEC1	Encoder 1 frequency	Actual value optional extension card
334	EEC2	Encoder 2 frequency	Actual value optional extension card
335	EIA	Phase current Ia	Current in phase A
336	EIB	Phase current Ib	Current in phase B
337	EIC	Phase current Ic	Current in phase C
338	EIRMS	R.m.s current	Output current
339	EISD	Isd / reactive current	Flux-forming current
340	EISQ	Isq / active current	Torque-forming current
341	EIMR	Rotor magnetizing current	Magnetising current
342	ET	Torque	Torque

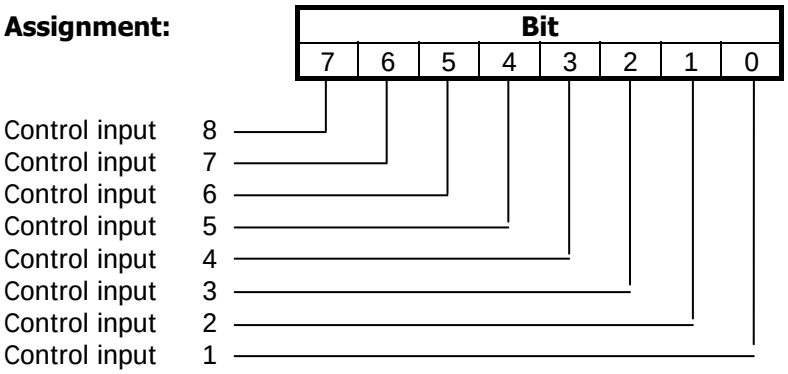
Actual error values			
Parameter			**Contents**
No.	**Abbr.**	**Meaning**	
343	EINA1	Analog input 1	Voltage value at analog input 1
344	EINA2	Analog input 2	Voltage value at analog input 2
345	EINA3	Analog input 3	Current value at analog input 3
346	EOUT1	Analog output 1	Current value at analog output 1
347	EOUT2	Analog output 2	Act. value of optional extension card
348	EOUT3	Analog output 3	Act. value of optional extension card
349	EFO	Repetition frequency output	Act. value of optional extension card
350	EIND	Status of digital inputs	Status of the digital inputs as hexa-decimal value (decimal code)
351	EOUTD	Status of digital outputs	Status of the digital outputs as hexa-decimal value (decimal code)
352	ETIME	Time since release	The error time after the last release of the frequency inverter HHHHH MM SS - $^{sec}/_{10}$ $^{sec}/_{100}$ $^{sec}/_{1000}$ Operation hours / Min-utes / Seconds
353	ETC	Heat sink temperature	Temperature of the heat sink
354	ETI	Inside temperature	Temperature inside
355	EC	Controller status	Active control functions and limits
356	EW	Warning status	Current warning messages
357	EI1	Int value 1	Software – service parameter
358	EI2	Int value 2	Software – service parameter
359	EF1	Long value 1	Software – service parameter
360	EF2	Long value 2	Software – service parameter
361	CHSUM	Checksum	Check the stored error environment

Note: The actual error values are stored after an error has occurred and are controlled with the checksum. If the frequency inverter remains inoperative after the malfunction, the error environment may be faulty. If the actual error values are improbable, please check the installation against the current EMC and installation guidelines.

Status Coding of the digital inputs

A decimal value is displayed which indicates the *Status of Digital Inputs* **350 (EIND)** and *Status of Digital Outputs* **351 (EOUTD)** bit-by-bit after conversion to a binary number.

Assignment:



If the bit assigned to the control input is set, then the input is active.

Example: The decimal value 33 is displayed. Conversion to the binary system results in the bit combination **OOIOOOOI**. The following contact inputs or outputs are thus activated:

- Controlsignal at Control input or output 1
- Controlsignal at Control input or output 6

Coding controller status

The parameter *Controller status* **355 (EC**) can be used to determine, which of the control functions were active at the time the last error occurred. The error message appears as a moving script in the display of the control unit.

CXXXX	**ABCDE**
I	I
Controller code	Controller abbr.

If several controllers are currently intervening, a controller code is shown in the display in the form of a hexadecimal value that is made up of the sum of the individual codes. This is followed by the respective controller abbreviation in the text. Refer to chapter 7.20.4.6 Status of the controller for a description of the status messages.

Coding the warning status

The parameter *Warning status* **356 (EW)** displays the warning status that existed when the last error occurred.
The warning message appears with its code number and its abbreviation in a moving script in the display of the control unit.

WXXXX	**ABCDE**
I	I
Warning code	Warning abbr.

Example: **W 0000** **NO WARNING**

If there were more than one warning when the error occurred, the display of the control unit shows the sum of the warning codes in hexadecimal values, followed by the warning abbreviations in a moving script. The warning messages are described in chapter 8.2.1.

8. OPERATION AND ERROR DIAGNOSIS

8.1. LED DISPLAYS

#

The two light-emitting diodes LED H1 (green) and LED H2 (red) in the frequency inverter indicate the status of the inverter. The position of the LED's is shown in the construction and layout diagram of the Operating instructions, Part 1.

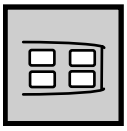
LED – displays

H1 (green)	H2 (red)	Status
off	off	Mains off, no function or mains on, charging circuit overheated.
on	on	Mains is switched on, self-test running.
flashes	off	Unit ready, no release (FUF + STR or STL).
on	off	Unit ready and released.
on	flashes	Unit is ready and released. A warning (see chapter 8.2.1) or the intervention of a controller (chapter 7.18.5) is signalled.
flashes	flashes	Unit ready and **not** released and signals "warning" (see chapter 8.2.1).
off	flashes	Unit error. Error not yet acknowledgeable (see chapter 8.2.2).
off	on	Unit error. Error acknowledgeable (see chapter 8.2.2).

