
Static frequency inverters **VCB 400**



2C

Installation /
Machine designation:
Frequency inverter Type:
Serial-No.:

**Operating instructions Part 2C,
sensor - less field orientated control,
speed controlled in configuration 410
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
Item No. of the operating instructions 051 005 020
Version: February 2000

A 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 2C control section and parameterisation** describes the configuration 410 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 2C Control section and parameterisation**.

According to the customised request of the frequency inverter, there are also device versions with special 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.



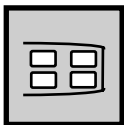
⇒ Caution! Disconnect the unit from the mains before performing any operation and wait at least 5 minutes until the intermediate circuits capacitors have discharged to a safe residual voltage.



⇒ Prohibited! Wrong handling may lead to damaging 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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A.1 WEITERE HINWEISE

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B 10 STEPS TO COMMISSIONING

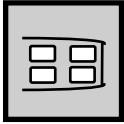
WHAT DO I DO ?	WHERE DO I FIND IT ?
Mount the inverter.	Operating instructions part 1
Connect the mains supply and the motor.	Operating instructions part 1
Check all control connections.	Operating instructions part 2C, chapter 6
Find out about the handling of the KP 100 control unit.	Operating instructions part 2C chapters 8
Switch on the mains voltage.	Operating instructions part 2C chapter 9.1
Carry out the guided commissioning	Operating instructions part 2C chapter 9.2
Check the basic setting or make alterations with the KP 100.	Operating instructions part 2C chapter 9.2.9
Carry out the first function test.	Operating instructions part 2C chapter 9.3
Perhaps correct the basic setting.	Operating instructions part 2C chapter 9
Perhaps optimise by adding additional functions.	Operating instructions part 2C chapter 10

6 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 and the internal connection of the software modules can be determined. These fixed assignments can be selected with the parameter *Configuration 30 (CONF)* (Chapter 10.1).

These operating instructions will describe the control connection assignments and parameterisation (Chapter 10) for the configuration

- **sensor-less field-oriented control (DMR), speed-controlled (configuration 410)**

from the variety of possible fixed assignments.



Note: **Configuration 110**, which should be chosen for a simplified commissioning, is described in the **Operating instructions Part 2** V/f – characteristic control without and with technology controller.

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 the construction and layout drawing in the Operating instructions Part 1)

6.1 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 from the firm of 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 terminals¹⁾ MC1.5 G-3.81 and²⁾ 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 (+/-4 mA ... +/-20 mA), Ri = 100 Ohm, resolution 12 bit
X211-8	Prog. analog output S1OUTAI, current output, current range 0 mA ... +/-20 mA (+/-4 mA ... +/-20 mA), max. load resistance 500 Ohm, resolution 10 bit



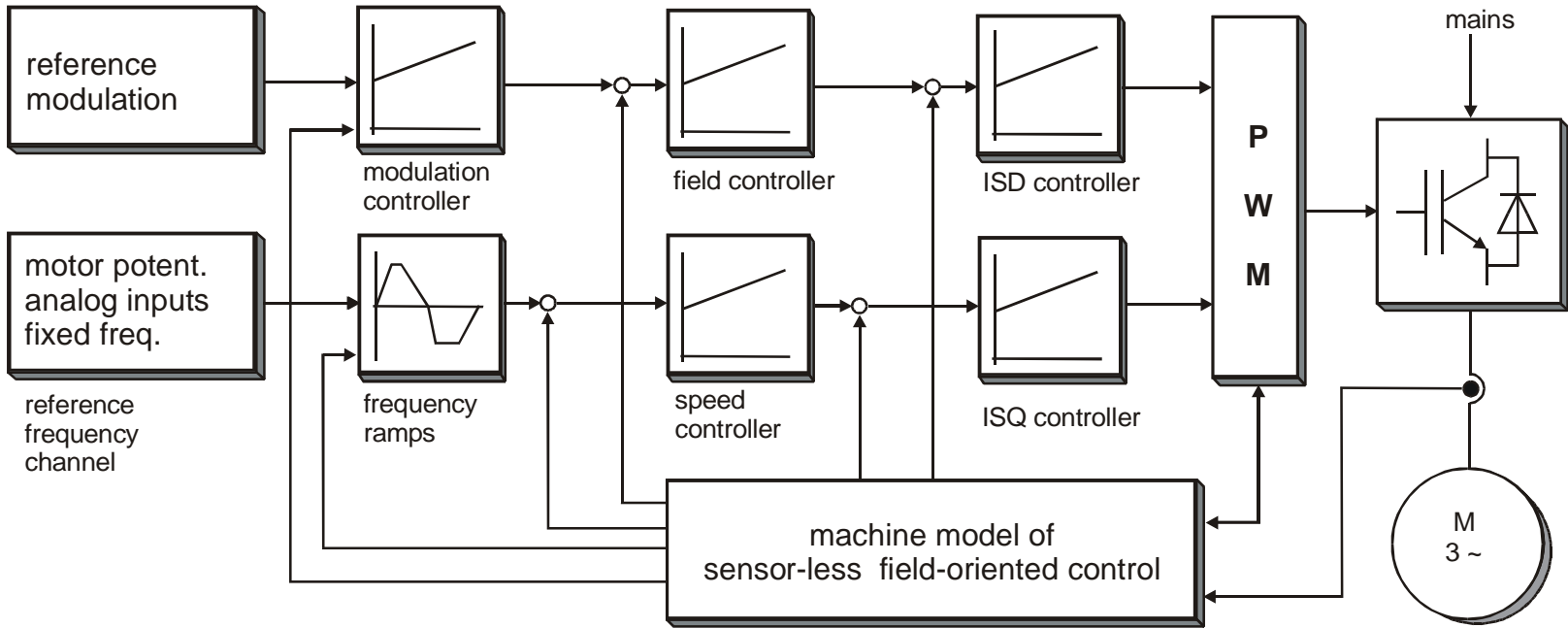
Caution: In the case of reference value and actual value cables which are longer than 4 m and reference and actual value sources with different potentials or which require a high common load rejection, isolation amplifiers are to be used for the potential isolation.

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 controller 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 purely ohmic
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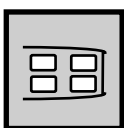
Configuration 410

Function:

- Reference frequency channel
- Frequency ramps
- Speed controller
- ISD and ISQ controller
- Field controller
- Modulation controller
- Auto-start
- Switching frequency
- Progr. Digital outputs
- Progr. analog outputs

- Setting of the reference speed source (chapter 10.9)
- Setting the acceleration, ramp rise/fall and deceleration time (chapter. 10.10.)
- Control of the drive speed (chapter. 10.11.3)
- Current controller for torque-forming and flux-forming current (chapter. 10.11.2)
- Control of the magnetic flow in the load (chapter. 10.11.5)
- Limiting the modulation above the parameterised rated frequency (chapter 10.11.2)
- Starting the inverter with main power up (chapter. 10.12.1)
- Reduction of the motor noise (chapter. 10.12.7)
- Setting of the messages for the external control (chapter. 10.5)
- Setting of the signals for the external control (chapter. 10.4)

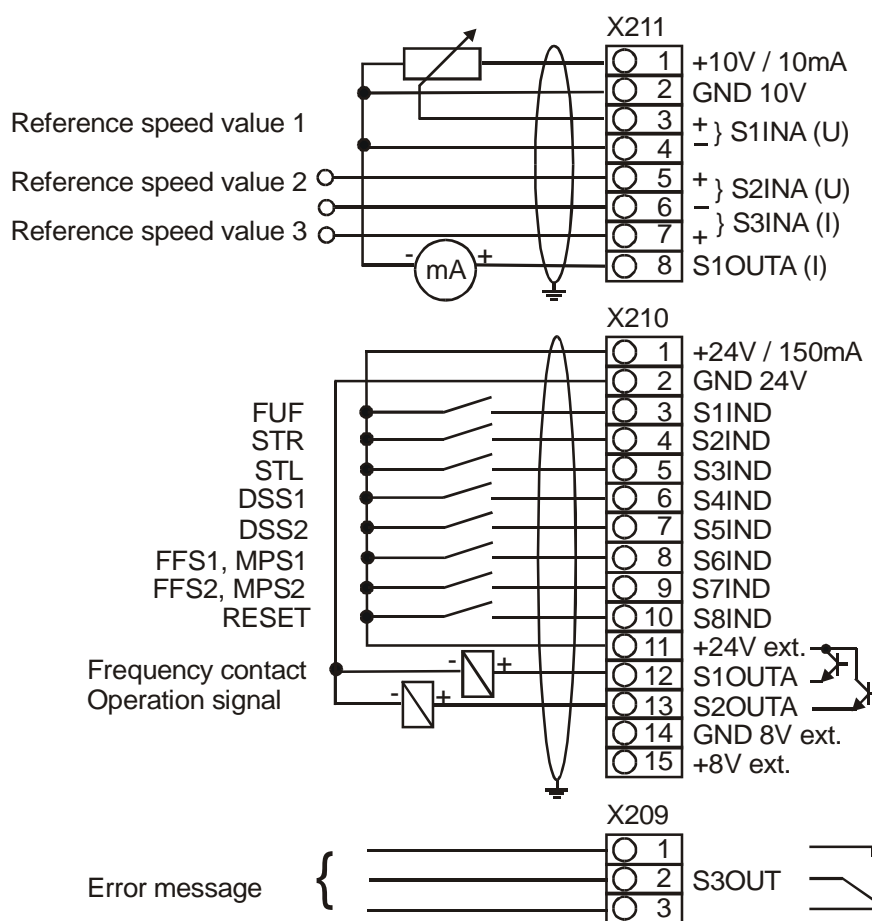
6.2.2 CONTROL TERMINAL CONNECTION PLAN FOR CONFIGURATION 410



For this connection plan the parameter *Configuration 30 (CONF)* must be set to value **410** with the control unit KP 100 (see chapter 10. 1). The sensor-less field-oriented 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 10.1).



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**.

6.2.3 EXPLANATION OF THE CONNECTION PLAN FOR CONFIGURATION 410

ANALOG INPUTS AND OUTPUTS, TERMINAL STRIP X211				
Class	Class symbol	Function	Explanation/Use	Chapter
1	+10 V	-	Reference voltage for reference value potentiometer	-
2	GND 10 V	-	Ground 10 V	-
3/4	S1INA	-	Nom. speed value input 1, 4.7-10 kOhm Potentiometer or 0 V ... +/-10 V	10.2
5/6	S2INA	-	Nom. speed value input 2	10.2
7/6	S3INA	-	Nom. speed value input 3. 0 mA ... +/-20 mA	10.2
8	S1OUTAI	-	Actual value output 0 mA ... +/-20 mA proportional to the <i>Stator Frequency 210 (FS)</i> , reference point terminal 2 (Ground/GND 10V)	10.4

DIGITAL INPUTS AND OUTPUTS, TERMINAL STRIP X210				
Class	Class symbol	Function	Explanation/Use	Chapter
1	+24 V	-	Supply voltage for digital inputs and outputs	-
2	GND 24 V	-	Ground 24 V	-
3	S1IND	FUF	Controller release	10.3.1
4	S2IND	STR	Start clockwise	10.3.1
5	S3IND	STL	Start anti-clockwise	10.3.1
6	S4IND	DSS1	Data set changeover	10.3.2
7	S5IND	DSS2	Data set changeover	10.3.2
8	S6IND	FFS1, MPS1	Fixed frequencies or motor potentiometer upwards	10.3.3
9	S7IND	FFS2, MPS2	Fixed frequencies or motor potentiometer downwards	10.3.3
10	S8IND	RESET	Acknowledge error message	10.3.4
11	+24 V EXT	-	Ext. supply input for S1OUT and S2OUT	-
12	S1OUT	-	Control output HIGH active, frequency contact 210 (FS) > 510 (FTRIG) (0 Hz factory setting)	10.5
13	S2OUT	-	Control output HIGH active, operation message, drive runs	10.5
14	GND 8 V	-	Ground 8 V ext.	-
15	+8 V EXT	-	Ext. supply input +8V for universal controller	-

RELAY OUTPUT, TERMINAL STRIP X209				
Class	Class symbol	Function	Explanation/Use	Chapter
1	S3OUT	-	Relay output make contact, error message, opened	10.5
2	S3OUT	-	Relay root contact	10.5
3	S3OUT	-	Relay output break contact, error message, closed	10.5

Function not activated in the factory

7 OPTIONAL COMPONENTS

7.1 EXPANSION OF THE FREQUENCY INVERTER

a) 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 analogue control outputs. There is additionally the connection of a motor temperature monitoring by a thermistor (PTC) or a bimetallic sensor.

b) 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.

c) Motor PTC connection VCM-PTC

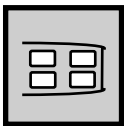
The connection to the expansion card motor PTC connection VCM-PTC is led to the terminal strip X455. Motor temperature monitoring is possible with the connection of a thermistor (PTC) or bimetallic sensor.

d) 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

7.2 PC CONNECTION



To parameterise, document, monitor and administer the settings right up to commissioning using PC and laptop a user interface is available.

For the connection of the PC to the inverter an **interface converter**, available as an option, is necessary. The connection is effected at the plug X215.

(connection for the KP 100 control unit, see construction and layout drawing)

Further information supplied on demand.

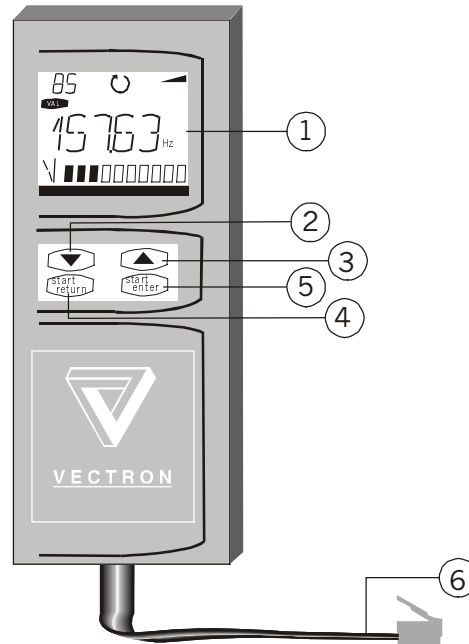
8 HANDLING THE CONTROL UNIT KP 100

8.1 CONNECTION AND FIXING OF THE KP 100

The KP 100 control unit is connected at plug X215 (see Operating instructions Part 1, construction and layout drawing chapter 2.1).

The control unit can be fixed under the inverter cover. Please remove the removable lid in the cover for this purpose.

8.2 LAYOUT DRAWING AND TECHNICAL DATA



Elements of the KP100		
Pos.	Description	Function
1	LCD 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, max. length 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

8.3 GENERAL INFORMATION

8.3.1 MENU BRANCHES

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

The inverter completes this with a direct jump to the current actual value of the calculated output frequency (background of display is illuminated green).



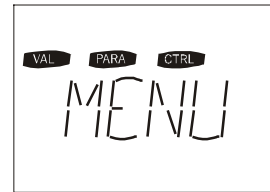
Note: This pre-set display value *Actual Frequency* **241 (FREQ)** can be adapted to your individual needs by selecting a different actual value in the menu branch VAL.

The menu branch VAL is active. Press the start/return key twice to change the display to menu and open 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



8.3.2 KEY FUNCTIONS

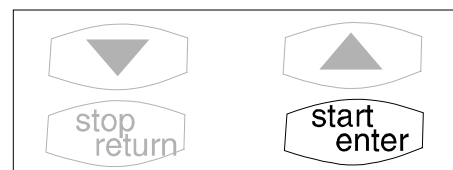
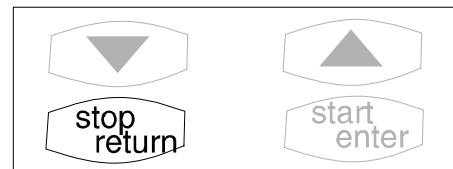
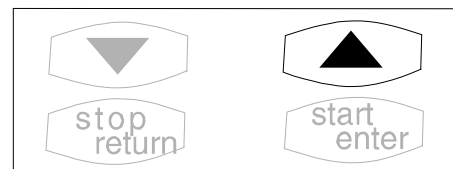
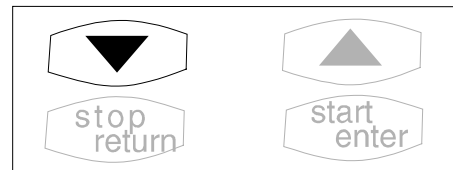
The arrow keys are used to select menu branches and individual parameters and change their values..

Press once in the main menu to jump to the next menu branch or in the sub-menus to jump to the next parameter. Press the key within the parameter level to make the smallest possible change to the parameter value.

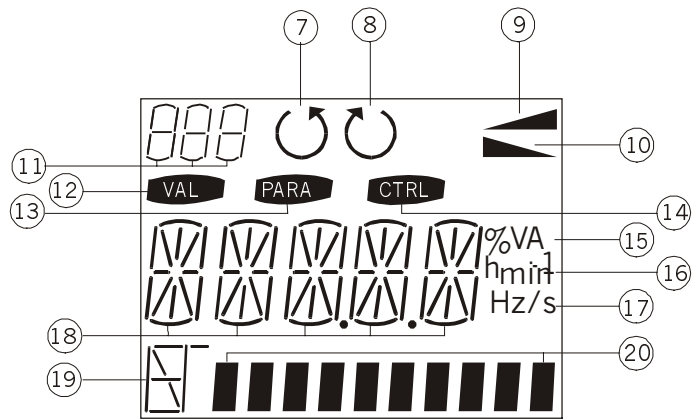
If the key is held down an automatic run (scrolling) starts which can be stopped by releasing the key.

Quit the menu branches or abort parameter changes (old value is retained) with the stop/return key.

Menu branches or parameters are called up or their changes stored with the start/enter key.