The named conditions of the frequency inverter are supplemented by the *Controller status message* **409 (CTMSG)**. The function described in chapter 7.18.5 facilitates the displaying of the controller status by the red LED .

8.2. DISPLAYS IN THE CONTROL UNIT KP 100

8.2.1. WARNING MESSAGES



If a critical state is recognised this is displayed with the light-emitting diodes LED H1 (green) and LED H2 (red).
The warning message can be read out with the control unit KP 100 in the menu VAL (actual values) with the parameter *Warning* **269 (WARN)**. The warning code and abbreviation are shown in moving script.

Example: W 0080 PTC

The following warning messages can be displayed:

Warning messages

KP 100 display		Meaning
Code	**Abbr.**	**Measures / Remedy**
W0000	NO WARNING	No warning message present.
W0001	IXT	Inverter overloaded, warning code W0002 or W0004
W0002	IXT	Inverter overloaded at low output frequency. Check drive and motor. The threshold value for this warning message can be set with the parameter *Warning Limit IxT-DC* **405 (WIXTD)**.
W0004	IXT	Inverter overloaded at high output frequency. Check drive and motor. Reduce speed controller limits, reference value. The threshold value for this warning message can be set with the parameter *Warning limit IxT* **406 (WIXT)**.

Warning messages (cont.)		
KP 100 display		**Meaning**
Code	**Abbr.**	**Measures / Remedy**
W0008	TC	Heat sink temperature shortly before switch-off limit. Check *Heats sink temperature* **255 (TC)**, mounting position, cooling and fan. The threshold value for this warning message can be set with the parameter *Warning limit Tc* **407 (WTC)**.
W0010	TI	Inside temperature shortly before switch-off limit. Check *Inside temperature* **256 (TI),** mounting position, cooling and fan. The threshold value for this warning message can be set with the parameter *Warning limit Ti* **408 (WTI)**.
W0020	ILIM	Reference values are limited by a controller. Details are stored in the controller status.
W0080	PTC	Motor temperature shortly before switch-off limit. Check motor or bridge X455-1/-2.
W0200	PMS	The motor protective switch has triggered. Check load conditions.
W0400	FLIM	Reference frequency reached the limit. Frequency limitation is active.
W0800	A1	Analog value 1 not present or below the configured minimum value. The *Operation mode analog input 1* **452 (A1SEL)** activates the monitoring function.
W1000	A2	Analog value 2 not present or below the configured minimum value. The *Operation mode analog input 1* **460 (A2SEL)** activates the monitoring function.
W2000	A3	Analog value 3 not present or below the configured minimum value. The *Operation mode analog input 1* **470 (A3SEL)** activates the monitoring function.
W4000	UDC	DC - link voltage reached the lower limit
W8000	BELT	The V-belt monitoring function detect no-load operation of the drive.

Example: W 008D IXT TC PTC

There are warning messages IxT for high output frequencies, heat sink temperature and motor temperature.
The warning sum code (hexadecimal) results as

W 0005 + W 0008 + W 0080 = W 008D

Note: The warning messages can be assigned to the digital control outputs **S1OUT, S2OUT** and **S3OUT** (see chapter 7.5).
Thus, for example, a drive can be brought to a standstill prematurely or a fan can be switched on before the frequency inverter is switched off by a failure when a warning message appears.

8.2.2. ERROR MESSAGES

The following error messages are displayed in the control unit KP 100 with code and text in moving script after an error occurs. The error display is terminated by pressing the start/enter key, whereby the red background to the display remains for a current error. The respective texts also appear when the fault memory is read out (chapter 7.20.5.4).

Error messages		
KP 100 display		**Meaning**
Code	**Text**	**Measures / Remedy**
F0000	NO ERROR	No error has occurred.
F0100	IXT	Inverter for 60 s overloaded. Check drive and motor. Reduce ramp gradient, reduce reference value.
F0101	IXT DC	Inverter overloaded at low output frequency. Check drive and motor.
F0200	HEAT SINK OVER-TEMPERATURE	Heat sink temperature over 80°C or 90°C. Check *Heat Sink Temperature* **255 (TC)**, mounting position, cooling and fan.
F0201	HEAT SINK SENSOR	Temperature sensor is defective or unit is too cold (see permissible temperature range). Check *Heat Sink Temperature* **255 (TC)**.
F0300	OVER-TEMPERATURE	Inside temperature over 70°C. Check *Inside Temperature* **256 (TI)**, mounting position, cooling and fan.
F0301	UNDER-TEMPERATURE	Inside temperature under 0 °C. Check *Inside Temperature* **256 (TI)**, ambient temperature and cabinet heating.
F0400	MOTOR TEMPERATURE	Motor temperature too high (PTC > 3 kOhm) or motor PTC input X455-1/-2 not connected. Check motor or bridge X455-1/-2.
F0401	MOTOR PROTECTIVE SWITCH	The motor protective switch is active. Check drive. The fault switch-off is only active when the corresponding operation mode of the motor protective switch circuit breaker has been set.
F0402	V-BELT MONITORING	The V-belt monitoring function detect no-load operation of the drive.
F0500	OVERCURRENT	Inverter overloaded. Check drive and motor. Reduce ramp gradient.
F0501	UCE-CONTROL	Short circuit or earth fault at output. Check drive, motor and motor cabling.
F0502	DYN. PHASE-CURRENT LIMITATION	Phase current limit value exceeded. Check drive. Increase phase current limit. Reduce ramp gradient.
F0503	DC – LINK OVERCURRENT	Short circuit or earth fault at output. Check drive, motor and motor cabling.
F0504	CURRENT LIMIT CONTROLLER	Overload too long with activated current limit controller. Check drive and motor. Increase current limit.
F0505	EARTH FAULT OVER-CURRENT	Incorrect sum of line currents, check motor and cabling
F0700	OVERVOLTAGE	DC-link voltage too high. Check *DC-Link Voltage* **222 (UDC)** and mains voltage, extend deceleration ramp, check brake chopper setting.

Error messages (cont.)

KP 100 display		Meaning
Code	**Text**	**Measures / Remedy**
F0701	UNDERVOLTAGE	DC-link voltage too low. Check *DC-Link Voltage* **222 (UDC)** and mains voltage and stabilise if necessary. Delay repeat switching of the mains relay by at least 10 s.
F0702	POWER FAILURE	Check the limits of the voltage controller in the operation mode power failure regulation.
F0800	15V–VOLTAGE TOO SMALL	+/-15 V too low on controller card. Inverter defective.
F0801	24V–VOLTAGE TOO SMALL	24 V too low on controller card. Inverter defective.
F0900	PRELOAD CONTACTOR	Pre-load contactor has fallen off or not attracted. Charging circuit overheated. Switch off mains, wait 5 minutes and switch on mains again.
F1100	FREQUENCY LIMIT	The frequency limit *Frequency Switch-Off Limit* **417 (F OFF)** was exceeded. Check limit parameter.
F1300	EARTH FAULT	Earth fault at output. Check drive, motor and motor cabling.
F1301	IDC-COMPENSATION	Uneven load at output. Check motor and motor cabling.
F1310	MIN. CURRENT CONTROL	The Reference current was not reached. Check motor and motor connection.
F1401	ANALOG VALUE 1 MISSING	The reference value at analog input 1 is missing or is lower than 1 V. This fault switch-off only occurs when the operation mode of the analog input was set accordingly.
F1402	ANALOG VALUE 2 MISSING	The reference value at analog input 2 is missing or is lower than 1 V. This fault switch-off only occurs when the operation mode of the analog input was set accordingly.
F1403	ANALOG VALUE 3 MISSING	The reference value at analog input 3 is missing or is lower than 2 mA. This fault switch-off only occurs when the operation mode of the analog input was set accordingly.

Note: A fault can be acknowledged with the control input S8IND or the control unit KP 100 (see chapter 7.3.4).
A collective fault message can be output via the digital control outputs **S1OUT, S2OUT** or the relay output **S3OUT** (see chapter 7.5).

To facilitate troubleshooting both in the inverter as well as in a complete installation the inverter software contains various test routines to test internal and external hardware. These tests are used to discover defects in the inverter, in external sensors and the load (motor) as well as to discover wiring faults (see unit test chapter 5.6).

Apart from the error messages above, there are further error messages which however are only used for internal company purposes and are not listed here.
If you should receive error messages which are not mentioned in the above list; we will be pleased to advise you by telephone.

9. PARAMETER LISTS

9.1. DISPLAY PARAMETERS

Menu VAL (Actual values)						
No.	**Abbr.**	**Control level**	**Name/Meaning**	**Dim.**	**Display range**	**Chapter**
210	FS	**1**	Stator Frequency	Hz	0.00 ... 999.99	7.20.3.2
211	I RMS	**1**	R.m.s Current	A	0.0 ... I_{max}	7.20.3.2
212	U RMS	**1**	Output Voltage	V	0.0 ... 460.0	7.20.3.2
213	PW	**1**	Active Power	kW	0.0 ... o · P_{FIN}	7.20.3.2
214	IW	**1**	Active Current	A	0.0 ... I_{max}	7.20.3.2
222	UDC	**1**	DC-Link Voltage	V	0.0 ... 800.0	7.20.3.1
223	A	2	Modulation	%	0 ... 100	7.20.3.1
224	T	2	Torque	Nm	± 9999.9	7.20.3.2
228	FREF	2	Internal Reference Frequency [1)]	Hz	0.00 ... f_{max}	7.20.3.1
229	PCREF	2	Reference Percentage Value [2)]	%	± 300.00	7.20.3.1
230	APCV	2	Actual Percentage Value [2)]	%	± 300.00	7.20.3.1
238	FLUX	2	Flux Value	%	100.0	7.20.3.2
239	IB	2	Reactive Current	A	0.0 ... I_{max}	7.20.3.2
240	SPEED	**1**	Actual Speed	1/min	0 ... 60000	7.20.3.2
241	FREQ	**1**	Actual Frequency	Hz	0.00 ... 999.99	7.20.3.2
244	TWORK	**1**	Working Hours Counter	h	9999	7.20.3.1
245	TOP	**1**	Operation Hours Counter	h	9999	7.20.3.1
249	DSET	2	Active Data Set	-	1 ... 4	7.20.4.3
250	IND	**1**	Digital Inputs	-	8 Bit	7.20.4.1
251	INA1	**1**	Analog Input 1	V	± 10.00	7.20.4.2
252	INA2	**1**	Analog Input 2	V	± 10.00	7.20.4.2
253	INA3	**1**	Analog Input 3	mA	± 20.00	7.20.4.2
254	OUTD	**1**	Digital Outputs	-	8 Bit	7.20.4.4
255	TC	**1**	Heat Sink Temperature	°C	0.0 ... 100.0	7.20.3.1
256	TI	**1**	Inside Temperature	°C	0.0 ... 100.0	7.20.3.1
257	OUTA1	**1**	Analog Output 1	mA	± 20.0	7.20.4.5
259	ERROR	**1**	Current Error	-	F0000 ... F9999	7.20.5.1
269	WARN	**1**	Warnings	-	W0000 ... W9999	7.20.5.2
275	CTRST	3	Controller Status	-	C0000 ... C9999	7.20.4.6
285	Q	**1**	Volumetric flow	m^3/h	0 ... 99999	7.20.3.3
286	H	**1**	Pessure	kPa	0 ... 999.9	7.20.3.3