8.3.3 LC DISPLAY

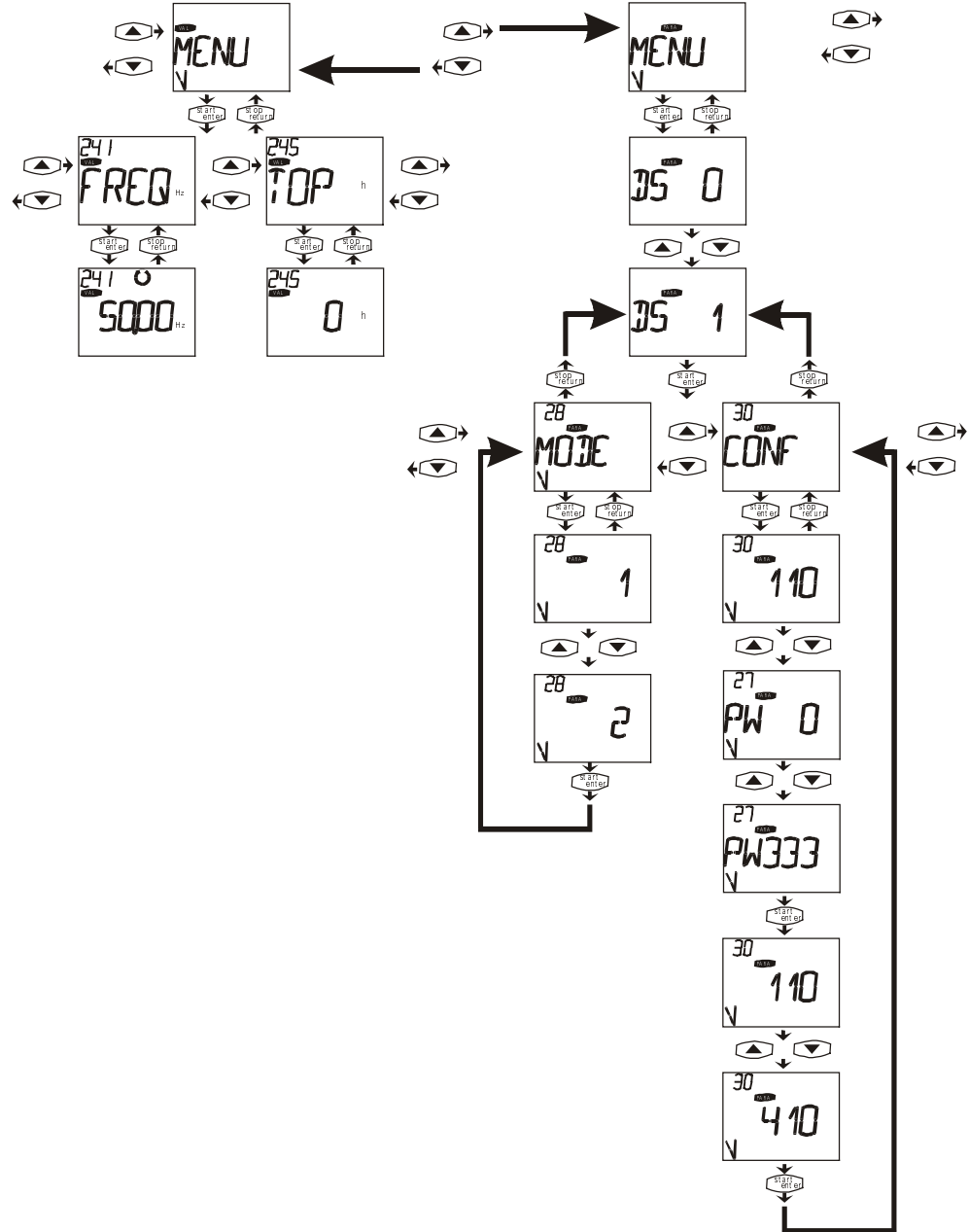


Displays on the KP100		
Pos.	Description	Function
7	Anti-clockwise rotation	Control display for output rotation field, anti-clockwise field of rotation active
8	Clockwise rotation	Control display for output rotation field, clockwise field of rotation active
9	Acceleration ramp	Control display, active 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, e. g .frequency, voltage, current
13	PARA menu	Alter parameter setting
14	CTRL 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, frequency, voltage, apparent current or real current

8.4 MENU STRUCTURE

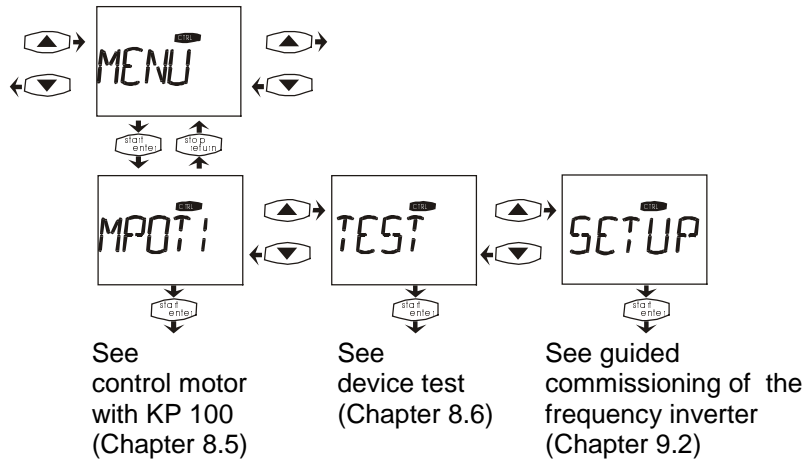
8.4.1 OVERVIEW (PART 1)

Menu VAL (actual values)	Menu PARA (parameter) no password entry	Menu PARA (parameter) with password entry
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8.4.2 OVERVIEW (PART 2)

Menu CTRL		
-----------	--	--



Note: The set-up routine to commission the frequency inverter is normally called after setting the works 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.

8.5 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 the 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. The reference frequency can be altered with the arrow keys.

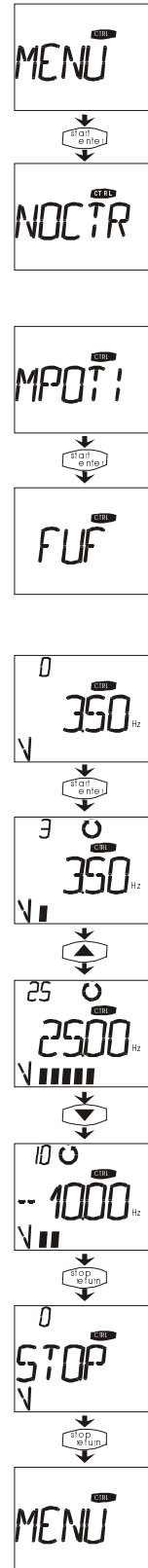
After the start/enter key is pressed the motor accelerates with the set acceleration ramp to the pre-set reference frequency. The actual frequency, the output voltage (as a bar display) and the direction of rotation are then also displayed.

The reference frequency can be increased in a clockwise direction of rotation (plus sign) with the arrow up key. The output frequency then increases with the pre-set *Acceleration Clockwise 420 (RACCR)*.

The reference frequency can be reduced in a clockwise direction of rotation with the arrow down key. If the minimum frequency is 0 Hz the reference frequency can become negative (minus sign). Increase the reference frequency with the arrow up key until the motor's direction of rotation changes again (at 0 Hz).

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

The main menu reappears after the stop/return key is pressed again.



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 changes. The reference line value which is transmitted via a communication card will be added to the value shown on the control unit.

8.6 DEVICE TEST

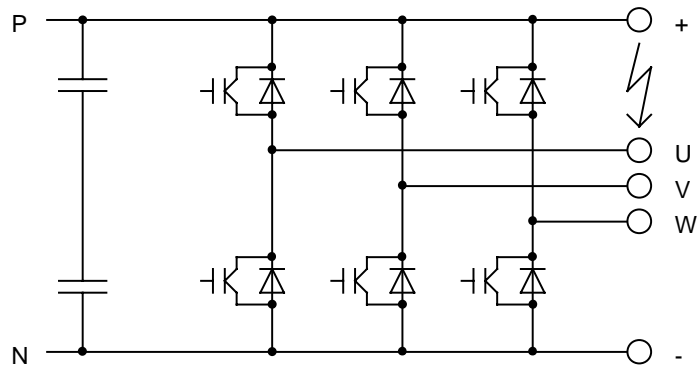
The inverter software contains various test routines to test internal and external hardware to facilitate troubleshooting in both the inverter as well as in a complete installation. These tests are used to discover errors in the inverter, in external sensors and the load (motor) and to discover wiring 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.

8.6.1 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 intermediate circuit 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 intermediate circuit 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 intermediate circuit terminals are occupied, an error between a motor phase and an intermediate circuit 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.

8.6.2 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 motor nominal current which can be set with parameter *Rated Current* **371 (MIR)** in **data set 1**. Alternatively, the rated data can also be set during commissioning.

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)**.

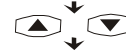
If test 2 signal an earth error after test 1 has signalled no earth error then one can assume that a shunt resistor or current transformer or one of the corresponding connections is defective.

8.6.3 PERFORMING THE DEVICE TEST WITH THE CONTROL UNIT KP 100

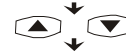
Select the menu **CTRL** in the main menu with the arrow keys.



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



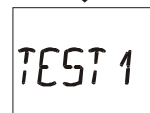
Select the functions in the CTRL menu with the arrow keys. Operation of the control unit KP100 (MPOTI) has been described in the previous chapter.



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



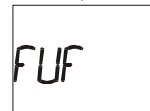
TEST1 appears after the start/enter key is pressed.



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.



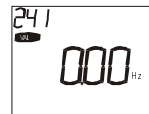
READY appears after carrying out test 2 and pressing the start/enter key.



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.



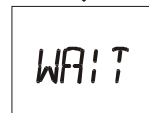
If an error message has occurred during a test, the message **T1FT or T2FT** appears (FT = error) in place of **T1 OK** or **T2 OK** on completion of the test



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.



8.6.4 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 troubleshooting so that the exact cause can be determined.

Error messages during Test 1		
KP 100 display		Meaning Measures / Remedy
Code	Text	
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	EARTH/N-U ERROR	A conductive connection has been found between the phase U and DC- or PE.
T0102	EARTH/N-V ERROR	A conductive connection has been found between the phase V and DC- or PE.
T0103	EARTH/N-W ERROR	A conductive connection has been found between the phase W and DC- or PE.
T0104	EARTH/P-U ERROR	A conductive connection has been found between the phase U and DC+ or PE.
T0105	EARTH/P-V ERROR	A conductive connection has been found between the phase V and DC+ or PE.
T0106	EARTH/P-W ERROR	A conductive connection has been found between the phase W and DC+ or PE.
T0111	WEAK EARTH/N-U ERROR	A conductive connection has been found between the phase U and DC- or PE.
T0112	WEAK EARTH/N-V ERROR	A conductive connection has been found between the phase V and DC- or PE.
T0113	WEAK EARTH/N-W ERROR	A conductive connection has been found between the phase W and DC- or PE.
T0114	WEAK EARTH/P-U ERROR	A conductive connection has been found between the phase U and DC+ or PE.
T0115	WEAK EARTH/P-V ERROR	A conductive connection has been found between the phase V and DC+ or PE.
T0116	WEAK EARTH/P-W ERROR	A conductive connection has been found between the phase W 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.

8.6.5 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 Measures / Remedy
Code	Text	
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.

9 COMMISSIONING THE FREQUENCY INVERTER

9.1 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** (control input open FUF (S1IND) terminal X210-3) the release of the inverter. 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".

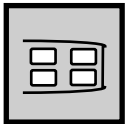
The inverter completes the self-test after approximately 10 s, the background of the control unit KP 100's display is green, the LED H1(green) flashes and thus signals "ready for operation", the relay (X209) attracts and signals "no error".

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 8 "Handling the control unit KP100".

9.2 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.

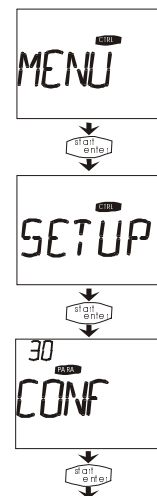


Note: Guided commissioning contains the parameter identification function. The parameters are determined and set accordingly through a measurement. The motor should not be run before the start of the measurement since some of the machine data depend on the operating temperature.

Guided commissioning automatically appears in the condition on delivery. Following successful commissioning please select the sub-menu CTRL in the main menu.

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 410 (sensor-less field-oriented control) using the arrow keys. Conclude the input with the start/enter – key and change to the next parameter. (see following Chapter)



9.2.1 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 a choice of a number of configurations with field-oriented control. The configurations differ mainly in the way in which the drive is controlled.

These operating instructions describe the speed-controlled, sensor-less field-orientation in **Configuration 410** which should be selected accordingly.

Configuration 410, sensor-less field-oriented control (DMR)

Configuration 410 contains the functions for the speed – torque – control (DMR) of an asynchronous machine. The current motor speed is determined from the momentary currents and voltages in combination with the machine parameters. Parallel switching of a number of machines on one frequency inverter is not possible.

The speed is specified as a reference frequency through various adjustable reference value sources. Analog and digital inputs can be combined and supplemented as a reference value source through linking to an optional communication protocol. When the set torque and power limits are reached the drive speed is regulated so that these are not exceeded. The operating behaviour is to be optimised in every operating point according to the load behaviour through an optional temperature measurement.

Guided commissioning, like manual setting, requires the sensor-less field-oriented control which must be selected according to the present operating instructions. The following sequences and descriptions of the parameters are analogous to the settings made in the parameter *Configuration 30 (CONF)*.



Note: Further information on the function overview, connection plans and explanations of the connection plans for the aforementioned configuration can be found in Chapter 6.

9.2.2 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.

9.2.3 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 the 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.

9.2.4 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. Configuration 410 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)	ASYNCHRONUS	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 pre-setting of the relevant parameters. Incorrect entries can lead to damage of the drive.

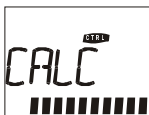
You should then enter the machine data described in the following chapter in the sequence in which they appear in the table. Confirm the parameter input and choice by pressing the start/enter key. Move between the parameters and change the corresponding values with the arrow keys. After the machine data 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.

9.2.5 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 sensor-less field-oriented 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
370	MUR	V	400,0		Rated voltage
371	MIR	A	I_{FIN}		Rated current
372	MNR	min^{-1}	1490		Rated speed
373	MPP	-	2		No. of pole pairs
374	MCOPR	-	0,85		Rated - $\cos(\varphi)$
375	MFR	Hz	50,00		Rated frequency
376	MPR	kW	P_{FIN}		Mech. rated power

9.2.6 CHECKING THE MACHINE DATA



The machine data check is implemented in the configuration 410 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, particularly for the sensor-less field-oriented control. Configuration 410 contains 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 <i>Rated Voltage</i> 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 <i>Rated Current 371 (MIR)</i> , <i>Rated Mech. Power 376 (MPR)</i> or <i>Rated Voltage 370 (MUR)</i> . The calculated efficiency reaches the limits for an asynchronous motor.
SW0003	COS-PHI	The <i>Rated - Cos Phi 374 (MCOPR)</i> is outside the standard range (0.7 to 0.95).
SW0004	SLIP FREQ	Check the <i>Rated Speed 372 (MNR)</i> , <i>Rated Frequency 375 (MFR)</i> and <i>No. of Pole Pairs 373 (MPP)</i> . 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 <i>Rated Current 371 (MIR)</i> is too low
SF0002	NOM. CURRENT 2	The <i>Rated Current 371 (MIR)</i> is too high relative to the <i>Rated Mech. Power 376 (MPR)</i> and <i>Rated Voltage 370 (MUR)</i> .
SF0003	COS-PHI	The <i>Rated - Cos Phi 374 (MCOPR)</i> 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 <i>Rated Speed 372 (MNR)</i> , <i>Rated Frequency 375 (MFR)</i> and <i>No. of Pole Pairs 373 (MPP)</i> .
SF0005	SLIP FRQ 2	Check the entered <i>Rated Speed 372 (MNR)</i> , <i>Rated Frequency 375 (MFR)</i> and <i>No. of Pole Pairs 373 (MPP)</i> because the calculated slip frequency is too 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 410 which should be set accordingly.

9.2.7 PARAMETER IDENTIFICATION

The sensor-less field-oriented 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.

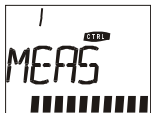
The sequence and duration of the parameter identification varies depending on the connected machine and device output. Measurements are split into separate sections and can be aborted at any time through digital input S1IND (FUF) or the stop/return key. Guided commissioning shows the status of the individual 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.

9.2.8 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
716	MIMAG	A		The rated magnetizing current is determined by parameter identification and is around 30% of the <i>Rated current 371 (MIR)</i> .	3
378	SIGMA	%		The leakage coefficient defines the ratio of leakage inductance to main inductance.	3
718	MSLIP	%		The rated slip correction factor compensates the difference between rated and parameterised motor data relative to the drive's nominal point.	3
623	STI	A		The starting current determines the current impressed at frequencies below the <i>Frequency Limit 624 (STFMX)</i> . The factory setting uses the <i>Rated Current 371 (MIR)</i> .	1
781	FSTI	A		The magnetizing current I_{sd} required for flux formation is set to the minimum current value. The rated value and nominal values of the frequency inverter are compared.	3
717	MFLUX	%		The reference flux changes the rotor magnetizing current relative to the entered rated value. This changes the flux and thus torque of the drive.	3

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 current controller is at present optimised from the measured values for the set *Switching Frequency 400 (FT)*. (see Chapter 10.11.2 Current controller)

9.2.9 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.

Setting						
Para. No.	Abbr.	Unit	Setting	Cust. setting	Name / Function	Control level
417	FOFF	Hz	999,99		Frequency switch-off limit	2
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
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 ant-clockwise	1



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.



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.

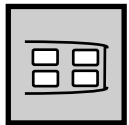
Guided commissioning facilitates the choice of the correct parameters and determines further rated data for the motor. If the parameters have been set via the optional control software or in the PARA – menu of the control unit KP100, the display of the chosen actual value should be activated manually. 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.

9.3 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.

9.4 OPTIMISE THE MAGNETIZING CURRENT

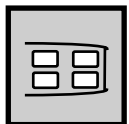


If the open-circuit current of the machine is known then this value can be set as the *Rated Magnetizing Current 716 (MIMAG)*. Guided commissioning determines this value at around 30% of the *Rated current 371 (MIR)*. The *Rated Magnetizing Current 716 (MIMAG)* is a measure for the machine flux and hence for the voltage in the machine during open-circuit operation, depending on the speed. This current is comparable to the field current of an externally excited DC machine. In order to find the optimal setting value the machine can be run in open-circuit operation at a rotation frequency below the *Rated Frequency 375 (MFR)*. The accuracy of the optimisation increases with the set *Switching Frequency 400 (FT)* and the open-circuit operation to be implemented for the drive. The actual flux-forming current *Isd 215 (ISD)* should roughly correspond to the set *Rated Magnetizing Current 716 (MIMAG)*.



Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
716	MIMAG	Rated magnetizing current	$0.01 \cdot I_{FIN}$	$0 \cdot I_{FIN}$	$0.3 \cdot I_{FIN}$	1

9.5 OPTIMISE THE ROTOR TIME CONSTANT



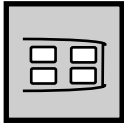
The rotor time constant results from the inductance of the rotor circuit and the rotor resistance. It is determined from the parameter identification measurements and is within the range 50 ... 500 ms. Because of the temperature-dependence of the rotor resistance and the saturation effects of the iron, the rotor time constant also depends on temperature and current. The following procedure can be employed for a fine adjustment or check of the rotor time constant:

The machine is loaded at half the *Rated Frequency 375 (MFR)*. This should produce around half the *Rated Voltage 370 (MUR)* with a max. deviation of 5%. If this is not the case the *Rated Slip Correction Factor 718 (MSLIP)* must be altered accordingly. The higher the correction factor setting, the more the voltage decreases when loaded. The rotor time constant value calculated by the software can be read off in the actual value *Act. Rotor Time Constant 227 (T ROT)*. Adjustment should be made at a winding temperature achieved during normal operation of the motor.

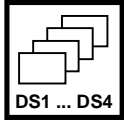


Settings						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
718	MSLIP	Rated slip correction factor	0.01 %	300.00 %	100.00 %	3

9.6 OPTIMISE THE LEAKAGE COEFFICIENT



The machine's leakage coefficient defines the ratio of the leakage inductance to the main inductance. The torque and flux-forming current components are thus coupled via the leakage coefficient. An optimisation of the leakage coefficient requires that the drive be run up to various operating points. The flux-forming current *Isd* **215 (ISD)** should be largely independent of the load moment, unlike the torque-forming current *Isq* **216 (ISQ)**. The flux-forming current component is inversely proportionate to the leakage coefficient. If the leakage coefficient is increased the torque-forming current rises and the flux-forming current falls. Adjustment should result in a relatively constant Actual current value *Isd* **215 (ISD)**, according to the pre-set *Rated Magnetizing Current* **716 (MIMAG)**, irrespective of the load on the drive.



Settings						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
378	SIGMA	Leakage coefficient	1.0 %	20.0 %	7.0 %	2



Note: The leakage coefficient should be optimised at operating points corresponding to the application of the drive. Operational reliability must be guaranteed by the user during the optimisation phase.

9.7 OPTIMISE THE STATOR RESISTANCE

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 $\sqrt{3}$.

The winding resistance determined during guided commissioning can be optimised, in particular for heavy start-up torque. The drive is run in open-circuit operation at a low speed above the set starting current impression. The parameters *Frequency Limit* **624 (STFMX)** and *Hysteresis Frequency* **625 (STFHY)** may have to be reduced for the measurement (starting behaviour).

In open-circuit operation the torque-forming current *Isq* **216 (ISQ)** should be equal to zero in a stationary case. The actual current value can be output via the control unit KP100. If the current *Isq* is not equal to zero the stator resistance must be increased or decreased depending on the current sign until the current *Isq* is equal to zero. Adjustment should be made at a winding temperature achieved during normal operation of the motor since the stator resistance is temperature-dependent.



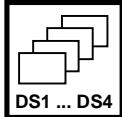
Settings						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
377	RS	Stator resistance	0 mΩ	6000 mΩ	depends on type	2



Note: In **Configuration 410** make sure that the parameter *Stator Resistance* **377 (RS)** is set correctly in the four data sets. Guided commissioning supports parameterisation through a corresponding measurement.

9.8 OPTIMISE THE FIELD CONTROLLER

The field controller, in conjunction with the modulation controller, is mainly used for operation above the basic speed range. In order to improve the operating behaviour, the rotor flux is set at this working point using the cascade control. The integral time of the field controller should be selected according to the rotor time constant calculated by the software. The actual value read out with the parameter *Act. Rotor Time Constant* **227 (T ROT)** should initially be used for the parameter *Integral Time* **742 (FC TI)**. The calculated rotor time constant can be above the setting range of the integral time for the field controller depending on the motor. In this case set the maximum value. Further parameters for the field controller and modulation controller are described in Chapter 10.11 Control functions.



Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
742	FC TI	Integral time	0 ms	200.0 ms	200.0	2

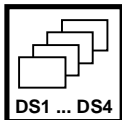


Note: The calculated value for the rotor time constant depends on the set motor parameter *Rated Magnetizing Current* **716 (MIMAG)**. If an estimated value is entered for the magnetizing current this must be adjusted for a correct rotor time constant.
(see Chapter 9.5 Optimise the magnetizing current)

9.9 OPTIMISE THE SPEED CONTROLLER

A PI controller is used for speed regulation. The outer control loop, the speed control, should first be checked in stationary operation at a low speed and then at a high speed. If a high oscillation of the speed is observed or determined through running noises then the speed controller can be optimised via the amplification and integral time. In this case the amplification is initially increased until a clear overshoot is detected. The amplification is then somewhat reduced (1/2 ... 3/4 etc) and the integral time increased.

In the second stage, if necessary, the setting of the speed regulation is checked during dynamic processes i. e. on acceleration and deceleration. The frequency at which the controller parameters are switched over can be set with the parameter *Switch-Over Limit*. **738 (SCSWP)**.



Settings						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
721	SC V1	Amplification 1 high speed	0.00	200.00	5.00	2
722	SCT11	Integral time 1 high speed	0 ms	60000 ms	200 ms	2
723	SC V2	Amplification 2 low speed	0.00	200.00	5.00	2
724	SCT12	Integral time 2 low speed	0 ms	60000 ms	200 ms	2
738	SCSWP	Switch-over time	0.00 Hz	999.99 Hz	0.00 Hz	3



Note: Parameterisation of the speed controller depends on the mass to be driven and the desired speed range. A high amplification may be favourable to start the drive. A lower amplification and higher time constant should be selected for the speed range above the nominal frequency (field weakening range).

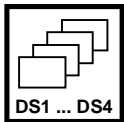
9.10 SETTING THE CONTROLLER LIMITS

The torque-forming current components are controlled by the speed controller. The output signal and the controller can be adjusted to the needs of the application via the configurable limits. Links between analog limit sources should be given special attention for the speed controller. The reference torque and power is limited at four points. The logical links between the selected limitation can be configured in the operation mode of the speed controller.

- a) The output value for the controller is limited by an upper and lower current limit, parameter *Isq Upper Limit 728 (SCULI)* and parameter *Isq Lower Limit 729 (SCLLI)*. The limits are entered in amperes.
- b) The output value for the controller is limited by an upper and lower torque limit, parameter *Torque Upper Limit 730 (SCULT)* and parameter *Torque Lower Limit 731 (SCLLT)*. The limits are entered as percentages of the rated motor torque.
- c) The output value for the controller is limited by an motor and generator power limit, parameter *Upper Power Limit 739 (SCULP)* and parameter *Lower Power Limit 740 (SCLLP)*. The limits are entered in kilowatts.
- d) The output value of the P-component is limited with the parameters *P-Component Torque Upper Limit 732 (SCUPT)* and *P-Component Torque Lower Limit 733 (SCLPT)*. The limits are entered as torque limits as percentages of the rated motor torque.



Note: The limits *Isq Upper Limit 728 (SCULI)*, *Isq Lower limit 729 (SCLLI)* and the limits *Torque Upper Limit 730 (SCULT)*, *Torque Lower Limit 731 (SCLLT)* are permanently active. Since these parameters are fixed values for data set change-over and are to be linked to external limit sources, they can be adjusted to a number of applications. The limits *P-Component Torque Upper Limit 732 (SCUPT)*, *P-Component Torque Lower Limit 733 (SCLPT)*, *Upper Power Limit 739 (SCULP)* and *Lower Power Limit 740 (SCLLP)* should only be parameterised as fixed values.



Settings						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
728	SCULI	Isq upper limit	0.0 A	0 · I _{FIN}	I _{FIN}	2
729	SCLLI	Isq lower limit	0.0 A	0 · I _{FIN}	I _{FIN}	2
730	SCULT	Torque upper limit	0.00 %	650.00 %	650.00 %	2
731	SCLLT	Torque lower limit	0.00 %	650.00 %	650.00 %	2
732	SCUPT	P-component torque upper limit	0.00 %	650.00 %	100.00 %	2
733	SCLPT	P-component torque lower limit	0.00 %	650.00 %	100.00 %	2
739	SCULP	Upper power limit	0.0 kW	0 · P _{FIN}	P _{FIN}	2
740	SCLLP	Lower power limit	0.0 kW	0 · P _{FIN}	P _{FIN}	2



Note: In the **Configuration 410** the aforementioned parameters must be entered in all data sets since when changing between contact inputs DSS1 and DSS2 (terminal X210.6 and X210.7) there is an automatic change-over between data sets 1 to 4. When one of the aforementioned limits is reached the speed is regulated so that the respective limit is not exceeded.

9.11 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 12) and the **FUNCTION DESCRIPTION AND PARAMETERISATION** (see chapter 10).

9.12 COMPLETE COMMISSIONING

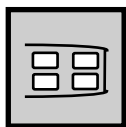
The installation or machine designation, the frequency inverter type with the serial number and all altered parameter settings should be noted for documentation purposes. For this purpose, the installation or machine designation and the frequency inverter type with serial number can be entered on the first page of these operating instructions. The parameter settings can be entered in the table in Chapter 9.3 or Chapter 12.



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 loaded to the frequency inverter for commissioning. The selected control level defines the scope of the displayed and saved parameters.

10 DESCRIPTION OF FUNCTIONS AND PARAMETERS

10.1 SETTING THE CONFIGURATION



The configuration of the inverter specifies the basic function of the control inputs and control outputs and determines the software functions which are available. Configuration 410 contains the sensor-less field-oriented control, speed-controlled.

Setting			
Parameter 30 (CONF)	Configuration	Description of the configuration	Control level
410	DMR speed-controlled	Chapter 6 and 9.1	1



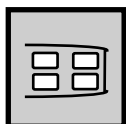
Caution: Other configurations can be set, but are not described in these operating instructions. They may only function in connection with certain extension cards to be built in by the manufacturer.

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.

10.2 ANALOG INPUTS S1INA, S2INA AND S3INA

Reference value signals can be specified as actual value signals or limits via the analogue inputs. Analog input 1 and analog input 2 are implemented as voltage inputs and analog input 3 as a current input (see chapter 6.1).

10.2.1 CHARACTERISTICS OF THE ANALOG INPUTS

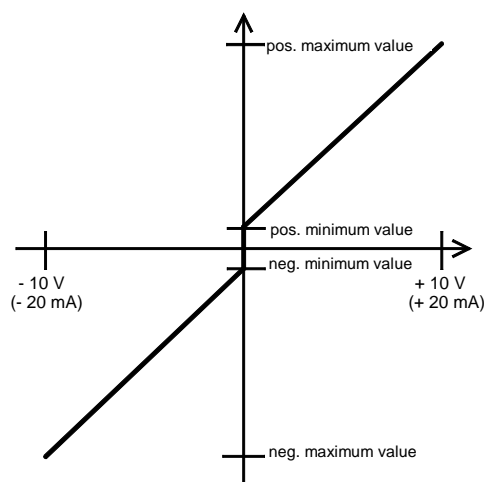


The analog inputs to specify reference speed values are parameterised in the factory in configuration 410, sensor-less field-oriented control.

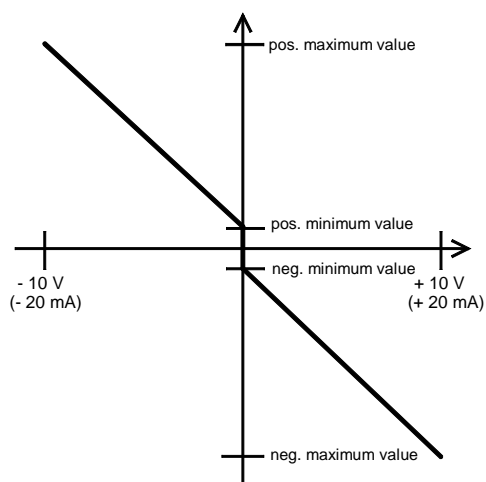
The inputs can be set for the range between positive minimum value and positive maximum value or for the range between negative maximum value and negative minimum value for various applications.

Four different characteristics and the corresponding inverted characteristics are available for signal adaptation.

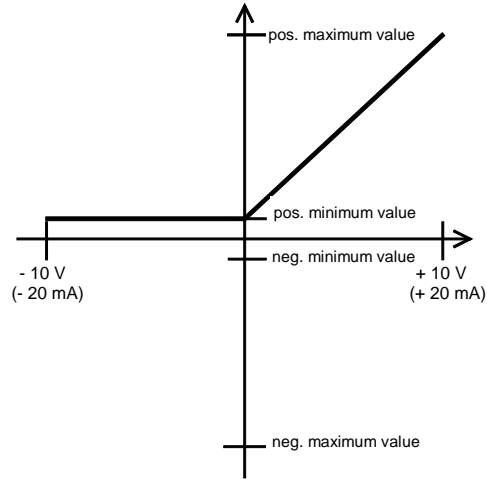
Bipolar (factory setting):



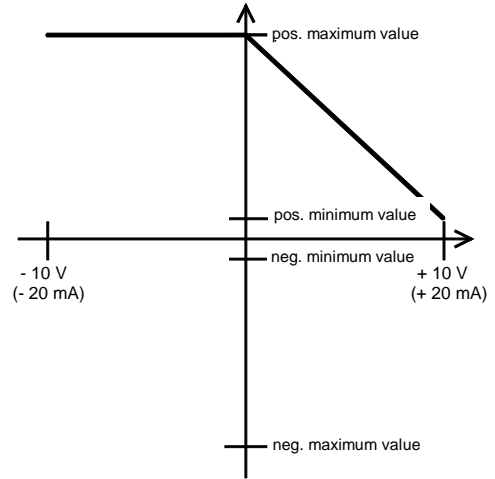
Bipolar inverted:



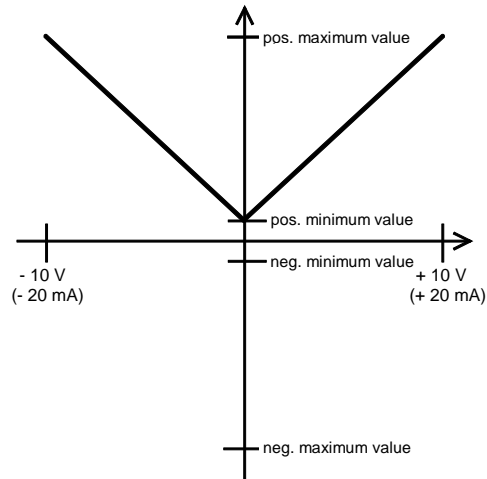
Unipolar:



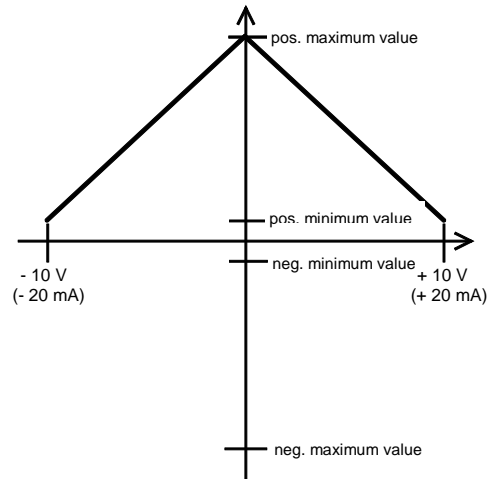
Unipolar inverted:



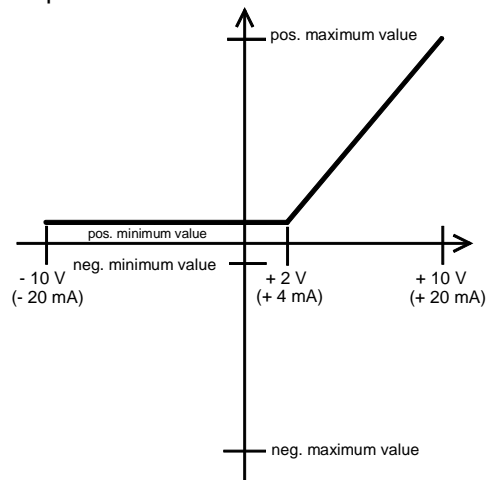
Absolute value function:



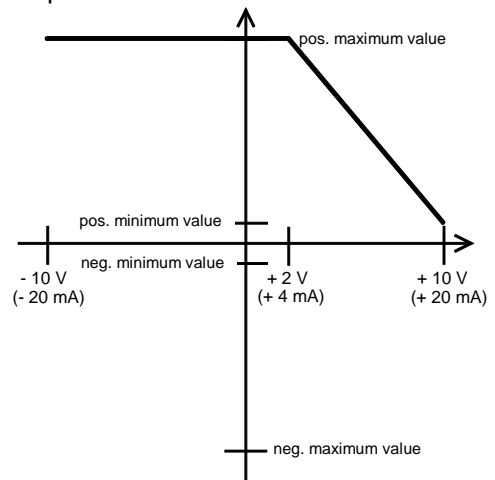
Absolute value function inverted:



Unipolar 2 – 10 V or 4 – 20 mA:



Unipolar inverted 2 – 10 V or 4 – 20 mA:



The characteristics described above can be set as follows 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)*:

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 a 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 10.8).

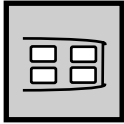
In the operation mode **302** or **312** the drive is stopped according to stopping behaviour 2 (stop and hold) (chapter 10.8), irrespective of the stopping behaviour.

When the set holding time has elapsed a fault message occurs.

10.2.2 SCALING THE CHARACTERISTICS

The characteristics of the analog inputs are assigned positive and negative minimum and maximum values during scaling (see chapter 10.2.1).

10.2.2.1 FREQUENCY RANGE



The analog inputs to process frequency values as reference speed values are defined in the configuration 410.

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 output frequency range and speed is determined with the minimum frequency and the maximum frequency. The pre-set maximum frequency and parameterised slip frequency results in the maximum output frequency of the frequency inverter. The parameter *Slip Frequency* **719 (MSLMX)** is set as a percentage of the rated slip of the motor. The rated slip is calculated from the synchronous speed and the parameterised rated speed.



Setting						
Parameter			Setting range		Factory setting	Control level
No.	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
719	MSLMX	Slip frequency	0 %	10000 %	500 %	3

The output frequency limit should be set separately 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)**.

Example: The parameters *Rated Speed* **372 (MNR)**, *No. of Pole Pairs* **373 (MPP)** and *Rated Frequency* **375 (MFR)**, which are set in the factory, result in the rated slip. The parameter *Slip Frequency* **719 (MSLMX)** allows the desired drive speed to be reached by increasing the maximum permissible output frequency (f_{\max}). A typical slip for an asynchronous machine is thus taken into account in the limitation.

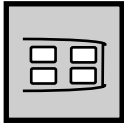
$$f_{\max} = \frac{\text{MSLMX} \cdot (\text{MFR} \cdot 60 - \text{MNR} \cdot \text{MPP})}{60} + \text{FMAX}$$

$$f_{\max} = \frac{500\% \cdot (50.00\text{Hz} \cdot 60 - 1490\text{min}^{-1} \cdot 2)}{60} + 50.00\text{Hz} = 51.67\text{Hz}$$



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 10.14.1).

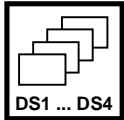
10.2.2.2 PERCENTAGE VALUE RANGE



The analog inputs are to be used to set the speed controller limits in the configuration 410 (see Chapter 10.11.2.1). The analog input signal is represented as a percentage of the respective rated value of the motor.

The *Maximum Reference 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 Value*, which can be set with parameter **518 (PRMIN)**, is assigned to the positive and negative minimum value of the respective analog input characteristic.



Setting						
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 output frequency range and speed is set with the parameters *Minimum Frequency* **418 (FMIN)** and *Maximum Frequency* **419 (FMAX)**.

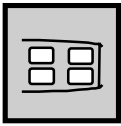
Example 1: A reference value source provides an analog voltage of 0 V – 10 V. A torque of 0 % - rated torque (M = 100 %) is to be set with this.

The parameter *Minimum Reference Percentage Value* **518 (PRMIN)** thus has to be set to 0% and the *Maximum Reference Percentage Value* **519 (PRMAX)** to 100%.

Example 2: A further reference value source provides an analog voltage of 0 V – 10 V. A torque of 0 % - 80 % rated torque is to be set with this. I.e. at 10 V only 80 % of the rated torque should be reached.

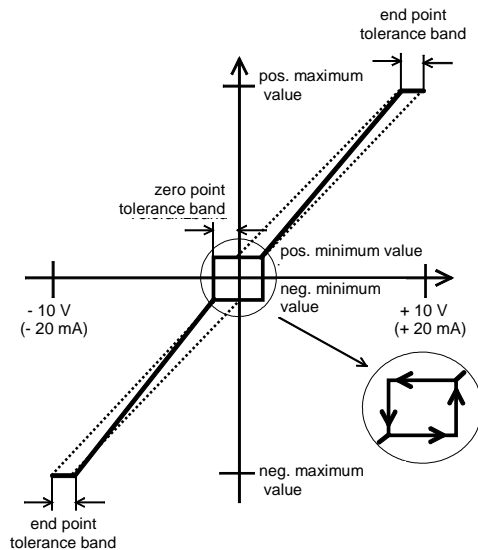
The parameter *Minimum Reference Percentage Value* **518 (PRMIN)** thus has to be set to 0% and the *Maximum Reference Percentage Value* **519 (PRMAX)** to 80%.

10.2.3 TOLERANCE RANGES AT THE ENDS OF THE CHARACTERISTICS

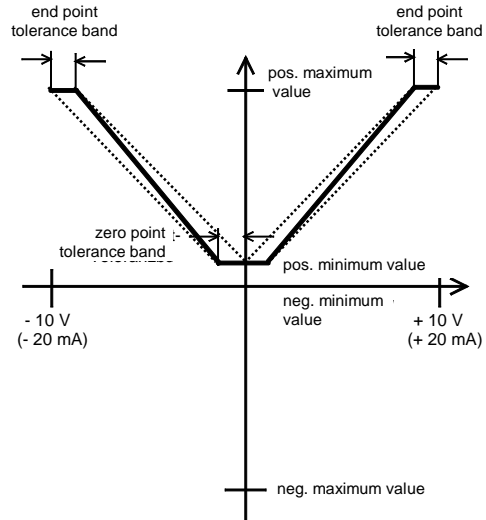


The analog inputs are adjusted in the factory. For special applications the tolerance ranges can be set at the range ends. This is useful, for example, if zero shifts from pre-located analog outputs must be compensated or when the input voltage, which perhaps does not reach its maximum value, must be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

Bipolar (with hysteresis):



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 can we continue on the set characteristic.

Setting						
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.

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

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

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

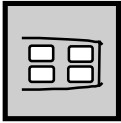


Note The tolerance band setting is effective for all analog inputs.

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.

10.2.4 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.

Setting						
No.	Abbr.	Parameter	Setting range		Factory setting	Control level
			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

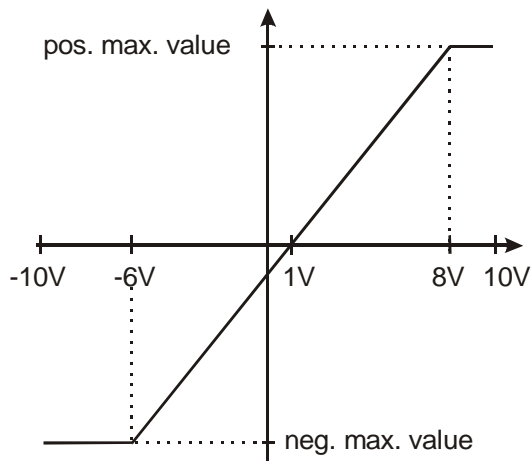
Example: A reference value source supplies a signal of 1V – 8V at analog input 1. The values thus known can be used directly to adapt the characteristic:

$$A1SET = 8 \text{ V} \quad A1OFF = 1 \text{ V}$$

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

$$\begin{aligned} \text{Lower end point} &= 2 \cdot \left(\begin{array}{c} \text{setting value} \\ \text{for zero} \\ \text{point} \end{array} \right) - \left(\begin{array}{c} \text{setting value for} \\ \text{upper end point} \end{array} \right) \\ &= 2 \cdot (1 \text{ V}) - (8 \text{ V}) = -6 \text{ V} \end{aligned}$$

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.

10.3 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).