... Parameter can be switched over in the data set

[1)] Parameter of configuration 110
[2)] Parameter of configuration 111

Menu VAL (Actual value memory)						
No.	**Abbr.**	**Control level**	**Name/Meaning**	**Dim.**	**Display range**	**Chapter**
231	PHIXT	3	Peak Value IxT	%	0.00 ... 999.99	7.20.3.4
232	PHIDC	3	Peak Value IxT-DC	%	0.00 ... 999.99	7.20.3.4
287	UDMAX	3	Peak Value Vdc	V	0.0 ... 9999.9	7.20.3.4
288	UDAVG	3	Average Value Vdc	V	0.0 ... 9999.9	7.20.3.4
289	TCMAX	3	Peak Value Tc	°C	0.0 ... 99.9	7.20.3.4
290	TCAVG	3	Average Value Tc	°C	0.0 ... 99.9	7.20.3.4
291	TIMAX	3	Peak Value Ti	°C	0.0 ... 99.9	7.20.3.4
292	TIAVG	3	Average Value Ti	°C	0.0 ... 99.9	7.20.3.4
293	IMAX	3	Peak Value Irms	A	0.0 ... 9999.9	7.20.3.4
294	IAVG	3	Average Value Irms	A	0.0 ... 9999.9	7.20.3.4
295	PMAXP	3	Peak Value Active Power pos.	kW	0.0 ... + 9999.9	7.20.3.4
296	PMAXN	3	Peak Value Active Power neg.	kW	0.0 ... - 9999.9	7.20.3.4
297	PAVG	3	Average Value Active Power	kW	0.0 ... 9999.9	7.20.3.4
301	ENRGP	3	Energy, positive	kWh	0.0 ... + 99999	7.20.3.4
302	ENRGN	3	Energy, negativ	kWh	0.0 ... - 99999	7.20.3.4

9.2. ERROR MEMORY

Menu VAL (Error Memory)						
No.	**Abbr.**	**Control level**	**Name/Meaning**	**Dim.**	**Display range**	**Chapter**
310	ERR1	**1**	00000:00; Last Error	-	F0000 ... F9999	7.20.5.4
311	ERR2	**1**	00000:00; Last Error but one	-	F0000 ... F9999	7.20.5.4
312	ERR3	**1**	00000:00; Error 3	-	F0000 ... F9999	7.20.5.4
313	ERR4	**1**	00000:00; Error 4	-	F0000 ... F9999	7.20.5.4
314	ERR5	2	00000:00; Error 5	-	F0000 ... F9999	7.20.5.4
315	ERR6	2	00000:00; Error 6	-	F0000 ... F9999	7.20.5.4
316	ERR7	2	00000:00; Error 7	-	F0000 ... F9999	7.20.5.4
317	ERR8	2	00000:00; Error 8	-	F0000 ... F9999	7.20.5.4
318	ERR9	2	00000:00; Error 9	-	F0000 ... F9999	7.20.5.4
319	ERR10	2	00000:00; Error 10	-	F0000 ... F9999	7.20.5.4
320	ERR11	2	00000:00; Error 11	-	F0000 ... F9999	7.20.5.4
321	ERR12	2	00000:00; Error 12	-	F0000 ... F9999	7.20.5.4
322	ERR13	2	00000:00; Error 13	-	F0000 ... F9999	7.20.5.4
323	ERR14	2	00000:00; Error 14	-	F0000 ... F9999	7.20.5.4
324	ERR15	2	00000:00; Error 15	-	F0000 ... F9999	7.20.5.4
325	ERR16	2	00000:00; Error 16	-	F0000 ... F9999	7.20.5.4
362	ESUM	3	No. of Errors	-	0 ... 32767	7.20.5.3

... Parameter can be switched over in the data set

[1)] Parameter of configuration 110
[2)] Parameter of configuration 111

9.3. ERROR ENVIRONMENT

Menu VAL (Error Environment)						
No.	**Abbr.**	**Control level**	**Name/Meaning**	**Dim.**	**Display range**	**Chapter**
330	EUDC	3	DC-Link Voltage	V	0.0 ... 800.0	7.20.6.2
331	EURMS	3	Output Voltage	V	0.0 ... 460.0	7.20.6.2
332	EFS	3	Stator Frequency	Hz	0.00 ... 999.99	7.20.6.2
333	EEC1	3	Speed Sensor 1 Frequency	Hz	0.00 ... 999.99	7.20.6.2
334	EEC2	3	Speed Sensor 2 Frequency	Hz	0.00 ... 999.99	7.20.6.2
335	EIA	3	Phase Current Ia	A	0.0 ... I_{max}	7.20.6.2
336	EIB	3	Phase Current Ib	A	0.0 ... I_{max}	7.20.6.2
337	EIC	3	Phase Current Ic	A	0.0 ... I_{max}	7.20.6.2
338	EIRMS	3	Effective Current	A	0.0 ... I_{max}	7.20.6.2
339	EISD	3	Isd / Reactive Current	A	0.0 ... I_{max}	7.20.6.2
340	EISQ	3	Isq / Active Current	A	0.0 ... I_{max}	7.20.6.2
341	EIMR	3	Rotor Magnetising Current	A	0.0 ... I_{max}	7.20.6.2
342	ET	3	Torque	Nm	± 9999.9	7.20.6.2
343	EINA1	3	Analog Input 1	V	± 10.0	7.20.6.2
344	EINA2	3	Analog Input 2	V	± 10.0	7.20.6.2
345	EINA3	3	Analog Input 3	mA	± 20.0	7.20.6.2
346	EOUT1	3	Analog Output 1	mA	± 20.0	7.20.6.2
347	EOUT2	3	Analog Output 2	mA	± 20.0	7.20.6.2
348	EOUT3	3	Analog Output 3	mA	± 20.0	7.20.6.2
349	EFO	3	Repetition Frequency Output	Hz	0.00 ... 999.99	7.20.6.2
350	EIND	3	Status of Digital Inputs	-	00 ... FF	7.20.6.2
351	EOUTD	3	Status of Digital Outputs	-	00 ... 07	7.20.6.2
352	ETIME	3	Time since Release	h.m.ms	00000:00:00.000	7.20.6.2
353	ETC	3	Heat Sink Temperature	°C	0.0	7.20.6.2
354	ETI	3	Inside Temperature	°C	0.0	7.20.6.2
355	EC	3	Controller Status	-	C0000 ... CFFFF	7.20.6.2
356	EW	3	Warning Status	-	W0000 ... W9999	7.20.6.2
357	EI1	3	Int Value 1	-	± 32768	7.20.6.2
358	EI2	3	Int Value 2	-	± 32768	7.20.6.2
359	EF1	3	Long Value 1	-	± 2147483647	7.20.6.2
360	EF2	3	Long Value 2	-	± 2147483647	7.20.6.2
361	CHSUM	3	Checksum	-	OK / NOK	7.20.6.1

... Parameter can be switched over in the data set

[1)] Parameter of configuration 110
[2)] Parameter of configuration 111

Note: The error environment can be read out over the control unit KP100 for the last occurred error. The optionally available PC program (see chapter 4.2) facilitates the selection to the error environment of the last four errors in the available data sets.

9.4. COMMISSIONING PARAMETERS

No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
Production data								
0	SN	2	Serial Number	-	Character	7.20.2.1	-	
1	OPT	2	Optional Modules	-	Character	7.20.2.2	-	
Specific Data								
10	BAUD	2	Baud Rate	-	Selection	7.17.10	3	
12	VERS	2	Inverter Software Version	-	Character	7.20.2.3	-	
27	PASSW	**1**	Set Password	-	0 ... 999	7.19.2	0	
28	MODE	**1**	Control Level	-	1 ... 3	7.19.1	1	
29	NAME	2	User Name	-	33 Characters	7.20.1	-	
Configuration data								
30	CONF	**1**	Configuration	-	Selection	7.1	110	
33	LANG	**1**	Language	-	Selection	7.19.4	0	
34	PROG	**1**	Program	-	123: Reset 4444: Fact. setting	7.19.3	4443	
39	TVENT	2	Fan Switch-On Temperature	°C	0 ... 75	7.17.8	0	
Actual value memory								
237	PHCLR	3	Reset Memory	-	Selection	7.20.3.4	0	
Motor data								
370	MUR	DS1 ... DS4 **1**	Rated Voltage	V	60.0 ... 800.0	7.6	400.0	
371	MIR	DS1 ... DS4 **1**	Rated Current	A	$0.01 \cdot I_{FIN}$ ... $10 \cdot o \cdot I_{FIN}$	7.6	I_{FIN}	
372	MNR	DS1 ... DS4 **1**	Rated Speed	min^{-1}	96 ... 60000	7.6	1490	
373	MPP	DS1 ... DS4 **1**	No. of Pole pairs	-	1 ... 24	7.6	2	
374	MCOPR	DS1 ... DS4 **1**	Rated Cosinus Phi	-	0.01 ... 1.00	7.6	0.85	
375	MFR	DS1 ... DS4 **1**	Rated Frequency	Hz	10.00 ... 1000.00	7.6	50.00	
376	MPR	DS1 ... DS4 **1**	Rated Mech. Power	kW	$0.1 \cdot P_{FIN}$ ... $10 \cdot P_{FIN}$	7.6	P_{FIN}	
377	RS	DS1 ... DS4 2	Stator Resistance [3]	mΩ	0 ... 6000	7.6	FI type	
System data								
397	QR	DS1 ... DS4 **1**	Nominal volumetric flow	m3/h	1 ... 99999	7.7	10	
398	HR	DS1 ... DS4 **1**	Nominal pressure	kPa	0.1 ... 999.9	7.7	100.0	
Pulse width modulation								
400	FT	**1**	Switching Frequency	kHz	1 ... 8	7.17.9.1	FI type	
402	PWCOM	2	Switching Compensation	%	0 ... 200	7.17.9.2	50	

DS1 ... DS4 ... Parameter can be switched over in the data set

[1] Parameter of configuration 110
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[3] Parameter setting via set-up