10.3.1 RELEASE OF THE INVERTER

The release of the frequency inverter in **configuration 410** and the control inputs S2IND and S3IND are occupied by the following functions:

Function		
Control input	Function	Meaning
S1IND	FUF	Release frequency inverter
S2IND	STR	Start clockwise rotation
S3IND	STL	Start anti-clockwise rotation



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 a 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 10.12.1).

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

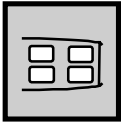
Activation			
FUF	STR	STL	Function
0	X	X	The converter of the frequency inverter is blocked. The drive runs out without control.
1	0	0	The drive is stopped. The stopping behaviour is determined by the setting of parameter <i>Stop Function 630 (DISEL)</i> .
1	1	0	The drive is released with a clockwise field of rotation. The behaviour during starting is defined with the aid of the flux formation settings and the frequencies. (see Chapter 10.7 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 flux formation settings and the frequencies. (see Chapter 10.7 Starting behaviour)
1	1	1	The drive is stopped. The stopping behaviour is determined by the setting of parameter <i>Stop Function 630 (DISEL)</i> .

- 0 ≙ contact open
- 1 ≙ contact closed
- X ≙ any contact



Note: Please refer to Chapter 10.7 and Chapter 10.8 for setting the start function and the stop function.

10.3.2 DATA SET CHANGE-OVER



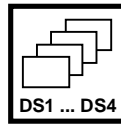
The digital control inputs S4IND and S5IND are occupied with the data set change-over function (see Chapter 6 Control connections). This permits a controlled adaptation of the parameters to the respective operating point of the application. The data set change-over can be made by the frequency inverter itself, irrespective of the status of the further control outputs, through connection with the digital control inputs. Parameterisation of the digital control inputs is described in Chapter 10.5. 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 12 for 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.

If parameterisation 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.

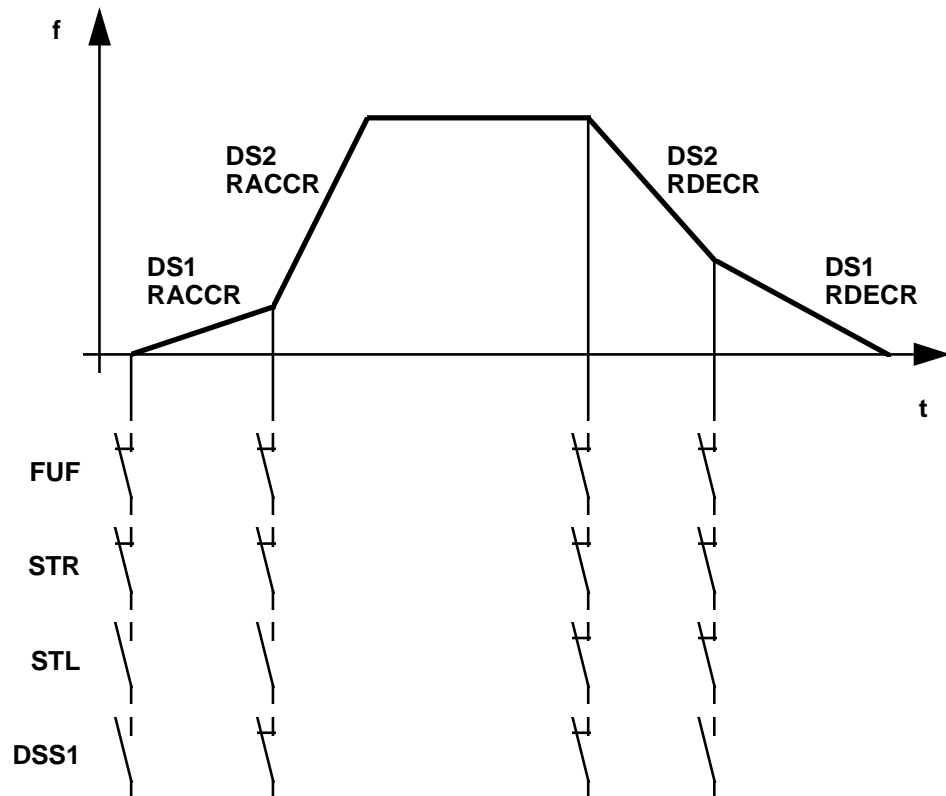
If you wish to alter the parameters which can be switched over in the data set using the KP 100 control unit then each data set (DS0 ... DS4) is to be selected on entering the menu PARA.



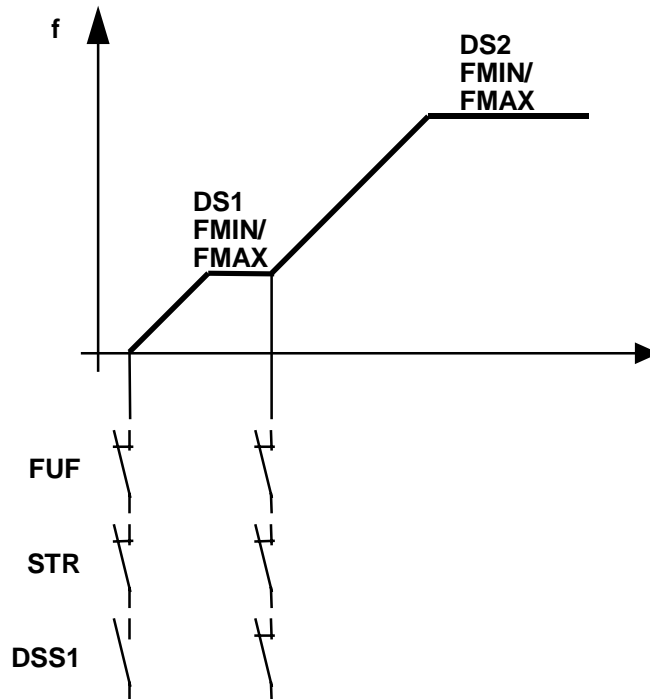
Note: Parameterisation via an optional communication card, guided commissioning and the PC user interface extend data set change-over by the data set 0 (DS0). Changes in data set 0 are taken over in all four data sets and thus facilitate configuration of the frequency inverter.

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

Example 1: Ramp change-over



Example 2: Fixed frequency change-over (FMIN = FMAX)

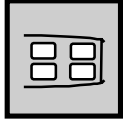


Note: The parameters *Maximum Frequency 419 (FMAX)*, *Minimum Frequency 418 (FMIN)* and the accelerations can be switched over in the data set. The transition between the frequency limits is carried out according to the set ramp rise/fall times. (see Chapter 10.10)

10.3.3 FIXED FREQUENCY CHANGE-OVER / MOTOR POTENTIOMETER FUNCTION

The control inputs S6IND and S7IND can be used in two operation modes in the **configuration 410**. You can change between the functions fixed frequency change-over and motor potentiometer via a data set change-over of the reference frequency value channel. The functions are described in the following chapters.

10.3.3.1 FIXED FREQUENCY CHANGE-OVER

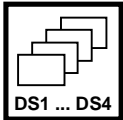


The control inputs S6IND and S7IND can be occupied with the control FFS1 and FFS2 in the **configuration 410**. In this way the fixed frequency change-over can be carried out with four fixed frequencies.

This control function is not activated in the factory settings. The parameter *Reference Frequency Source 475 (RFSEL)* of the reference frequency value channel must be set to fixed frequency change-over (see 10.9) to activate the function.

If fixed frequency change-over is activated the motor potentiometer function can no longer be used.

The fixed frequencies can be activated at the contact inputs as follows:



Activation		
FFS1	FFS2	Active fixed frequency
0	0	Fixed frequency 1 (FF1)
1	0	Fixed frequency 2 (FF2)
1	1	Fixed frequency 3 (FF3)
0	1	Fixed frequency 4 (FF4)

0 = contact open
1 = contact closed



Note: 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.

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)*.

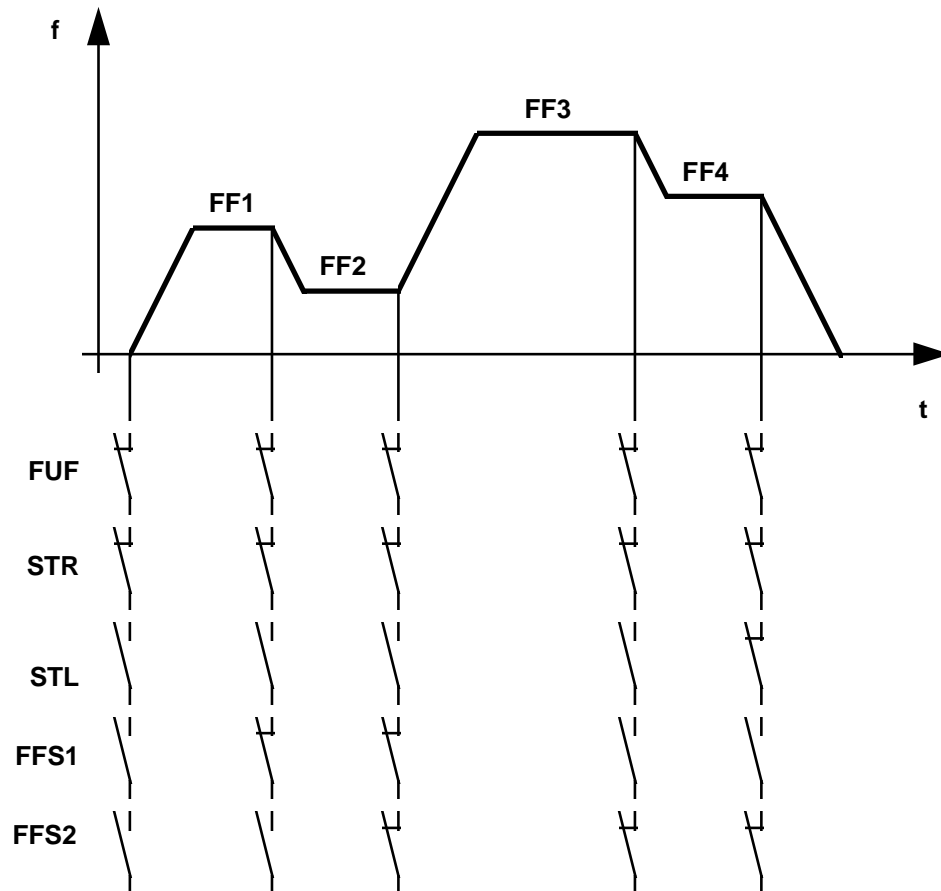
Setting						
No.	Abbr.	Parameter Meaning	Setting range		Factory setting	Control level
			Min	Max		
480	FF1	Fixed frequency 1	-999.99 Hz	999.99 Hz	5 Hz	1
481	FF2	Fixed frequency 2	-999.99 Hz	999.99 Hz	10 Hz	1
482	FF3	Fixed frequency 3	-999.99 Hz	999.99 Hz	25 Hz	1
483	FF4	Fixed frequency 4	-999.99 Hz	999.99 Hz	50 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 10.9).

Example: Fixed frequency change-over (FF1, FF2, FF3 and FF4)

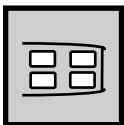


FF1...FF4 ≡ Fixed frequency 1 ...Fixed frequency 4



Note: The data set change-over (Chapter 10.3.2 and Chapter 10.3.3) thus permits a setting of 16 fixed frequencies.

10.3.3.2 MOTOR POTENTIOMETER FUNCTION



The control inputs S6IND and S7IND can only be occupied with the function MPS1 and MPS2 in the **configuration 410**. The motor potentiometer function can thus be activated for reference frequency values.

This control function is not activated in the factory settings. The parameter *Reference Frequency Source 475 (RFSEL)* of the reference frequency value channel must be set to motor potentiometer function (see 10.9) to activate the function.

If the motor potentiometer function is activated the fixed frequency change-over can no longer be used.

The output frequency can be altered as follows using the motor potentiometer function:

Activation		
MPS1	MPS2	Function
0	0	Output frequency does not change
1	0	Output frequency rises with set acceleration ramp
0	1	Output frequency falls with set deceleration ramp
1	1	Output frequency is reset to initial value

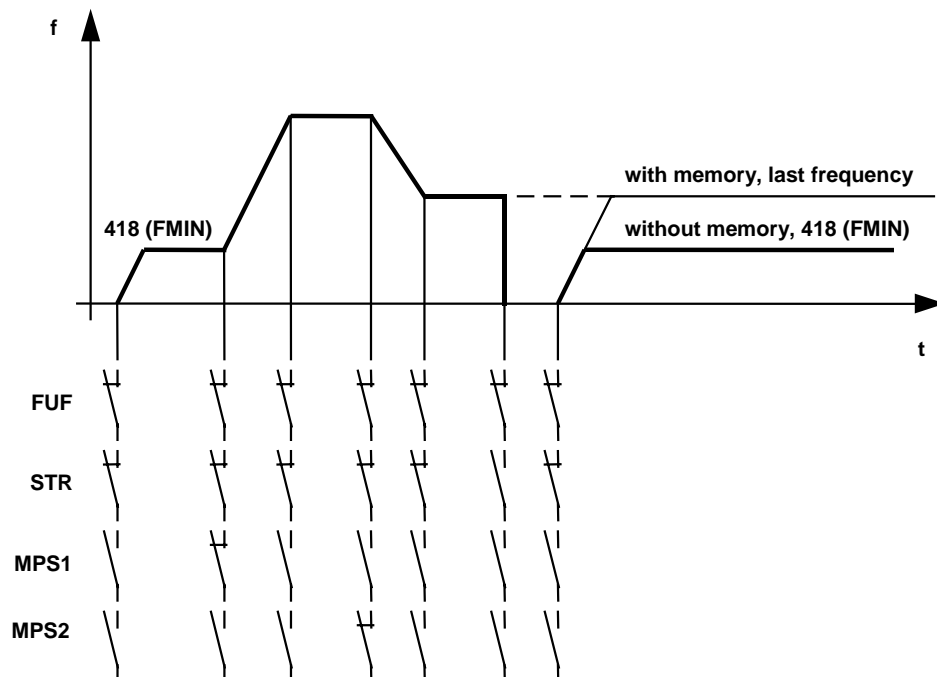
0 = contact open
1 = contact closed



Note: The frequency range which can be set is **418 (FMIN)** to **419 (FMAX)**. The operation mode of the motor potentiometer function is set in operation level 2 with parameter *Operation Mode* **474 (MPOTI)**.

Setting	
Operation mode 474 (MPOTI)	Function
0 (Factory setting)	In the operation mode motor potentiometer without memory the motor runs at the frequency set with the parameter <i>Minimum Frequency</i> 418 (FMIN) at each start.
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	The operation mode motor potentiometer acceptance should be used for the data set change-over of the reference fixed frequency channel. The current reference frequency value is used when changing to the motor potentiometer function.

Example: Motor potentiometer with and without memory



10.3.4 ACKNOWLEDGE ERROR MESSAGE

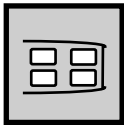
The control input S8IND is occupied by the RESET function in **configuration 410**. An error message is acknowledged by activating the contact input RESET.



Note: A fault message should 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.

10.4 ANALOG OUTPUT S1OUTAI

10.4.1 SET OUTPUT VALUE



The analog output S1OUTAI provides a direct current which is proportionate to an actual value. The desired actual value is set with parameter *Operation Mode Analog Output 1 550 (O1SEL)*. 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	O1SEL	Operation mode analog output 1	0	252	1	1



Note: Further analog outputs are available as options with the extension module EAL-1.

Output switched off		
Operation mode analog output 1 550 (O1SEL)	Function	
0	Analog output switched off	
Frequencies		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
1 (Factory setting)	Output frequency	0 mA \triangleq 0 Hz 20 mA \triangleq Maximum frequency
2	Output frequency	0 mA \triangleq Minimum frequency 20 mA \triangleq Maximum frequency
7	Actual frequency	0 mA \triangleq 0 Hz 20 mA \triangleq Maximum frequency
Currents		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
21	Flux-forming current Isd	0 mA \triangleq 0 A 20 mA \triangleq FI – nominal current
22	Torque-forming current Isq	0 mA \triangleq 0 A 20 mA \triangleq FI – nominal current

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Mechanical values		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
30	Active power	0 mA \triangleq 0 kW 20 mA \triangleq Rated power
32	Inside temperature	0 mA \triangleq 0 °C 20 mA \triangleq 100 °C
33	Heat sink temperature	0 mA \triangleq 0 °C 20 mA \triangleq 100 °C

Analog inputs		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
40	Analog input 1	0 mA \triangleq 0 V 20 mA \triangleq 10 V
41	Analog input 2	0 mA \triangleq 0 V 20 mA \triangleq 10 V
42	Analog input 3	0 mA \triangleq 0 mA 20 mA \triangleq 20 mA

Unsigned parameters		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
50	Absolute current	0 mA \triangleq 0 A 20 mA \triangleq FI – nominal current
51	DC-link voltage	0 mA \triangleq 0 V 20 mA \triangleq 1000 V
52	Output voltage	0 mA \triangleq 0 V 20 mA \triangleq 1000 V

Signed frequencies		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
101	Output frequency	- 20 mA \triangleq f_{max} (anticlockw.) 0 mA \triangleq 0 Hz + 20 mA \triangleq f_{max} (clockw.)
102	Output frequency	- 20 mA \triangleq f_{max} (anticlockw.) 0 mA \triangleq f_{min} (anticlockw.) < f < f_{min} (clockw.) + 20 mA \triangleq f_{max} (clockw.)
107	Actual frequency	- 20 mA \triangleq f_{max} (anticlockw.) 0 mA \triangleq 0 Hz + 20 mA \triangleq f_{max} (clockw.)

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Signed currents		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
121	Flux-forming current I_{sd}	- 20 mA \triangleq - FI – nominal current 0 mA \triangleq 0 A + 20 mA \triangleq + FI – nominal current
122	Torque-forming current I_{sq}	- 20 mA \triangleq - FI – nominal current 0 mA \triangleq 0 A + 20 mA \triangleq + FI – nominal current

Signed mechanical parameters		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
130	Active power	- 20 mA \triangleq - Rated power 0 mA \triangleq 0 kW + 20 mA \triangleq Rated power
132	Inside temperature	- 20 mA \triangleq - 100 °C 0 mA \triangleq 0 °C + 20 mA \triangleq + 100 °C
133	Heat sink temperature	- 20 mA \triangleq - 100 °C 0 mA \triangleq 0 °C + 20 mA \triangleq + 100 °C

Signed analog inputs		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
140	Analog input 1	- 20 mA \triangleq - 10 V 0 mA \triangleq 0 V + 20 mA \triangleq + 10 V
141	Analog input 2	- 20 mA \triangleq - 10 V 0 mA \triangleq 0 V + 20 mA \triangleq + 10 V
142	Analog input 3	- 20 mA \triangleq - 20 mA 0 mA \triangleq 0 mA + 20 mA \triangleq + 20 mA

Frequencies		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
201	Output frequency	4 mA \triangleq 0 Hz 20 mA \triangleq Maximum frequency
202	Output frequency	4 mA \triangleq Minimum frequency 20 mA \triangleq Maximum frequency
207	Actual frequency	4 mA \triangleq 0 Hz 20 mA \triangleq Maximum frequency

VECTRON

Currents		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
221	Flux-forming current I_{sd}	4 mA \triangleq 0 A 20 mA \triangleq FI - nominal current
222	Torque-forming current I_{sq}	4 mA \triangleq 0 A 20 mA \triangleq FI - nominal current

Mechanical parameters		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
230	Active power	4 mA \triangleq 0 kW 20 mA \triangleq Rated power
232	Inside temperature	4 mA \triangleq 0 °C 20 mA \triangleq 100 °C
233	Heat sink temperature	4 mA \triangleq 0 °C 20 mA \triangleq 100 °C

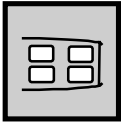
Analog inputs		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
240	Analog input 1	4 mA \triangleq 0 V 20 mA \triangleq 10 V
241	Analog input 2	4 mA \triangleq 0 V 20 mA \triangleq 10 V
242	Analog input 3	4 mA \triangleq 0 mA 20 mA \triangleq 20 mA

Unsigned parameters		
Operation mode analog output 1 550 (O1SEL)	Output value	Range
250	Absolute current	4 mA \triangleq 0 A 20 mA \triangleq FI - nominal current
251	DC-link voltage	4 mA \triangleq 0 V 20 mA \triangleq 1000 V
252	Output voltage	4 mA \triangleq 0 V 20 mA \triangleq 1000 V



Note: If optional modules with further analog outputs are installed the aforementioned actual values can also be output to these analog outputs.

10.4.2 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.

Both the zero point as well as the amplification can be set in order to facilitate the adaptation of the analog output to the very varied operational conditions.

10.4.2.1 ZERO POINT SHIFT

The zero point of analog output 1 can be adjusted with parameter *Zero Adjustment AI 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.

For example, if a current of 1 mA was measured the following setting value results:

$$01OFF = \frac{1\text{mA}}{20\text{mA}} \cdot 100 = 5\%$$

10.4.2.2 AMPLIFICATION SETTING

The amplification factor of the analog output 1 is corrected with the parameter *Amplification AI 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

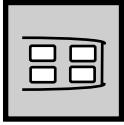
Example : The operation mode of the analog output has been set in the factory to the output frequency. The amplification was accidentally shifted and should now be adjusted again.

The drive is run in an operating 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.

For example, if a current of 18 mA was measured at maximum torque the following setting value results:

$$01SC = \frac{20\text{mA}}{18\text{mA}} \cdot 100 = 111\%$$

10.5 DIGITAL CONTROL OUTPUTS S1OUT, S2OUT AND S3OUT



Various monitoring functions can be set with the digital outputs **S1OUT** and **S2OUT**, as well as the relay output **S3OUT**.

These monitoring functions can be set via the parameters *Operation Mode Digital Output 1 530 (D1SEL)* for **S1OUT**, *Operation Mode Digital Output 2 531 (D2SEL)* for **S2OUT** and *Operation Mode Digital Output 3 532 (D3SEL)* for **S3OUT**.

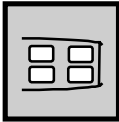
If the message to be monitored is present at the outputs S1OPUT or S2OU the digital output becomes HIGH active. The various events which can be assigned via the operation mode are described in the corresponding chapters of the operating instructions.

Setting		
Operation mode 530 (D1SEL) 531 (D2SEL) 532 (D3SEL)	Function	Control 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 for D2SEL	2
3	Error message	2
4	Message when the <i>Stator Frequency 210 (FS)</i> is greater than the <i>Setting Frequency 510 (FTRIG)</i> . Factory setting for D1SEL	2
5	Message when the calculated output frequency has reached the reference frequency	2
7	Message in the event 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_K, T_i, T_{PTC})	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
30	Flux formation complete	2
40	Activate brake	2
100	Control output active	2
101 to 140	Operation modes 1 to 40 inverted (LOW active) Factory setting for D3SEL = 103	2



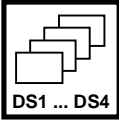
Note: The voltage supply for the digital outputs S1OUT and S2OUT can be carried out via the terminal X210-1 (+24 V). Alternatively, an external supply voltage of, for example, +24 V(max +30 V) can be connected. Pay attention to the galvanic isolation. The reference potential (GND) should be connected accordingly. 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.

10.5.1 OPERATION MODE SETTING FREQUENCY REACHED



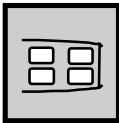
If the **operation mode 4** is called up the respective output becomes active when the *Stator Frequency 210 (FS)* exceeds the set nominal value of parameter *Setting Frequency 510 (FTRIG)*.

The respective output is switched over again as soon as the *Stator Frequency 210 (FS)* falls below the nominal value.



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

10.5.2 OPERATION MODE REFERENCE VALUE REACHED

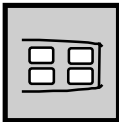


In the **operation mode 5** a message is generated at the relevant output when the calculated actual frequency reaches the reference frequency.

The maximum deviation in percent of the adjustable frequency range can be set with the parameter *Max. Control Deviation 549 (DEV MX)*.

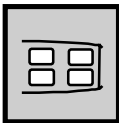
Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
549	DEV MX	Max. control deviation	0.01 %	20.00 %	5.00 %	2

10.5.3 OPERATION MODE FLUX FORMATION



If the **operation mode 30** is selected the relevant output become 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 remagnetization. (see Chapter 10.7 Starting behaviour)

10.5.4 OPERATION MODE BRAKE



The brake function in the **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.

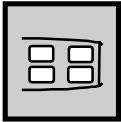
The output is activated with the standby message (green flashing LED) of the frequency inverter. The output is switched off on completion of the motor remagnetization according to the configured starting behaviour (Chapter 10.7). The brake is released and the drive accelerated according to the selected setting.

The stopping behaviour of the drive depends on the configuration of the parameter *Operation Mode Stop Function 630 (DISEL)* (Chapter 10.8). 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 is output is set, and thus the brake activated within the pre-set holding time.



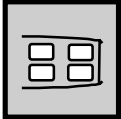
Note: The brake function in the **operation mode 140** should be given preference for a safe operation since in this operation mode the brake is activated even if the frequency inverter's mains protection is deactivated and in the event of a wire beak.

10.5.5 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 (Chapter 10.11). The reduction of power 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.

10.5.6 OPERATION MODES 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
3	Message when stator frequency amount > limit	Maximum frequency 419 (FMAX)	2
6	Message when winding temperature > limit for C2SEL	Reference temperature 100 °C	2
7	Message when actual frequency amount > limit	Maximum frequency 419 (FMAX)	2
103	Message when stator frequency > limit	Maximum frequency 419 (FMAX)	2
107	Message when actual frequency > limit	Maximum frequency 419 (FMAX)	2

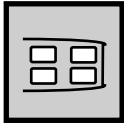
The switch-on and switch-off thresholds for the comparator 1 are set with the parameter *Comparator On Above 541 (C1ON)* and the parameter *Comparator Off Below 542 (C1OFF)*.

Comparator 2 is set with the parameter *Comparator On Above 544 (C2ON)* and *Comparator Off Below 545 (C2OFF)*.

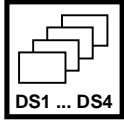
The limits are specified as a percentage of the relevant reference values (see table above).

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

10.6 SETTING THE MOTOR DATA



The machine data recorded during guided commissioning should be entered separately in the menu PARA. The parameter identification of the SETUP – Function has determined the further machine data which is not shown on the ratings plate of the asynchronous machine. These should only be modified by a qualified user since guided commissioning has determined the parameter values through measurement and calculation.

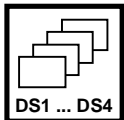


Setting the motor rated data						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
370	MUR	Rated voltage-	100.0 V	800.0 V	400.0 V	1
371	MIR	Rated current	$0.1 \cdot I_{FIN}$	$10 \cdot I_{FIN}$	I_{FIN}	1
372	MNR	Rated speed	100 rpm	60000 rpm	1490 rpm	1
373	MPP	No. of pole pairs	1	24	2	1
374	MCOPR	Rated cosinus phi	0.01	1.00	0.85	1
375	MFR	Rated frequency	10.00 Hz	999.99 Hz	50.00 Hz	1
376	MPR	Mech. rated power	$0.1 \cdot P_{FIN}$	$10 \cdot P_{FIN}$	P_{FIN}	1

The sensor-less field-oriented control requires the input and monitoring of further motor data. These are used to adjust the controller and compensate any tolerances in the existing drive system.

The *Stator Resistance* **377 (RS)** is a reference value which is measured during parameter identification. This value can vary from the motor manufacturer's data sheet depending on the motor temperature during measurement.

The parameter *Leakage Coeff.* **378 (SIGMA)**, the *Rated magnetising Current* **716 (MIMAG)** and the optimisation of the rotor time constant using the parameter *Rated Slip Correction Factor* **718 (MSLIP)** have already been described in Chapter 9 on commissioning the frequency inverter.

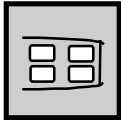


Further motor data						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
377	RS	Stator resistance	0	6000	type-dependent	2
378	SIGMA	Leakage coeff.	1.0 %	20.0 %	7.0 %	2
716	MIMAG	Rated magnetizing current	$0.01 \cdot I_{FIN}$	I_{FIN}	$0.3 \cdot I_{FIN}$	1
718	MSLIP	Rated slip correction factor	0.01 %	300.00 %	100.00 %	3



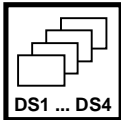
Note: Parameterisation and correction of the rated motor values is only necessary in special applications. The standard application cannot be further optimised with the motor data following successful commissioning.

10.7 STARTING BEHAVIOUR



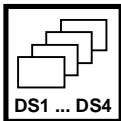
The asynchronous machine is started in freely configurable stages. Following release of the frequency inverter (see Chapter 10.3.1) the machine is initially excited or a current impressed. The magnetizing current I_{sd} is set with the *Current during Flux-Formation* **781 (FSTI)** and the maximum time for current impression with the parameter *Max. Flux-Formation Time* **780 (STT)**.

Current impression is carried out until the reference value of the rated magnetizing current is reached or the *Max. Flux-Formation Time* has come to an end.

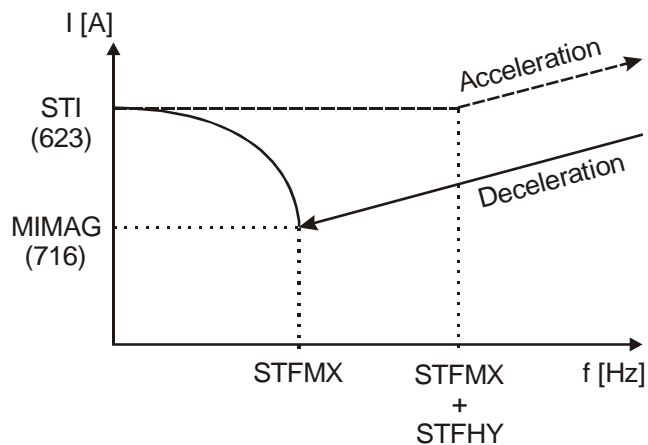


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
780	STT	Maximum flux-formation time	0 ms	10000 ms	1000 ms	3
781	FSTI	Current during flux-formation	$0.1 \cdot I_{FIN}$	$0 \cdot I_{FIN}$	I_{FIN}	1

Following impression of the flux-forming current components the asynchronous machine is supplied with the pre-set *Starting Current* **623 (STI)** up to the *Frequency Limit* **624 (STFMX)**. The transition from current impression to sensor-less field-oriented control takes place in the range of the *Hysteresis Frequency* **625 (STFH Y)**. The starting current guarantees an adequate torque at lower speeds, in particular for gravity starting. The dynamics of field-oriented control are available above the successive limit and hysteresis frequency.

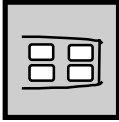


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
623	STI	Starting current	0.0 A	$0 \cdot I_{FIN}$	I_{FIN}	1
624	STFMX	Limit frequency	0.00 Hz	100.00 Hz	2.60 Hz	2
625	STFH Y	Hysteresis frequency	0.50 Hz	10.00 Hz	2.50 Hz	2



Caution: The starting behaviour set in the factory defines a current impression up to a frequency of 5.10 Hz. The *Starting Current* **623 (STI)** and the speed set with the parameter *Minimum Frequency* **418 (FMIN)** require a force-ventilated motor if the drive remains in this operating point for a longer period of time.

10.8 STOPPING BEHAVIOUR



The stopping behaviour of the drive (see Chapter 10.3) should be adapted in the various operation modes of the *Operation Mode Stop Function 630 (DISEL)*. The stopping behaviour, as well as the starting behaviour, is to be configured in the four data records according to the requirements of the application.

The following possibilities are available for the stopping behaviour:



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

Stopping behaviour	
Operation mode 0 Free run down	The converter is immediately blocked. The drive is immediately voltage-free and runs down freely.
Operation mode 1 Stop + switch off	The drive is brought to a standstill with the set deceleration. When standstill is reached the converter is blocked after a holding time. The holding time can be set with the parameter <i>Holding Time 638 (DI T)</i> . The speed is set to zero during the holding time.
Operation mode 2 Stop + hold	The drive is brought to a standstill with the set deceleration and stays permanently supplied with current. The speed is set to zero.
Operation mode 4 Emergency stop + switch off	The drive is brought to a standstill with the emergency stop deceleration. When standstill is reached the converter is blocked after a holding time. The holding time can be set with the parameter <i>Holding Time 638 (DI T)</i> . The speed is set to zero during the holding time.
Operation mode 5 Emergency stop + hold	The drive is brought to a standstill with the set emergency deceleration and stays permanently supplied with current. The speed is set to zero.

The stopping behaviour can be assigned to the control input combinations (STR, STL) according to the following matrix:

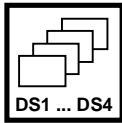
Stopping behaviour						
Operation mode Stop function 630 (DISEL)		STR = 0 and STL = 0				
		Stopping behaviour 0	Stopping behaviour 1	Stopping behaviour 2	Stopping behaviour 4	Stopping behaviour 5
STR = 1 and STL = 1	Stopping behaviour 0	0	1	2	4	5
	Stopping behaviour 1	10	11	12	14	15
	Stopping behaviour 2	20	21	22	24	25
	Stopping behaviour 4	40	41	42	44	45
	Stopping behaviour 5	50	51	52	54	55

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

For safety reasons (wire break or similar) the drive should be brought to a standstill with the combination of control inputs STR = 0 and STL = 0 according to stopping behaviour 5.

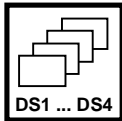
The settings for the parameter *Operation Mode Stop Function 630 (DISEL)* is determined at the intersection of the column stopping behaviour 2 for (STR = 0 and STL = 0) and the line stopping behaviour 5 for (STR = 1 and STL = 0) as being the value 25.

The holding time needed in stopping behaviours 1 and 4 can be set with the parameter *Holding Time 638 (DI T)* in control 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	3

The drive standstill is detected when the *Actual Speed 240 (SPEED)* falls below the frequency value which can be set with the parameter *Switch-Off Threshold 637 (DIOFF)*. The percentage value entered is relative to the *Maximum Frequency 419 (FMAX)*.

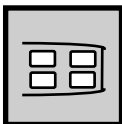


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
637	DIOFF	Switch-off threshold	0.0 %	100.0 %	1.0 %	3



Note: The frequency inverter can only provide the power needed to regulate down to zero speed if adequately dimensioned according to the load behaviour of the drive.

10.9 SETTING THE REFERENCE FREQUENCY CHANNEL



The various possibilities of the reference frequency specification can be selected with the parameter *Reference Frequency Source 475 (RFSEL)* and set with special operational behaviours in the **configuration 410**.

Settings according to the following table can be made 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 possible settings for the desired reference frequency sources (reference speed).

Reference frequency source		
Operation mode 475 (RFSEL)	Selected reference frequency source	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	±

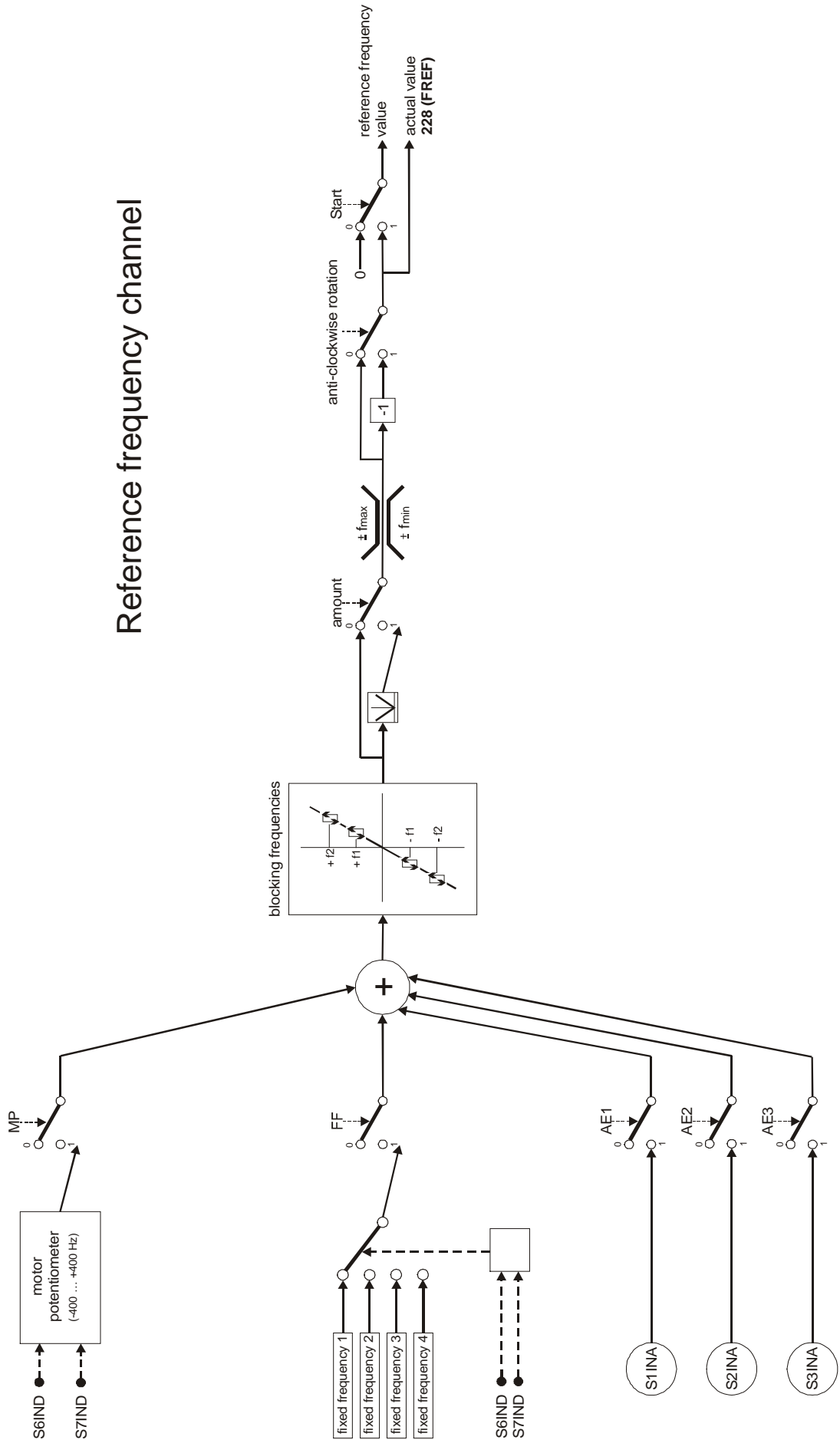
The following block diagram shows all possibilities for the reference frequency default setting and the software switches which are switched on or off with the various operation modes through the parameter *Reference Frequency Source* **475 (RFSEL)**.



Note: In this context see also the Chapter Fixed frequency change-over / Motor potentiometer function (Chapter 10.3.3).

Block diagram of the reference frequency channel

Reference frequency channel

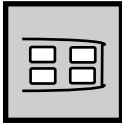




Switch position depending on the operation mode						
Operation	Software switch					Sign
475 (RFSEL)	AE1	AE2	AE3	FF	MP	Sign
1	1					Amount
2		1				Amount
3			1			Amount
4	1	1				Amount
5	1		1			Amount
10				1		Amount
11	1			1		Amount
12		1		1		Amount
13			1	1		Amount
14	1	1		1		Amount
15	1		1	1		Amount
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

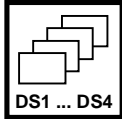
Switch position depending on the operation mode						
Operation	Software switch					Sign
475 (RFSEL)	AE1	AE2	AE3	FF	MP	Sign
101	1					+ / -
102		1				+ / -
103			1			+ / -
104	1	1				+ / -
105	1		1			+ / -
110				1		+ / -
111	1			1		+ / -
112		1		1		+ / -
113			1	1		+ / -
114	1	1		1		+ / -
115	1		1	1		+ / -
120					1	+ / -
121	1				1	+ / -
122		1			1	+ / -
123			1		1	+ / -
124	1	1			1	+ / -
125	1		1		1	+ / -

10.10 SETTING THE RAMPS



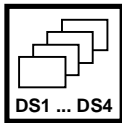
The ramps determine how quickly the frequency value is changed at a reference value change or after a start, stop or brake command. The maximum permissible ramp gradient should be selected depending on the application and the current consumption of the motor. If the acceleration is set to 0 Hz/s the corresponding direction of rotation is blocked.

The parameter *Maximum Leading* **426 (RFMX)** limits the difference between the output of the ramp and the current 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.