No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
General functions								
403	IDYN	3	Dyn. phase current limit	A	0.0 ... o · I_{FIN}	7.17.5	0.0	
Error and warning behaviour								
405	WIXTD	3	Warning limit IxT DC	%	6 ... 100	7.18.1	80	
406	WIXT	3	Warning limit IxT	%	6 ... 100	7.18.1	80	
407	WTC	3	Warning limit Tk	°C	-25 ... 0	7.18.1	-5	
408	WTI	3	Warning limit Ti	°C	-25 ... 0	7.18.1	-5	
409	CTMSG	3	Controller-Status Message	-	Selection	7.18.5	1	
Communication interface								
412	REMOT	DS1 ... DS4 3	Local Remote-Flag	-	Selection	7.17.10	0	
413	WDOG	3	RS232/RS485 Watchdog Timer	s	0 ... 10000	7.17.10	0	
Error and warning behaviour								
415	DCCMX	3	IDC Compensation Limit	V	0.0 ... 1.5	7.18.4	1.5	
416	IEOFF	3	Earth Fault Switch-Off Limit	A	0.0 ... o · I_{FIN}	7.18.3	0.25 · I_{FIN}	
417	F OFF	2	Frequency Switch-off Limit	Hz	0.00 ... 999.99	7.18.2	999.99	
Frequencies / Ramps								
418	FMIN	DS1 ... DS4 **1**	Minimum Frequency	Hz	0.00 ... 999.99	7.2.2.1	3.50	
419	FMAX	DS1 ... DS4 **1**	Maximum Frequency	Hz	0.00 ... 999.99	7.2.2.1	50.00	
420	RACCR	DS1 ... DS4 **1**	Acceleration Clockwise	Hz/s	0.01 ... 9999.99	7.15	1.00	
421	RDECR	DS1 ... DS4 **1**	Deceleration Clockwise	Hz/s	0.01 ... 9999.99	7.15	1.00	
422	RACCL	DS1 ... DS4 **1**	Acceleration Anticlockwise	Hz/s	0.01 ... 9999.99	7.15	1.00	
423	RDECL	DS1 ... DS4 **1**	Deceleration Anticlockwise	Hz/s	0.01 ... 9999.99	7.15	1.00	
424	RDNCR	DS1 ... DS4 **1**	Emergency Stop Clockwise	Hz/s	0.01 ... 9999.99	7.15	1.00	
425	RDNCL	DS1 ... DS4 **1**	Emergency Stop Anticlockwise	Hz/s	0.01 ... 9999.99	7.15	1.00	
426	RFMX	DS1 ... DS4 3	Maximum Leading	Hz	0.01 ... 999.99	7.15	5.00	
430	RRTR	DS1 ... DS4 **1**	Ramp Rise Time Clockwise	ms	0 ... 65000	7.15	100	
431	RFTR	DS1 ... DS4 **1**	Ramp Fall Time Clockwise	ms	0 ... 65000	7.15	100	
432	RRTL	DS1 ... DS4 **1**	Ramp Rise Time Anticlockwise	ms	0 ... 65000	7.15	100	
433	RFTL	DS1 ... DS4 **1**	Ramp Fall Time Anticlockwise	ms	0 ... 65000	7.15	100	

DS1 ... DS4 ... Parameter can be switched over in the data set

1) Parameter of configuration 110
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3) Parameter setting via set-up

Technology Controller [2]								
No.	**Abbr.**	**Ctrl. level**	**Name / Meaning**	**Dim.**	**Display range**	**Chapter**	**Fact. setting**	**Cust. setting**
440	TCSEL	DS1 ... DS4 1	Oper. mode technology controller [2]	-	Selection	7.16.5	0-Off	
441	TCFF	DS1 ... DS4 1	Fixed frequency [2]	Hz	± 999.99	7.16.5	0.00	
442	TCPMX	DS1 ... DS4 1	Max. P-component [2]	Hz	0.01...999.99	7.16.5	50.00	
443	TCHYS	DS1 ... DS4 1	Hysteresis [2]	%	0.01...100.00	7.16.5	10.00	
444	TCV	DS1 ... DS4 1	Amplification [2]	-	± 15.00	7.16.5	1.00	
445	TCTI	DS1 ... DS4 1	Integral time [2]	ms	0...32767	7.16.5	200	
446	KV	DS1 ... DS4 1	Ind. Volumetric Flow Control Factor	-	0.10...2.00	7.16.5	1.00	
Blocking frequency [1]								
447	FB1	DS1 ... DS4 2	1. Stop frequency [1]	Hz	0.00...999.99	7.17.4	0.00	
448	FB2	DS1 ... DS4 2	2. Stop frequency [1]	Hz	0.00...999.99	7.17.4	0.00	
449	FBHYS	DS1 ... DS4 2	Frequency-Hysteresis [1]	Hz	0.00...100.00	7.17.4	0.00	
Analog Inputs								
450	TBLOW	2	Zero-Point Tolerance Band	%	0.00 ... 25.00	7.2.3	2.00	
451	TBUPP	2	End-Point Tolerance Band	%	0.00 ... 25.00	7.2.3	2.00	
452	A1SEL	2	Op. Mode Analog Input 1	-	Selection	7.2.1	1	
453	A1SET	DS1 ... DS4 2	Upp. End Point A1	V	-6.00 ... 10.00	7.2.4	10.00	
454	A1OFF	DS1 ... DS4 2	Zero Point A1	V	± 8.00	7.2.4	0.00	
460	A2SEL	2	Op. Mode Analog Input 2	-	Selection	7.2.1	1	
461	A2SET	DS1 ... DS4 2	Upper End Point A2	V	-6.00 ... 10.00	7.2.4	10.00	
462	A2OFF	DS1 ... DS4 2	Zero Point A2	V	± 8.00	7.2.4	0.00	
470	A3SEL	2	Op. mode Analog input 3	-	Selection	7.2.1	1	
471	A3SET	DS1 ... DS4 2	Upper End point A3	mA	-12.00...20.00	7.2.4	20.00	
472	A3OFF	DS1 ... DS4 2	Zero Point A3	mA	± 16.00	7.2.4	0.00	
Reference and Actual Value Source								
474	MPOTI	2	Operation mode Motorpoti	-	Selection	7.3.3.2	0	
475	RFSEL	DS1 ... DS4 1	Reference Frequency Source [1]	-	Selection	7.11	5	
476	RPSEL	DS1 ... DS4 1	Reference Percentage Source [2]	-	Selection	7.12	101	
477	PCINC	DS1 ... DS4 1	Ramp Gradient Percentage [2]	%/s	0 ... 60000	7.13	10	
478	APSEL	DS1 ... DS4 1	Actual Percentage Source [2]	-	Selection	7.14	2	