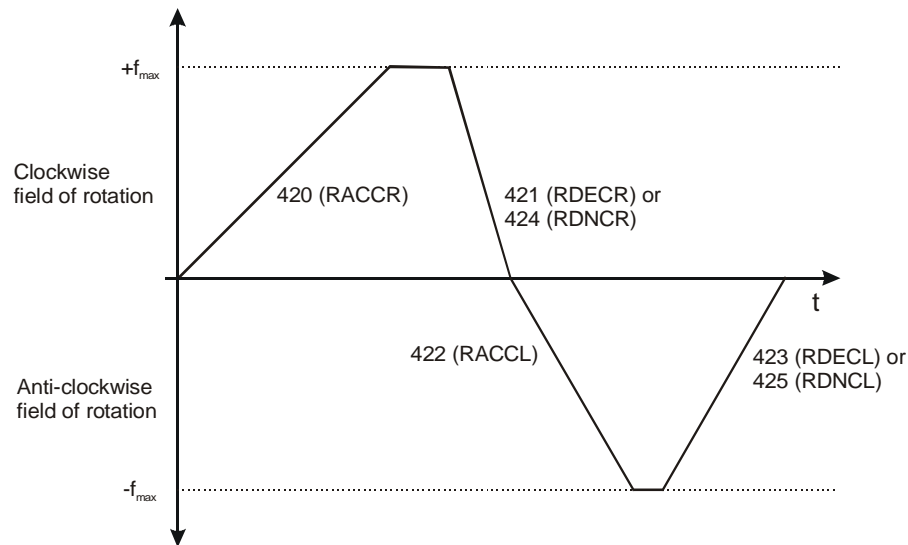


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
420	RACCR	Acceleration clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
421	RDECR	Deceleration clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
422	RACCL	Acceleration anti-clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s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

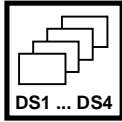


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
424	RDNCR	Emergency stop clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1
425	RDNCL	Emergency stop anti-clockwise	0.01 Hz/s	999.99 Hz/s	1.00 Hz/s	1

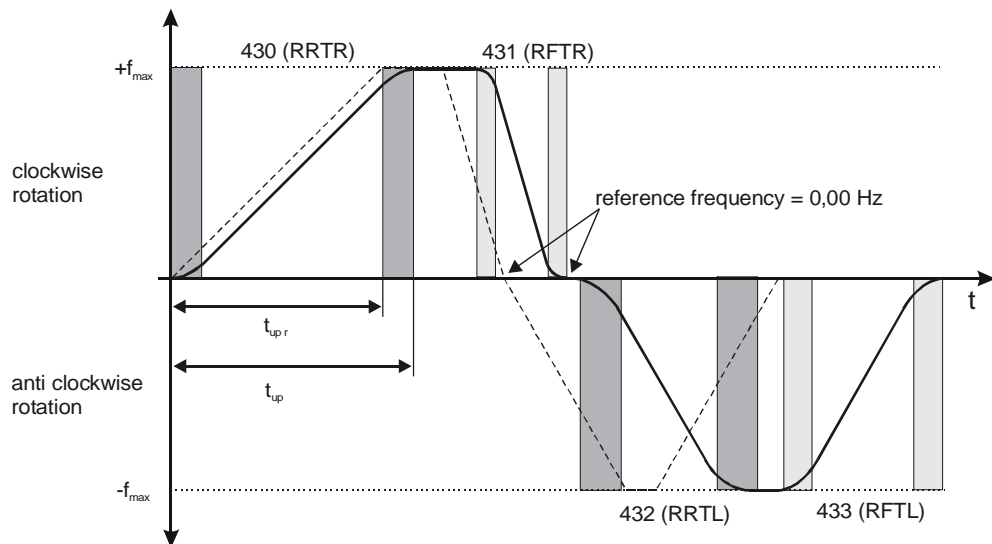


The load which occurs during a linear acceleration of the drive is reduced by the rates of increase which have to be set (S-curve). The non-linear frequency course is defined as a ramp fall or rise time and specifies over which time the frequency is to be brought to the pre-set ramp. The accelerations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

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 transgression of reference values and enables data set change-over between extremely deviant values.



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 (f_{max}) and an acceleration ramp **420 (RACCR)** of 2 Hz/s. The ramp rise time **430 (RRTR)** is set at 100 ms.

$$t_{up,r} = \frac{\Delta f}{RACCR} \qquad t_{up,r} = \text{Acceleration time clockwise rotation}$$

$$t_{up,r} = \frac{50\text{Hz} - 20\text{Hz}}{2\text{Hz/s}} = 15\text{s} \qquad \Delta f = \text{Frequency change acceleration ramp}$$

$$t_{up} = t_{up,r} + RRTR \qquad RACCR = \text{Acceleration clockwise}$$

$$t_{up} = 15\text{s} + 100\text{ms} = 15,1\text{s} \qquad RRTR = \text{Ramp rise time clockwise}$$

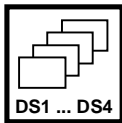


Note: The pre-set ramp rise/fall times are to be taken into consideration when calculating the time intervals. The data set change-over between the parameterised ramp rise/fall times can be delayed depending on the operating point of the drive.

10.11 CONTROL FUNCTIONS

10.11.1 INTELLIGENT CURRENT LIMITS

The current limits to be set depending on the application prevent an inadmissible strain on the connected load and an error shutdown 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 can be selected via the parameter *Operation Mode 573 (LISEL)*, defines the threshold for the activation of the intelligent current limit. The flux and torque-forming currents are limited by the respective controller. The parameterised limit for the controller is synchronised by the intelligent current limits according to the selected function. The parameterised rated motor current and nominal current of the frequency inverter are synchronised as limits by the intelligent current limits.



Intelligent current limits		
Operation mode 573 (LISEL)	Function	Control level
0	Switched off	2
1	Limitation to the type-dependent current limit (IxT)	2
10	Limitation to the max. heat sink temperature (T _K)	2
11	Operation mode 1 and 10 (IxT + T _c)	2
20	Limitation to motor temperature (T _{PTC})	2
21	Operation mode 20 and 1 (T _{PTC} + IxT)	2
30	Operation mode 10 and 20 (T _c + T _{PTC})	2
31 (Factory setting)	Operation mode 10, 20 and 1 (T _c + T _{PTC} + IxT)	2

The threshold set with the parameter *Operation Mode 573 (LISEL)* is monitored by the intelligent current limit. 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.

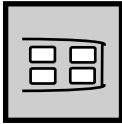


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
574	LIPR	Power limit	40.00 %	95.00 %	80.00 %	2
575	LID	Limitation time	5 min	300 min	15 min	2



Note: The control behaviour of the current 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.

10.11.2 CURRENT CONTROLLER



The sensor-less field-oriented control impresses the motor current in the machine via two controllable components.

This is carried by means of:

- controlling the flux-forming current I_{sd}
- controlling the torque-forming current I_{sq}

The separate control of these two parameters leads to a decoupling of the system, equivalent to separately-excited DC machines.

Both current controllers are of an identical design and allow a joint setting of both the amplification and the integral time for both controllers. The parameters *Amplification 700 (CC V)* and *Integral Time 701 (CC TI)* are available for this purpose. The integrating component of the current controller is to be switched off with the integral time, with the value zero milliseconds. In this setting we are dealing with a purely P controller.



Setting the controller parameter

Parameter		Meaning	Setting range		Factory setting	Control level
No.	Abbr.		Min	Max		
700	CC V	Amplification	0.0	2.00	0.13	3
701	CC TI	Integral time	0.00 ms	10.00 ms	10.00 ms	3

The guided commissioning has selected the current controller parameters so that they can remain unchanged for the majority of applications.

If the behaviour of the current controller has to be optimised in exceptional cases the reference value jump during the flux-formation phase can be used for this purpose. With a suitable parameterisation the reference value of the flux-forming current components jumps to the value *Current during Flux-Formation 781 (FCIFF)* and on expiry of the *Maximum Flux-Formation Time 780 (FCTFF)* this then jumps to the pre-set value for *Starting Current 623 (STI)*. The operating point needed for adjustment calls for a setting of the parameter *Minimum Frequency 418 (FMIN)* with the frequency value 0.00 Hz, since the drive is accelerated after magnetization (Starting behaviour Chapter 10.7). The jump response, which is defined by the ratio of the named currents, should be measured in the motor feeder using a test current transformer with a suitable bandwidth.



Note: The internally calculated actual value for the flux-forming current components cannot be output via the analog output for this measurement since the temporal resolution of the measurement is inadequate.

To set the parameter for the PI-controller first increase the amplification (Parameter 700) until the actual value displays a significant overshoot in the control method. The amplification is now reduced to around half and the *Integral Time 701(CC TI)* synchronised until the actual value displays a slight overshoot in the control method.

The current controller setting should not be too dynamic since at high speeds this reduces the available adjusting reserves. The control tends towards increased vibrations in this operating point.

The current controller parameter should be dimensioned for a switching frequency of 2 kHz by calculating the time constant. At other switching frequencies the values are adjusted internally so that the switching frequency setting can remain unchanged. The dynamic properties of the current controller improve with an increasing switching and scanning frequency.

The following scanning frequencies for the current controller result from the fixed time interval for modulation via the parameter *Switching Frequency* **400 (FT)**. The marked switching frequencies do not appear in the parameter selection for field-oriented configurations.

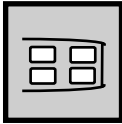
Setting	
Switching frequency	Scanning frequency
1 kHz	1 kHz
2 kHz	2 kHz
3 kHz	1 kHz
4 kHz	4 kHz
5 kHz	1 kHz
6 kHz	2 kHz
7 kHz	1 kHz
8 kHz	8 kHz



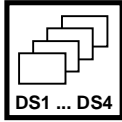
Note:

The interim values for the switching frequency which are available within other configurations and which lead to scanning frequencies of 1 kHz are impractical for field-oriented control methods. The choice of switching frequency is adapted accordingly and can lead to an automatic change-over when the configuration is changed. The sensor-less field-oriented control should be used with a switching frequency over 2 kHz since the dynamics essentially depend on.

10.11.3 SPEED CONTROLLER

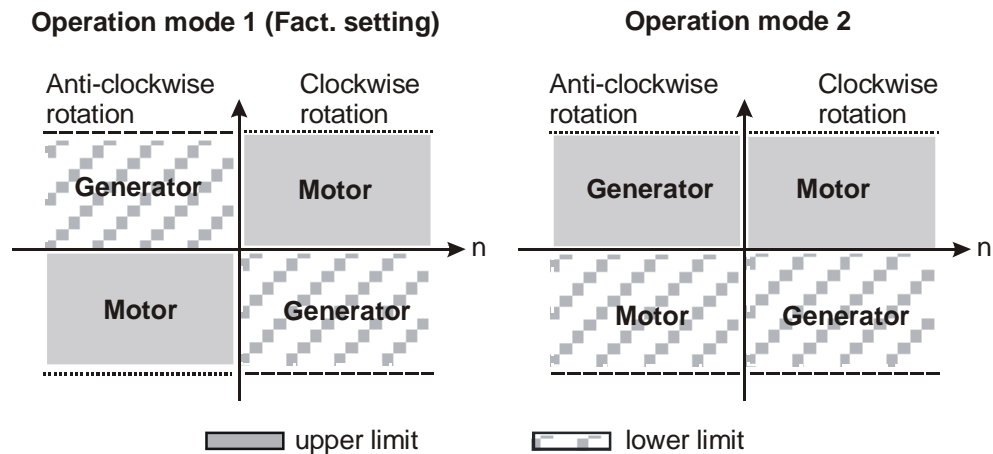


The speed controller should be used in various operation modes which can be selected with the parameter *Op. Mode Speed Controller 720 (SCSEL)*. The operation mode setting defines the uses of the parameterised limits relative to the direction of rotation and direction of torque. Deactivating the speed controller leads to a shut-down of the torque-forming current components and thus a special control case.



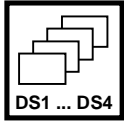
Setting Speed controller		
Operation mode 720 (SCSEL)	Function	Control level
0	Speed controller off	2
1 (Fact. setting)	<ul style="list-style-type: none"> Upper limit – motor operation clockwise and anti-clockwise Lower limit – generator operation clockwise and anti-clockwise 	2
2	<ul style="list-style-type: none"> Upper limit – motor operation clockwise – generator operation anti-clockwise Lower limit – motor operation anti-clockwise – generator operation clockwise 	2

The parameterised limits are assigned according to the following illustration. The four-quadrant operation of the drive is to be set via the upper and lower limits depending on the application requirements.



- Operation mode 1 (factory setting)**
 The configuration set in the factory assigns the upper limit to the motor operation of the drive. The same limit is used irrespective of the direction of rotation. This also applies accordingly for generator operation with the lower limit.
- Operation mode 2**
 The assignment of the limit is carried out by the sign for the parameter to be limited. The positive limit for the upper limit is carried out irrespective of motor or generator operation of the drive. The lower limit is regarded as a negative limit.

The speed controller properties are to be adapted for an adjustment and optimisation of the control. The amplification as well as integral time of the speed controller can be set via the parameters *Amplification 1* **721 (SC V1)**, *Integral Time 1* **722 (SCTI1)** and for lower speeds via the parameters *Amplification 2* **723 (SC V2)**, *Integral time 2* **724 (SCTI2)**. The value selected for the parameter *Switch –Over Limit* **738 (SCSWP)** permits a differentiation between the speed ranges.



Setting the controller parameter

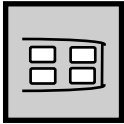
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
721	SC V1	Amplification 1 Speed controller	0.00	200.00	5.00	2
722	SCTI1	Integral time 1 Speed controller	0 ms	60000 ms	200 ms	2
723	SC V2	Amplification 2 Speed controller (low speed)	0.00	200.00	5.00	2
724	SCTI2	Integral time 2 Speed controller (low speed)	0 ms	60000 ms	200 ms	2
738	SCSWP	Switch-over limit	0.00 Hz	999.99 Hz	0.00 Hz	2

The factory setting for the amplification and integral time is related to the pre-set machine data (see Chapter 9.3 Basic settings with the control unit KP 100). This enables an initial functional test in a number of applications. The differentiation between the parameters for the current frequency range is carried out through the software according to the selected limit.

The speed controller can be optimised with the aid of a reference value jump. The amount of the jump is defined by the set ramp and limitation. The PI controller should be optimised at the maximum possible reference value change. First increase the amplification until the actual value displays a significant overshoot during adjustment. This is indicated by a strong vibration of the speed and running noises. In the next step the amplification should be reduced slightly (1/2 ...3/4 etc.), and then the integral time decreased (larger I-component) until the actual value only displays a slight overshoot during adjustment.

In the second stage you should check the speed control setting during dynamic processes, i.e. acceleration and deceleration, if necessary. The frequency at which the control parameter is to be switched over can be set with the parameter *Switch –Over limit*. **738 (SCSWP)**.

10.11.3.1 OUTPUT LIMITATION SPEED CONTROLLER



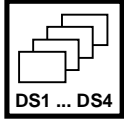
The output signal of the speed controller is the torque-forming current component I_{sq} . The output and I-component of the speed controller are limited by the parameters *Isq Upper Limit 728 (SCULI)*, *Isq Lower Limit 729 (SCLLI)*, *Torque Upper Limit 730 (SCULT)*, *Torque Lower Limit 731 (SCLLT)* or *Upper Power Limit 739 (SCULP)*, *Lower Power Limit 740 (SCLLP)*.

The limits of the proportional component are set with the parameters *P-Component Torque Upper Limit 732 (SCUPT)* and *P-Component Torque Lower Limit 733 (SCLPT)*.

- The output value of the controller is limited by an upper and a lower current limit, parameter *Isq Upper Limit 728 (SCULI)* and parameter *Isq Lower Limit 729 (SCLLI)*. The limits are specified in amperes. The current limits for the controller should be linked to the fixed limits and the analog input variables. Assignment is carried out via the parameters *Source Isq upper limit 734 (SCSUI)* and *Isq Lower Limit Source 735 (SCSLI)*.
- The output value of the controller is limited by an upper and a lower torque limit, parameter *Torque Upper Limit 730 (SCULT)* and parameter *Torque Lower Limit 731 (SCLLT)*. The limits are specified as a percentage of the rated motor torque. In the configuration 410 the fixed limit is assigned as a limit for the torque in the factory. Fixed values or analog limits can be assigned with the parameter *Torque Upper Limit Source 736 (SCSUT)* and *Torque Lower Limit Source 737 (SCSLT)*.
- The output value of the P – component is limited with parameter parameters *P-Component Torque Upper Limit 732 (SCUPT)* and parameters *P-Component Torque Lower Limit 733 (SCLPT)*. The limits are entered as torque limits as a percentage of the rated motor torque.
- The power output by the motor is proportionate to the product of speed and torque. This output power can be limited at the controller output with an *Upper Power Limit 739 (SCULP)* and *Lower Power Limit 740 (SCLLP)*. The power limits are specified in watts.



Note: The limits described here active in parallel. The signal limitation at the output of the speed controller is achieved by the narrow limits. If the data set change-over facility is used the parameters should be set in all data sets.



Setting the controller parameter						
No.	Abbr.	Parameter Meaning	Setting range		Factory setting	Control level
			Min	Max		
728	SCULI	Upper limit torque-forming current I_{sq}	0.0 A	$0 \cdot I_{FIN}$	I_{FIN}	2
729	SCLLI	Lower limit torque-forming current I_{sd}	0.0 A	$0 \cdot I_{FIN}$	I_{FIN}	2
730	SCULT	Upper torque limit	0.00 %	650.00 %	650.00 %	2
731	SCLLT	Lower torque limit	0.00 %	650.00 %	650.00 %	2
732	SCUPT	P-comp. upper limit speed controller	0.00 %	650.00 %	100.00 %	2
733	SCLPT	P-comp. lower limit speed controller	0.00 %	650.00 %	100.00 %	2
739	SCULP	Upper power limit	0.00 kW	$2 \cdot 0 \cdot P_{FIN}$	$2 \cdot 0 \cdot P_{FIN}$	2
740	SCLLP	Lower power limit	0.00 kW	$2 \cdot 0 \cdot P_{FIN}$	$2 \cdot 0 \cdot P_{FIN}$	2



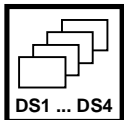
Note: The limitation of the output signals by the aforementioned limits for the speed controller are simultaneously active in the configuration 410. This means that the limit ratios must be observed.

10.11.3.2 ANALOG LIMIT SOURCES FOR THE SPEED CONTROLLER

The output values of the individual controllers are to be limited by a fixed value. Alternatively, they can also be linked to an analog input variable as a limit. The analog limit is to be formed via the parameters *Minimum Reference Percentage Value 518 (PRMIN)* and *Maximum Reference Percentage Value 519 (PRMAX)*, relative to the nominal value. (Chapter 10.2.2.2)

The assignment of the torque-forming current component I_{sq} is carried out with the parameters *Isq Upper Limit Source 734 (SCSUI)* and *Isq Lower Limit Source 735 (SCSLI)*. The fixed values are saved in the parameters *Isq Upper Limit 728 (SCULI)* and *Isq Lower Limit 729 (SCLLI)*.

The sources for the torque limits are to be specified in the same way via the parameters *Torque Upper Limit Source 736 (SCSUT)* and *Torque Lower Limit Source 737 (SCSLT)*. The corresponding fixed limits can be set with the parameters *Torque Upper Limit 730 (SCULT)* and *Torque Lower Limit 731 (SCLLT)*.



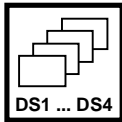
Setting the limit – source	
Operation mode 734(SCSUI),735(SCSLI), 736(SCSUT),737(SCSLT)	Function
101	Limit set via analog input 1 (S1INA)
102	Limit set via analog input 2 (S2INA)
103	Limit set via analog input 3 (S3INA)
110 (Factory setting)	Limit set via fixed limit



Note: The selected limits and links with various limit sources can be changed over in the data set in configuration 410. The use of data set change-over requires a check of the respective parameter.

10.11.4 ACCELERATION PRE-CONTROL

The acceleration pre-control is activated with the parameter *Operation Mode Acceleration Pre-Control 725 (ACSEL)*. The response time resulting from the parameters of the speed controller is reduced by the acceleration pre-control. The minimum acceleration time defines the modification speed of the reference speed from which a torque, necessary to accelerate the drive, is pre-controlled. The acceleration of the mass depends on the *Mechanical Time Constant 727 (AC TM)* of the system. The value calculated from the increase of the reference value and the multiplication factor of the required torque is added to the output signal of the speed controller.