DS1 ... DS4 ... Parameter can be switched over in the data set

[1] Parameter of configuration 110
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Fixed Frequency [1]								
No.	**Abbr.**	**Ctrl. level**	**Name / Meaning**	**Dim.**	**Display range**	**Chapter**	**Fact. setting**	**Cust. setting**
480	FF1	DS1 ... DS4 1	Fixed frequency 1 [1]	Hz	± 999.99	7.3.3.1	5.00	
481	FF2	DS1 ... DS4 1	Fixed frequency 2 [1]	Hz	± 999.99	7.3.3.1	10.00	
482	FF3	DS1 ... DS4 1	Fixed frequency 3 [1]	Hz	± 999.99	7.3.3.1	25.00	
483	FF4	DS1 ... DS4 1	Fixed frequency 4 [1]	Hz	± 999.99	7.3.3.1	50.00	
Brake Chopper								
506	UD BC	3	Trigger treshold brake chopper	V	425.0 ... 1000.0	7.17.7	725.0	
Comparator – Value								
510	FTRIG	DS1 ... DS4 2	Setting frequency	Hz	0.00 ... 999.99	7.5.1	3.00	
Percentage Values [2]								
518	PRMIN	DS1 ... DS4 1	Min. Reference Percentage Value [2]	%	0.00 ... 300.00	7.2.2	0.00	
519	PRMAX	DS1 ... DS4 1	Max. Reference Percentage Value [2]	%	0.00 ... 300.00	7.2.2	100.00	
520	FP1	DS1 ... DS4 1	Fixed Percentage Value 1 [2]	%	± 300.00	7.3.3.1	10.00	
521	FP2	DS1 ... DS4 1	Fixed Percentage Value 2 [2]	%	± 300.00	7.3.3.1	20.00	
522	FP3	DS1 ... DS4 1	Fixed Percentage Value 3 [2]	%	± 300.00	7.3.3.1	50.00	
523	FP4	DS1 ... DS4 1	Fixed Percentage Value 4 [2]	%	± 300.00	7.3.3.1	100.00	
Digital and Relay Outputs								
530	D1SEL	2	Operation mode Digital output 1	-	Selection	7.5	4	
531	D2SEL	2	Op. Mode Digital Output 2	-	Selection	7.5	2	
532	D3SEL	2	Op. Mode Digital Output 3	-	Selection	7.5	103	
540	C1SEL	2	Op. Mode Comparator 1	-	Selection	7.5	1	
541	C1ON	2	Comparator On above	%	± 300.00	7.5.6	100.00	
542	C1OFF	2	Comparator Off below	%	± 300.00	7.5.6	50.00	
543	C2SEL	2	Op. Mode Comparator 2	-	Selection	7.5.6	1	
544	C2ON	2	Comparator On above	%	± 300.00	7.5.6	100.00	
545	C2OFF	2	Comparator Off below	%	± 300.00	7.5.6	50.00	
549	DEVMX	2	Max. Control Deviation	%	0.01 ... 20.00	7.5.2	5.00	

DS1 ... DS4 ... Parameter can be switched over in the data set

[1] Parameter of configuration 110
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[3] Parameter setting via set-up

Analog Output								
No.	**Abbr.**	**Ctrl. level**	**Name / Meaning**	**Dim.**	**Display range**	**Chapter**	**Fact. setting**	**Cust. setting**
550	O1SEL	**1**	Oper. mode Analog Output 1	-	Selection	7.4.1	1	
551	O1OFF	**1**	Zero Adjustment A1	%	± 100.0	7.4.2.1	0.0	
552	O1SC	**1**	Amplification A1	%	5.0 ... 1000.0	7.4.2.2	100.0	
Motor protective switch								
571	MSEL	DS1 ... DS4 2	Oper. mode Motor Protective Switch	-	Selection	7.17.6	0-Off	
Intelligent current limits								
573	LISEL	DS1 ... DS4 **1**	Oper. mode intelligent current limits	-	Selection	7.16.1	31	
574	LIPR	DS1 ... DS4 **1**	Power Limit	%	40.00 ... 95.00	7.16.1	80.00	
575	LID	DS1 ... DS4 **1**	Limitation Time	min	5 ... 300	7.16.1	15	
V - Belt monitoring								
573	BMSEL	DS1 ... DS4 **1**	Oper. mode V - Belt monitoring	-	Selection	7.17.2	0-Off	
574	BMTLI	DS1 ... DS4 **1**	Trigger Limit Iactive	%	0.1 ... 100.0	7.17.2	10.0	
575	BMTD	DS1 ... DS4 **1**	Delay Time	s	0.1 ... 600.0	7.17.2	10.0	
V/f – Characteristic								
600	US	DS1 ... DS4 **1**	Starting voltage **3)**	V	0.0 ... 100.0	7.8	5.0	
601	UK	DS1 ... DS4 **1**	Voltage Rise **3)**	%	-100 ... 200	7.8	10	
602	FK	DS1 ... DS4 **1**	Rise frequency **3)**	%	0 ... 100	7.8	20	
603	UC	DS1 ... DS4 **1**	Cut-off voltage **3)**	V	60.0 ... 530.0	7.8	400.0	
604	FC	DS1 ... DS4 **1**	Cut-off frequency **3)**	Hz	0.00 ... 999.99	7.8	50.00	
Voltage Pre-Control								
605	UDYN	DS1 ... DS4 3	Dyn. voltage pre-control	%	0 ... 200	7.8.1	100	
Current Limit Controller								
610	ILSEL	DS1 ... DS4 **1**	Oper. mode Current limit value controller	-	0: Off / 1: On	7.16.2	1-On	
611	ILV	DS1 ... DS4 3	Amplification	-	0.01 ... 30.00	7.16.2	1.00	
612	ILTI	DS1 ... DS4 3	Integral Time	ms	1 ... 10000	7.16.2	24	
613	ILIMX	DS1 ... DS4 **1**	Current Limit **3)**	A	0.0 ... o · I_{FIN}	7.16.2	o · I_{FIN}	
614	ILFMN	DS1 ... DS4 3	Frequency Limit **3)**	Hz	0.00 ... 999.99	7.16.2	0.00	