Setting the acceleration pre-control

Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
725	ACSEL	Operation mode accelerations pre-control	0: off	1: on	0: off	2
726	ACMIN	Minimum acceleration time	0.1 Hz/s	6500.0 Hz/s	1.0 Hz/s	2
727	AC TM	Mechanical time constant	1 ms	60000 ms	10 ms	2

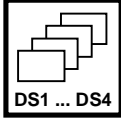
For the optimum setting the acceleration pre-control is switched on and the mechanical time constant set to the minimum value. The output values of the speed controller and of the acceleration pre-control during the acceleration processes are now compared. The acceleration ramp (chapter 10.10) must be set to the highest value which occurs during operation, at which the output value of the speed controller is not yet limited. The value for the *Minimum Acceleration 726 (ACMIN)* is now set to half of the set acceleration ramp to ensure that the acceleration pre-control is active. By increasing the *Mechanical Time Constant 727 (AC TM)* the acceleration pre-control is now increased until the output value corresponds to change in the output value of the speed controller during acceleration.



Note: If the acceleration pre-control was clearly set too high or the inertia factor decreases during operation then an overshoot of the speed over the reference value may occur with the acceleration pre-control. The speed controller must compensate the fault made by the selected acceleration being too high.

10.11.5 FIELD CONTROLLER

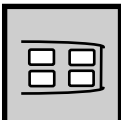
The proportional and integrating components of the field controller can be set with the parameters *Amplification 741 (FC V)* and *Integral Time 742 (FC TI)*. The controller functions are to be deactivated by the value zero. In this setting we are dealing with a purely P-controller or I-controller.



Setting the controller parameter						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
717	MFLUX	Reference flux	0.01 %	300.00 %	100.00 %	3
741	FC V	Amplification	0.0	200.0	2.0	2
742	FC TI	Integral time	0.0 ms	100.0 ms	200.0 ms	2

The controller parameters for the field controller should be optimised in the basic speed range. The frequencies to be set should be immediately before the limits for the modulation controller set with the parameter *Reference Modulation 750 (MCREF)* so that this is not active. The *Reference Flux 717 (MFLUX)* should only be optimised in exceptional cases. The pre-set percentage alters the flux-forming current component relative to the torque-forming current component. Corrections to the rated magnetizing current, by means of the reference flux, thus alter the drive's torque. If the parameter *Reference Flux 717 (MFLUX)* is suddenly reduced (change-over from 100% to 50%) the jump response of the field controller can be measured by an oscillograph of the output variable I_{sd} . The procedure to output the analog actual value is described in Chapter 10.4. The signal of the flux-forming current I_{sd} should reach the stationary value after an oscillation without oscillating. The parameter integral time should be roughly identical to the actual value *Act. Rotor Time Constant 227 (T ROT)* calculated from the machine data. If a quick change to field monitoring is required for the application the integral time should be reduced. A relatively large amplification should be chosen for a good dynamic behaviour of the controller. Remember that an increased overshoot during control of a load with a low-pass behaviour, e.g. an asynchronous machine, is required for a good control behaviour.

10.11.5.1 OUTPUT LIMITATION FIELD CONTROLLER



The output signal of the field controller, the integrating and proportional components are limited by the parameters *Ref. Isd Upper Limit 743 (FC UL)* and *Ref. Isd Lower Limit 744 (FC LL)*. The limits set in the factory were chosen according to the nominal values of the frequency inverter. These may have to be adjusted according to motor data and properties in certain applications.



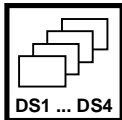
Setting the controller limit						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
743	FC UL	Ref. Isd upper limit	$0.1 \cdot I_{FIN}$	$0 \cdot I_{FIN}$	I_{FIN}	2
744	FC LL	Ref. Isd lower limit	$- I_{FIN}$	I_{FIN}	0.0	2

The limits of the field controller define not only the maximum occurring current but also the dynamic properties of the control. The upper and lower limits limit the modification speed of the machine flux and the resulting torque. The speed range above the nominal frequency must be given special attention for modifications to the flux-forming components. The upper limit should be estimated from the product of the pre-set magnetizing current and the flux correction factor, whereby the limit may not exceed the rated current of the drive.

10.11.6 MODULATION CONTROLLER

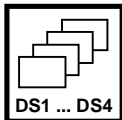
The modulation controller, designed as a PI-controller, automatically adjusts the output value of the frequency inverter to the machine behaviour in the basic speed range and in the field weakening range. If the modulation exceeds the value set with the parameter *Reference Modulation 750 (MCREF)* the field-forming current component and thus the flux in the machine is reduced.

To enable the best possible use of the available voltage, the value set in the *Operation Mode 753 (MCSEL)* is placed in ratio to the DC-link voltage. This means that with a high mains voltage a high output voltage is also available, the drive reaches the field weakening range later and produces a higher torque. The operation mode set in the factory takes into account the ratio between the flux-forming and torque-forming components for a standard motor. In individual cases a control via the voltage amount, depending on the properties of the motor, may be sensible (large leakage inductance).



Setting Modulation controller		
Operation mode 753 (MCSEL)	Function	Control level
0 (Fact. setting)	The modulation is calculated from the ratio of the torque-forming voltage component U_{sq} to the DC-link voltage	2
1	The modulation is calculated from the ratio of the voltage amount to the DC-link voltage	2

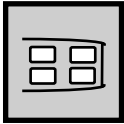
The proportional and integrating components of the modulation controller can be set with the parameters *Amplification 751 (MC V)* and *Integral Time 752 (MC TI)*. The proportional component is deactivated in the factory by the value zero. In this setting we are dealing with a purely I-controller. The P-component should be set low for the modulation controller to ensure a good control behaviour.



Setting the controller parameter						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
750	MCREF	Nom. modulation	3.00 %	98.00 %	95.00 %	2
751	MC V	Amplification mod. controller	0.00	2.00	0.50	2
752	MC TI	Integral time mod. controller	0.0 ms	1000.0 ms	40.0 ms	2

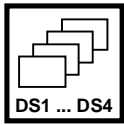
The percentage setting of the *Reference Modulation 750 (MCREF)* essentially depends on the leakage inductance of the machine. The default value has been set so that in the majority of cases the remaining difference of 5% is adequate as an adjusting reserve for the current controller. To optimise the controller parameters the drive is accelerated up to the field weakening range with a flat ramp so that the modulation controller engages. The limit is set with the parameter *Reference modulation 750 (MCREF)*. The control loop can then be excited with a jump function by altering the reference frequency (switch between 95% and 50%). The adjustment behaviour of the modulation controller can be assessed by an oscillographic measurement of the flux-forming current component at the analog output of the frequency inverters (Chapter 10.4). The signal of the flux-forming current I_{sd} should reach the stationary value after an oscillation without oscillating. An oscillation of the current can be attenuated by increasing the integral time. The parameter *Integral Time 752 (MC TI)* should roughly correspond to the actual value *Act. Rotor Time Constant 227 (T ROT)*.

10.11.6.1 LIMITATION OF THE MODULATION CONTROLLER



The output signal of the modulation controller is the internal reference flux. The controller output and the integrating component are limited by the parameters *Reference Imr Lower Limit* **755 (MC LL)** or the product *Rated Magnetizing Current* **716 (MI-MAG)** with *Reference Flux* **717 (MFLUX)**. The magnetizing current parameter which forms the upper limit should be set to the nominal value of the machine (see Chapter 10.6). For the lower limit you should chose a value which generates an adequate flux in the machine even in the field weakening range. Check the factory setting for the connected motor.

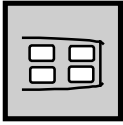
The limitation of the control deviation at the modulation controller input prevents a possible oscillation of the control loop during load surges. The parameter *Control Deviation Limitation* **756 (MCLCD)** is set as an amount and functions as both a positive and negative limit.



Setting the controller limit						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
755	MC LL	Reference I_{mr} lower limit	$1 \% \cdot I_{FIN}$	$0 \cdot I_{FIN}$	$5 \% \cdot I_{FIN}$	2
756	MCLCD	Control deviation limitation	0.00 %	100.00 %	10.00 %	2

10.12 SPECIAL FUNCTIONS

10.12.1 AUTOSTART



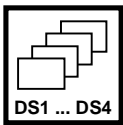
By activating the auto-start function with parameter *Operation Mode 651 (ASSEL)* in operation level 1 the inverter starts automatically after the mains voltage is connected and a start command is received.



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 overvoltage protection.

Risk to persons, machinery and production goods must be excluded in the event of one of these cases.

In addition, any special provisions for the relevant application must be complied with and national regulations observed.

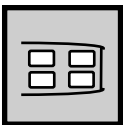


Setting	
Operation mode 651 (AUTO)	Function
0 (Factory setting)	Autostart switched off
1	Autostart switched on



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.

10.12.2 TEMPERATURE SYNCHRONISATION OF THE ROTOR TIME CONSTANT



The rotor time constant is an important machine parameter for the sensor-less, field oriented control method. The value to be read out from the parameter *Act. Rotor Time Constant 227 (T ROT)* is calculated from the inductance of the rotor circuit and the rotor resistance (see Chapter 9.5). The dependence of the rotor time constant on the motor temperature should be taken into account through a suitable measurement during operation. Various methods and actual value sources to record the temperature can be selected via the parameter *Operation Mode Temp. Synchronisation 465 (MTSEL)*.



Setting		
Operation mode 465 (MTSEL)	Function	Ctrl. level
0 (Factory setting)	Off, no temperature synchronisation	3
1	Temperature synchronisation, actual temp. value via analog input 1 (0...200°C => 0/2...10V)	3
2	Temperature synchronisation, actual temp. value via analog input 2 (0...200°C => 0/2...10V)	3
3	Temperature synchronisation, actual temp. value via analog input 3 (0...200°C => 0/4...20mA)	3
11	VECTRON - Temperature synchronisation, actual temp. value via analog input 1 (-26.0...207.8°C => 0...10V)	3
12	VECTRON - Temperature synchronisation, actual temp. value via analog input 2 (-26.0...207.8°C => 0...10V)	3
13	VECTRON - Temperature synchronisation, actual temp. value via analog input 3 (-26.0...207.8°C => 0...20mA)	3

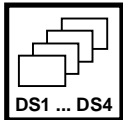


Note: The adjustment of the selected analog input for temperature synchronisation can be carried out as described in Chapter 10.2.

Two temperature measurements are available:

- An external connecting group evaluates the temperature sensor (PT100) and maps the temperature range from 0 ... 200°C to an analog voltage or current signal. (Operation mode of temperature synchronisation = 1,2,3)
- The optionally available temperature recording card is supplied via the control terminals of the frequency inverter VCB. The card maps the temperature range from -26.0 ... 207.8°C to an analog voltage or current signal. The resistance range of the temperature sensor used for the named temperature range of the PTC precision resistor is 90...180Ω. (Operation mode of temperature synchronisation = 11,12,13)

The material used for the rotor winding of the motor is taken into account with the parameter *Temperature Coefficient* **466 (MTCAL)**. This value defines the change in rotor resistance as a function of the temperature for a certain material used for the rotor winding. The following temperature coefficients are specified for a temperature of 20°C.



Setting		
Temperature coeff. 466 (MTCAL)	Material	Control level
39% / 100°C	Copper	3
36% / 100°C	Aluminium	3

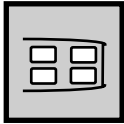
The temperature characteristic is calculated within the software through the specified temperature coefficient and the parameter *Adjusting Temperature* **467 (MTCAT)**. The adjusting temperature allows an additional optimisation of the rotor time constant along with the parameter *Rated Slip Correction Factor* **718 (MSLIP)** (Chapter 9.6).



Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
467	MTCAT	Adjusting temperature	-50°C	300°C	100°C	3

The synchronisation of the rotor time constant as a function of the winding temperature can be adjusted by the user. The values set in the factory should normally be accurate enough so that no adjustment of the rotor time constants is needed via the parameter *Rated Slip Correction Factor* **718 (MSLIP)** nor any adjustment of the temperature synchronisation via the parameter *Temperature Coefficient* **466 (MTCAL)**. During adjustment you should remember that the rotor time constant is calculated from the input machine data. The commissioning described in Chapter 9 with the necessary controller adjustment should be completed before adjustment of the temperature synchronisation. If the data on the ratings plate of the motor are not accurate enough or high demands are made on the accuracy of the adjustment the rotor time constants should be adjusted at a normal operating point. The temperature can be read out via the actual value parameter *Winding Temperature* **226 (T MOT)** and used during optimisation for the parameter *Adjusting Temperature* **467 (MTCAT)**.

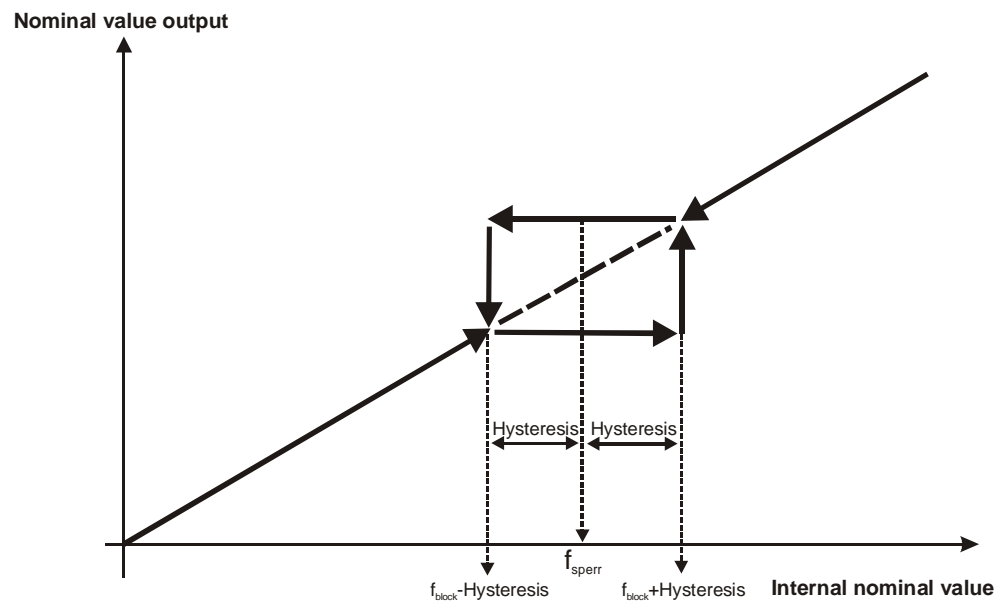
10.12.3 BLOCKING FREQUENCIES



In **configuration 410** there is the possibility for certain applications of fading out reference frequencies which means that resonance points are avoided as stationary operation points. For this purpose, two frequencies can be fixed via parameter *1st Blocking Frequency 447 (FB1)* and parameter *2nd Blocking Frequency 448 (FB2)* with a hysteresis range (parameter *Frequency Hysteresis 449 (FBHYS)*). This means that both frequencies have the same hysteresis band.

A blocking frequency is active when parameter *1st Blocking Frequency 447 (FB1)* or parameter *2nd Blocking Frequency 448 (FB2)* and parameter *Frequency Hysteresis 449 (FBHYS)* are unequal to 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.

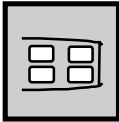


Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
447	FB1	1 st blocking frequency.	0.00 Hz	999.99 Hz	0.00 Hz	2
448	FB2	2 nd blocking frequency	0.00 Hz	999.99 Hz	0.00 Hz	2
449	FBHYS	Frequency-hysteresis	0.00 Hz	999.99 Hz	0.00 Hz	2



Note: The area faded out by hysteresis as a stationary bias 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.

10.12.4 MOTOR PROTECTIVE SWITCH

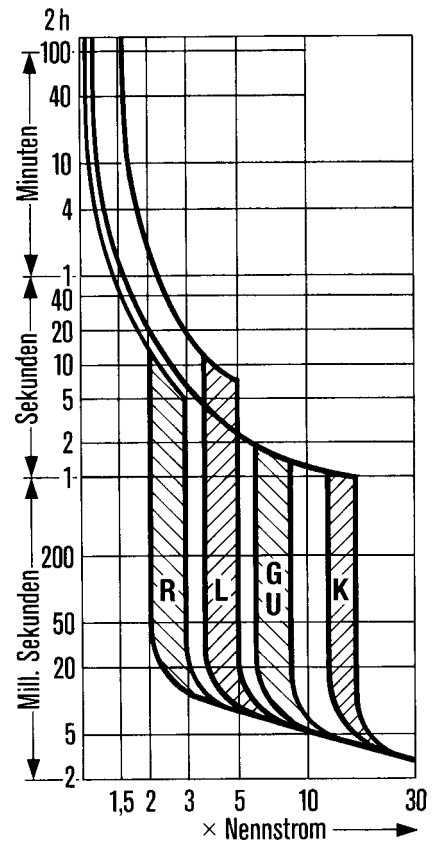


Motor protective switches protect a motor and its lead from overheating due to overloading. Depending on the size of the overload, they serve as short circuit protection with their quick triggering and at the same time as overload protection with their slow switching off.

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.

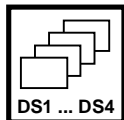
Unlike the mode of a conventional motor protective switch, which immediately disconnects the operational appliance to be protected when the trigger threshold is reached, this function offers the possibility of issuing a warning message instead of an immediate switch-off.

The rated 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.



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 therefore have its own motor protective switch.

If a motor is being operated with the inverter, for which several settings e. g. 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 571 (MSEL)* for single motor operation or multiple motor operation.



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

10.12.4.1 MOTOR PROTECTIVE SWITCH FOR MULTIPLE MOTOR OPERATION

The function of the motor protective switch is set for multiple motor operation with the parameter *Operation mode 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.

10.12.4.2 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 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.

10.12.4.3 MOTOR PROTECTIVE SWITCH FAULT SWITCH OFF

A fault switch-off is triggered when the motor protection is triggered with the parameter *Operation mode 571 (MSEL) = 1* or *571 (MSEL) = 2*.

If the motor protective switch triggers, the frequency inverter is switched off with the error message "**F0401 motor protective switch**".

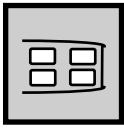
10.12.4.4 MOTOR PROTECTIVE SWITCH WITH WARNING MESSAGE

A warning message is triggered when the motor protection is triggered with the parameter *Operation mode 571 (MSEL) = 11* or *571 (MSEL) = 22*. 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 10.5).

10.12.5 BRAKE CHOPPER THRESHOLD



The frequency inverters are optionally fitted with a brake chopper. The external braking resistance is connected to terminals Rb 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 generator power of the drive, leading to the rise 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.

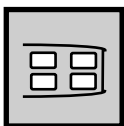
$$U_{\text{main}} \cdot 1,1 \cdot \sqrt{2} < \text{UDBC} < 750 \text{ V}$$

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.

10.12.6 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 11.2) are active.

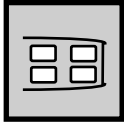
Setting						
Parameter			Setting range		Factory setting	Control level
No.	Abbr.	Meaning	Min	Max		
39	TVENT	Switch-on temperature	0 °C	75°C	0 °C	2



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.

10.12.7 PULSE WIDTH MODULATION

10.12.7.1 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	FU - type-dep.	2



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.

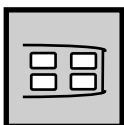
Setting Switching frequency	
Inverter type	Switching frequency
VCB400-010 to VCB400-115	1 ... 8 kHz
VCB400-135	1 ... 4 kHz
VCB400-150	1 ... 8 kHz
VCB400-180 to VCB400-250	1 ... 4 kHz
VCB400-300 to VCB400-370	1 ... 2 kHz
VCB400-460 to VCB400-610	1 kHz ^{*)}

^{*)} The configurations for a frequency inverter with field-oriented control methods require a minimum switching frequency of 2 kHz. Devices with a rated current of 460A to 610A 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 part)

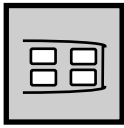
10.12.7.2 SETTING THE SWITCHING COMPENSATION



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

10.12.8 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 – user interface 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
1	2400 Bit/s
2	4800 Bit/s
3 (Factory setting)	9600 Bit/s
4	19200 Bit/s

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.

Setting						
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.



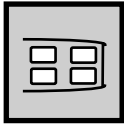
Setting	
Parameter 412 (REMOT)	Function
0 (Factory setting)	Control via contact
1	Control via interface



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

10.13 SETTING THE ERROR AND WARNING BEHAVIOUR

10.13.1 SETTING 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 three digital control outputs.

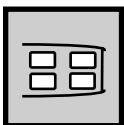
If the limits are set below the switch-off limits of the inverter then a drive, for example, can be brought to a standstill prematurely or a fan can be switched on before the inverter breaks down in the event of a warning message.

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 a an over-load limit above a frequency of 2.5 Hz. A value is hereby set which indicates at what 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.