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Starting Behaviour								
No.	**Abbr.**	**Ctrl. level**	**Name / Meaning**	**Dim.**	**Display range**	**Chapter**	**Fact. setting**	**Cust. setting**
620	STSEL	DS1 ... DS4 **1**	Operation Mode Start function	-	Selection	7.9	14	
621	STV	DS1 ... DS4 3	Amplification	-	0.01 ... 10.00	7.9.2	1.00	
622	STTI	DS1 ... DS4 3	Integral Time	ms	1 ... 30000	7.9.2	50	
623	STI	DS1 ... DS4 **1**	Starting Current **3)**	A	$0.0 \cdot I_{FIN}$ ... $o \cdot I_{FIN}$	7.9.2	I_{FIN}	
624	STFMX	DS1 ... DS4 2	Frequency Limit **3)**	Hz	0.00 ... 100.00	7.9.2	2.60	

Stopping behaviour								
630	DISEL	DS1 ... DS4 **1**	Operation mode stopping function	-	Selection	7.10	11	
631	DC IB	DS1 ... DS4 2	Braking current **3)**	A	0.00 ... $\sqrt{2} \cdot I_{FIN}$	7.10.1	$\sqrt{2} \cdot I_{FIN}$	
632	DC TB	DS1 ... DS4 2	Braking time	s	0.0 ... 200.0	7.10.1	10.0	
633	DC TD	DS1 ... DS4 2	Demagnetising time	s	0.1 ... 30.0	7.10.1	5.0	
634	DC V	DS1 ... DS4 3	Amplification	-	0.00 ... 10.00	7.10.1	1.00	
635	DC TI	DS1 ... DS4 3	Integral time	ms	0 ... 1000	7.10.1	50	
637	DIOFF	DS1 ... DS4 2	Switch-Off Thresh-old Stopping func-tion	%	0.0 ...100.0	7.10	1.0	
638	DI T	DS1 ... DS4 2	Holding Time Stopping function	s	0.0 ... 200.0	7.10	1.0	

Autostart / Synchronisation								
645	SYSEL	DS1 ... DS4 **1**	Operation mode synchronisation	-	Selection	7.17.3	0-Off	
646	SYTB	DS1 ... DS4 2	Braking time after search run	s	0.0 ... 200.0	7.17.3	10.0	
647	SYIS	DS1 ... DS4 2	Current / Rated motor current	%	1.00 ... 100.00	7.17.3	70.00	
648	SYV	DS1 ... DS4 3	Amplification	-	0.00 ... 10.00	7.17.3	1.00	
649	SYTI	DS1 ... DS4 3	Integral Time	ms	0 ... 1000	7.17.3	20	
651	ASSEL	**1**	Operation mode Autostart	-	0: Off / 1: On	7.17.1	0-Off	

Slip Compensation **1)**								
660	SLSEL	DS1 ... DS4 **1**	Operation mode slip compensation **1)**	-	0: Off / 1: On	7.16.4	0-Off	
661	SLV	DS1 ... DS4 3	Amplification **1)**	%	0.0 ... 300.0	7.16.4	100.0	
662	SLR	DS1 ... DS4 3	maximum Slip ramp **1)**	Hz/s	0.01 ... 650.00	7.16.4	5.00	
663	SLFMN	DS1 ... DS4 2	Min. frequency **1)**	Hz	0.01 ... 999.99	7.16.4	2.50	

DS1 ... DS4 ... Parameter can be switched over in the data set

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Voltage Controller								
No.	**Abbr.**	**Ctrl. level**	**Name / Meaning**	**Dim.**	**Display range**	**Chapter**	**Fact. setting**	**Cust. setting**
670	UDSEL	DS1 ... DS4 2	Operation mode voltage controller	-	Selection	7.16.3	3	
671	UDTRG	3	Threshold power failure	V	-200.0 ... -50.0	7.16.3	-100.0	
672	UDU1	3	Reference Value power regulation	V	-200.0... -10.0	7.16.3	-40.0	
673	UDDEC	DS1 ... DS4 3	Deceleration power regulation	Hz/s	0.01 ... 9999.99	7.16.3	50.00	
674	UDACC	DS1 ... DS4 2	Acceleration on re-sumption of power	Hz/s	0.00 ... 9999.99	7.16.3	0.00	
675	UDOFF	DS1 ... DS4 2	Threshold shutdown	Hz	0.00 ... 999.99	7.16.3	0.00	
676	UDU2	3	Ref. value shutdown	V	425.0 ... 725.0	7.16.3	680.0	
677	UDV	DS1 ... DS4 3	Amplification	-	0.00 ... 30.00	7.16.3	1.00	
678	UDTI	DS1 ... DS4 3	Integral Time	ms	0 ... 10000	7.16.3	8	
680	UDLIM	3	Reference Value Ud-Limitation	V	425.0 ... 725.0	7.16.3	680.0	
681	UDFMX	3	max. frequency rise	Hz	0.00 ... 999.99	7.16.3	10.00	

DS1 ... DS4 ... Parameter can be switched over in the data set

[1] Parameter of configuration 110
[2] Parameter of configuration 111

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