10.13.2 OVERFREQUENCY SWITCH-OFF



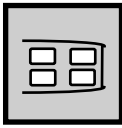
The maximum occurring output frequency of the frequency inverter can be set with the parameter *Frequency Switch-Off Limit* **417 (F OFF)**. If the *Stator Frequency* **210 (FS)** exceeds this frequency limit the inverter switches of with the error message ,**"F1100 OVERFREQUENCY"**.

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, set the switch-off frequency above the sum total of the *Maximum Frequency* **419 (FMAX)** and the *Slip Frequency* **719 (MSLMX)**.

10.13.3 EARTH FAULT IDENTIFIER



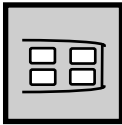
The limit of the resultant current can be set with the parameter *Earth Fault Switch-Off Limit 416 (IEOFF)*. If there is an unbalance between the three motor phases, for example due to an earth fault, the inverter will be switched off after a triple check with the error message "**F0505 Earth fault overload**". 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	$0 \cdot I_{FIN}$	$0.25 \cdot I_{FIN}$	3



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

10.13.4 DC COMPENSATION



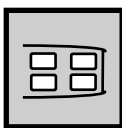
A DC component can appear in the output current at the inverter output due to unbalances. This DC component can be compensated by the inverter. The maximum output voltage of the compensation is hereby set with the parameter *IDC Compensation Limit 415 (DCCMX)*. If a voltage higher than the set limit is required to compensate the DC component the error "**F1301 IDC-compensation**" is triggered.

If this error occurs check if the load is defective. The voltage limit may have to be raised.

If the parameter *IDC Compensation Limit 415 (DCCMX)* is lowered to zero DC compensation is deactivated.

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

10.13.5 CONTROLLER STATUS



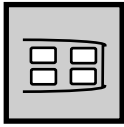
Intervention of the intelligent current limits and the speed controller can be shown by setting the *Controller-Status Message 409 (CTMSG)*. The status messages can be read out with the parameter *Controller Status 275 (CTRST)*. The limits and events leading to the intervention of the respective controller are described in the corresponding chapters.

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)*.

10.14 GENERAL SETTINGS

10.14.1 SETTING THE CONTROL LEVEL



The parameters are divided into 3 control levels.

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

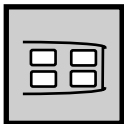
Level 2 includes all parameters from level 1. It also allows access to further parameters as well as special and control functions, e.g. controller parameters or control output settings.

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

10.14.2 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.

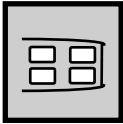
If there is no input via the keypad of the control unit KP 100 for approx. 10 minutes the password protection is automatically reactivated.

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.

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

10.14.3 ACTIVATE FACTORY SETTING



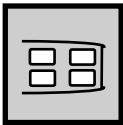
The factory setting can be activated or a RESET carried out with the parameter *Program 34 (PROG)* in control level 1. The factory setting sets the parameters for the set configuration to the default values. The guided commissioning is shown in the display of the control unit KP 100 after a reset and when the frequency inverter is switched on.

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.

10.14.4 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 an PC user interface will be shown in the chosen language.

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.

10.15 DISPLAY PARAMETERS

Various actual values and states can be read out in the KP 100 menu **VAL**. The existing display parameters can be read out via the control unit or PC user interface. The display parameters can only be read.

10.15.1 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

10.15.2 PRODUCTION DATA

The production data can only be read and are in control level 2.

10.15.2.1 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	9906269
FI - Type	Serial - No.

10.15.2.2 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:

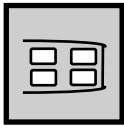
EAL-1

10.15.2.3 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

10.15.3 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 chapter contains the parameters in the menu VAL with no installed extension cards in the configuration 410 transmitter-less field-oriented control. 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.

10.15.3.1 ACTUAL VALUES OF THE FREQUENCY INVERTER

Actual values of the frequency inverter				
No.	Parameter		Control level	Contents
	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	2	Current reference frequency
245	TOP	Operation hours counter	1	Current operation hours
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 abbr. in moving script
269	WARN	Warnings	1	Warning code and abbr. 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 10.15.1 Setting the control level).

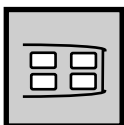
10.15.3.2 ACTUAL VALUES FOR THE MACHINE

Actual values for the machine				
No.	Parameter		Control level	Contents
	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
215	ISD	Current Isd	1	Present flux-forming current
216	ISQ	Current Isq	1	Present torque-forming current
221	FSLIP	Slip frequency	2	Load-dependent slip frequency
225	IMR	Rated magnetizing current	2	Present rated magnetizing current
226	T MOT	Winding temperature	1	Current winding temperature
227	T ROT	Current rotor time constant	3	Calculated rotor time constant
235	U SD	Flux-forming voltage	1	Current flux-forming voltage
236	U SQ	Torque-forming voltage	1	Current torque-forming voltage
240	SPEED	Actual speed	1	Measured or calculated speed of the drive
241	FREQ	Actual frequency	1	Measured or calculated frequency of the drive



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 10.15.1 Setting the control level).

10.15.3.3 ACTUAL VALUE MEMORY



The assessment and maintenance of the frequency inverter in the application is facilitated by the saving 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 mean and peak values.

Setting						
No.	Parameter		Setting range		Factory setting	Control level
	Abbr.	Meaning	Min	Max		
237	PHCLR	Reset memory	0	102	0	3

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

Setting		
Parameter 237 (PHCLR)	Function	Description
0 (Factory 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

The various values of the actual value memory can be read out via the menu VAL parameters in control level 3 according to the previous table.

Actual value memory				
No.	Parameter		Unit	Contents
	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 the specified control levels. The parameter *Control Level 28 (MODE)* allows you to change the active control level (see Chapter 10.15.1 Setting the control level).

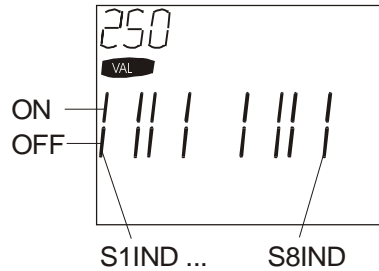
10.15.4 STATUS DISPLAY



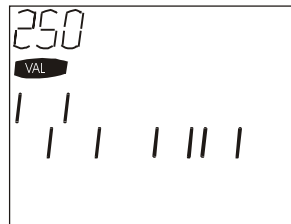
The status displays are in operation level 1 and can only be read out.

10.15.4.1 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 **250**) to be read out via the optional PC user interface is coded as a decimal value. The operational state given in the example corresponds to the decimal value 5 to be read out.

10.15.4.2 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)*.

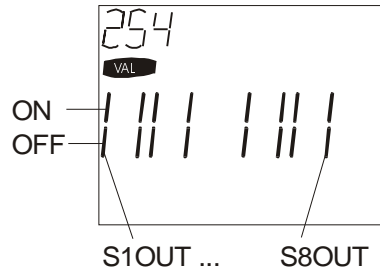
10.15.4.3 READ OUT ACTIVE DATA SET

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

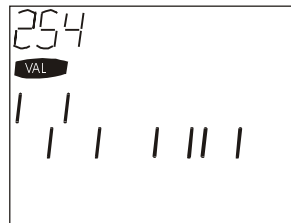
10.15.4.4 STATUS OF THE DIGITAL OUTPUTS

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 **254**) to be read out via the optional PC user interface is coded as a decimal value. The operational state given in the example corresponds to the decimal value 5 to be read out

10.15.4.5 OUTPUT SIGNAL OF THE ANALOG OUTPUT

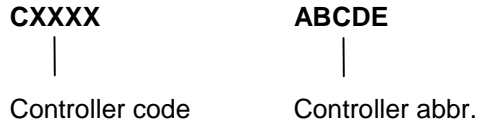
The output current at the analog output S1OUTAI can be read out with the parameter *Analog Output 1 257 (OUTA1)*.

This value depends on the configuration set with the parameter Operation mode *Analog Output 1 550 (O1SEL)*. (see Chapter 10.4)

The output signal at connection S1OUTAI can be between -20mA and +20mA.

10.15.4.6 STATUS OF THE CONTROLLERS

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



The following status displays are available in the configuration 410:

Status display		
Controller code	Controller abbr.	Meaning
C0000		No controller active
C0020	ILIM	Isq current limit 728 (SCULI) or 729 (SCLLI) reached (Speed controller limited)
C0040	TLIM	Torque limit 730 (SCULT), 731 (SCLLT) or power limit 739 (SCULP), 740 (SCLLP) reached (Speed controller limited)
C0100	IXTLIM	Utilisation limit of overload above the starting current impression (0 Hz – 2.5 Hz) reached (limit intelligent current limits)
C0200	IXTDCLIM	Utilisation limit of overload in the range of the starting current impression (0 Hz – 2.5 Hz) reached (limit intelligent current limits)
C0400	TCLIM	The pre-set warning limit for the heat sink temperature has been reached. (limit intelligent current limits)
C0800	PTCLIM	The pre-set warning limit for the motor temperature has been reached (limit intelligent current limits)

If several controllers are in operation at the time of the intervention 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

C0040 TLIM

The pre-set power limit or torque limit has been reached in the speed control controller function.

10.15.5 ERROR AND WARNING MESSAGES

10.15.5.1 CURRENT ERRORS

The parameter *Current Error 259 (ERROR)* displays the current pending error. The error messages and their meanings can be found in Chapter 11.2.2.

10.15.5.2 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 11.2.1.

10.15.5.3 ERROR SUM

The number of errors faults which have appeared since delivery of the inverter can be read out with the parameter *No. Off 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.

10.15.5.4 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		Error messages	
Parameter number	Parameter abbr.	Parameter number	Parameter abbr.
310	ERR1	318	ERR9
311	ERR2	319	ERR10
312	ERR3	320	ERR11
313	ERR4	321	ERR12
314	ERR5	322	ERR13
315	ERR6	323	ERR14
316	ERR7	324	ERR15
317	ERR8	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.

HHHHH - MM FXXX abcdefghijklmn
 | | | |
 Operation Operation Error Text of the
 hours minutes code error type

Example : 0012 56 F0500 OVERCURRENT

An overcurrent has occurred 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 (see Chapter 10.14.1) must be set. The meaning of the error codes can be found in Chapter 11.2.2.

10.15.6 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 user interface, 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.

10.15.6.1 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.

10.15.6.2 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	Speed sensor 1 frequency	Act. value optional extension card
334	EEC2	Speed sensor 2 frequency	Act. 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	Current amount	Output current
339	EISD	Current Isd	Flux-forming current
340	EISQ	Current Isq	Torque-forming current
341	EIMR	Current Imr	Magnetizing 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 hexadecimal value (decimal code)
351	EOUTD	Status of digital outputs	Status of the digital outputs as hexadecimal 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 Min- Seconds hours utes
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 saved error environment

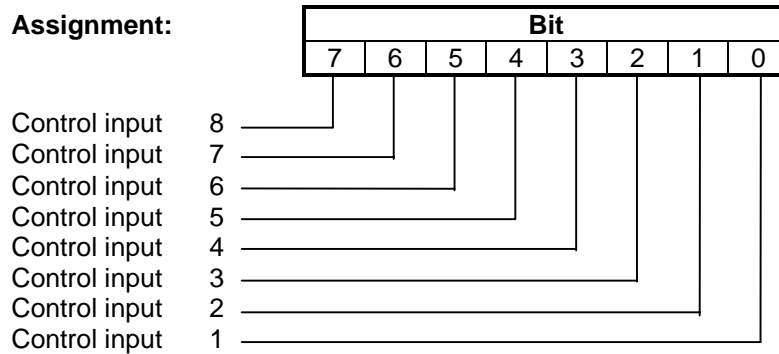


Note: The actual error values are saved after the occurrence of an error and are controlled with the checksum. If the frequency inverter remains inoperative after the error the error environment may be faulty. If the actual error values are improbable check the installation against the current EMC and installation guidelines.

STATUS CODING OF THE DIGITAL INPUTS

A decimal value is displayed which indicates the status of the inputs 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.

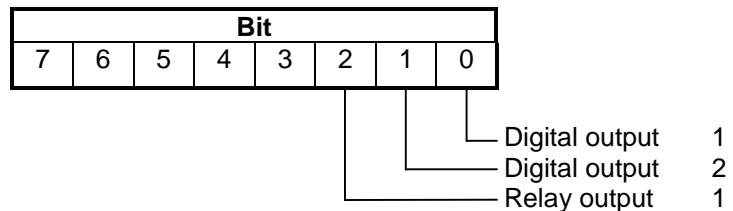
Example: The decimal value 45 is displayed. Conversion to the binary system results in the bit combination **00101101**. The following contact inputs are thus activated:

- Control input 1
- Control input 3
- Control input 4
- Control input 6

STATUS CODING OF THE DIGITAL OUTPUTS

A decimal value is displayed which indicates the status of the outputs bit-by-bit after conversion to a binary number.

Assignment:



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

Example: The decimal value 03 is displayed. Conversion to the binary system results in the bit combination **00000011**. The following outputs are thus active

- Digital output 1
- Digital output 2 active.

Coding the 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**
 | |
 Controller code Controller abbr.

The following status displays are possible:

Status displays		
Controller code	Controller abbr.	Meaning
C0000		No controller active
C0020	ILIM	Isq current limit 728 (SCULI) or 729 (SCLLI) reached (Speed controller limited)
C0040	TLIM	Torque limit 730 (SCULT), 731 (SCLLT) or power limit 739 (SCULP), 740 (SCLLP) reached (Speed controller limited)
C0100	IXTLIM	Utilisation limit of overload above the starting current impression (0 Hz – 2.5 Hz) reached (limit intelligent current limits)
C0200	IXTDCLIM	Utilisation limit of overload in the range of the starting current impression (0 Hz – 2.5 Hz) reached (limit intelligent current limits)
C0400	TCLIM	The pre-set warning limit for the heat sink temperature has been reached. (limit intelligent current limits)
C0800	PTCLIM	The pre-set warning limit for the motor temperature has been reached (limit intelligent current limits)

If several controllers are in operation at the time of the intervention 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
C0040 TLIM

The pre-set power limit or torque limit has been reached in the speed control controller function.

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.

CXXXX **ABCDE**
 | |
 Warning code Warning abbr.

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

If more than one warning were present 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 11.2.1.

11 OPERATION AND ERROR DIAGNOSIS

11.1 LED DISPLAYS

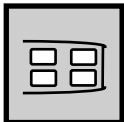
The two light-emitting diodes LED H1 (green) and LED H2 (red) in the frequency inverter indicate the status of the inverter. The position of the LED's is shown in the construction and layout diagram in Chapter 2.1. of the operating instructions part 1.

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 ready and released and signals "warning" (see Chapter 11.2.1).
flashes	flashes	Unit ready and not released and signals "warning" (see Chapter 11.2.1).
off	flashes	Unit error. Error not yet acknowledgeable (see Chapter 11.2.2).
off	on	Unit error. Error acknowledgeable (see Chapter 11.2.2).

The named statuses of the frequency inverter are supplemented by the *Controller Status Message 409 (CTMSG)*. The function described in Chapter 10.13.5 allows the user to be shown the limitation of a controller by the red LED .

11.2 DISPLAYS IN THE CONTROL UNIT KP 100

11.2.1 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 <i>Warning Limit IxT-DC 405 (WIXTD)</i> .
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 <i>Warning Limit IxT 406 (WIXT)</i> .

Warning messages (cont.)		
KP 100 display		Meaning Measures / Remedy
Code	Abbr.	
W0008	TC	Heat sink temperature shortly before switch-off limit. Check <i>Heat Sink Temperature 255 (TC)</i> , mounting position, cooling and fan. The threshold value for this warning message can be set with the parameter <i>Warning Limit Tc 407 (WTC)</i> ..
W0010	TI	Inside temperature shortly before switch-off limit. Check <i>Inside Temperature 256 (TI)</i> , mounting position, cooling and fan. The threshold value for this warning message can be set with the parameter <i>Warning Limit Ti 408 (WTI)</i> .
W0020	ILIM	Reference values are limited by a controller..
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 <i>Operation Mode Analog Input 1 452 (A1SEL)</i> activates the monitoring function.
W1000	A2	Analog value 1 not present or below the configured minimum value. The <i>Operation Mode Analog Input 1 460 (A2SEL)</i> activates the monitoring function.
W2000	A3	Analog value 1 not present or below the configured minimum value. The <i>Operation Mode Analog Input 1 470 (A3SEL)</i> activates the monitoring function.
W4000	UDC	DC - link voltage reached the lower limit

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 10.5).

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 fault when a warning message appears.

11.2.2 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 10.16.4.4)

Error messages		
KP 100 display		Meaning
Code	Text	Measures / Remedy
F0000	NO ERROR	No error has occurred.
F0100	IXT	Inverter 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 <i>Heat Sink Temperature 255 (TC)</i> , mounting position, cooling and fan.
F0201	HEAT SINK SENSOR	Temperature sensor is defective or unit is too cold (see permissible temperature range). Check <i>Heat Sink Temperature 255 (TC)</i> .
F0300	OVER-TEMPERATURE	Inside temperature over 70°C. Check <i>Inside Temperature 256 (TI)</i> , mounting position, cooling and fan.
F0301	UNDER-TEMPERATURE	Inside temperature under 0 °C. Check <i>Inside Temperature 256 (TI)</i> , 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.
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 LIMITATION	Overload too long with activated current limit controller. Check drive and motor. Increase current limit.
F0505	EARTH FAULT	Incorrect sum of line currents, check motor and cabling
F0700	OVERVOLTAGE	DC-link voltage too high. Check <i>DC-Link Voltage 222 (UDC)</i> and mains voltage, extend deceleration ramp, if necessary add brake unit.

Error messages (cont.)		
KP 100 display		Meaning Measures / Remedy
Code	Text	
F0701	UNDERVOLTAGE	DC-link voltage too low. Check <i>DC-Link Voltage</i> 222 (UDC) and mains voltage and stabilise if necessary. Delay repeat switching of the mains relay by at least 10 s.
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 <i>Frequency Switch-Off Limit</i> 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 13 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 10.3.4).
A collective fault message can be output via the digital control outputs **S1OUT**, **S2OUT** or the relay output **S3OUT** (see chapter 10.5).
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 8.6).

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 in the above list we will be pleased to advise you by telephone.

12 PARAMETER LISTS

12.1 DISPLAY PARAMETERS IN CONFIGURATION 410

Menu VAL (Actual value)						
No.	Abbr.	Control level	Name / Meaning	Dim.	Display range	Chapter
210	FS	1	Stator Frequency	Hz	0.00 ... 999.99	10.15.3.2
211	I RMS	1	R.m.s Current	A	0.0 ... I _{max}	10.15.3.2
212	U RMS	1	Output Voltage	V	0.0 ... 460.0	10.15.3.2
213	PW	1	Active Power	kW	0.0 ... 0 · P _{FIN}	10.15.3.2
215	I SD	1	Isd	A	0.0 ... I _{max}	10.15.3.2
216	I SQ	1	Isq	A	0.0 ... I _{max}	10.15.3.2
222	UDC	1	DC-Link Voltage	V	0.0 ... 800.0	10.15.3.1
223	A	2	Modulation	%	0 ... 100	10.15.3.1
226	T MOT	1	Winding Temperature	°C	0.0 ... 300	10.15.3.2
227	T ROT	3	Act. Rotor Time Constant	ms	0.0 ... type	10.15.3.2
228	FREF	2	Internal Reference Frequency	Hz	0.00 ... f _{max}	10.15.3.1
235	U SD	1	Flux-Forming Voltage	V	0.0	10.15.3.2
236	U SQ	1	Torque-Forming Voltage	V	0.0	10.15.3.2
240	SPEED	1	Actual Speed	1/min	0 ... 60000	10.15.3.2
241	FREQ	1	Actual Frequency	Hz	0.00 ... 999.99	10.15.3.2
245	TOP	1	Operation Hours Counter	h	9999	10.15.3.1
249	DSET	2	Active Data Set	-	1 ... 4	10.15.3.1
250	IND	1	Digital Inputs	-	8 Bit	10.15.3.1
251	INA1	1	Analog Input 1	V	-10.00 ... +10.00	10.15.3.1
252	INA2	1	Analog Input 2	V	-10.00 ... +10.00	10.15.3.1
253	INA3	1	Analog Input 3	mA	-20.00 ... +20.00	10.15.3.1
254	OUTD	1	Digital Outputs	-	8 Bit	10.15.3.1
255	TC	1	Heat Sink Temperature	°C	0.0 ... 100.0	10.15.3.1
256	TI	1	Inside Temperature	°C	0.0 ... 100.0	10.15.3.1
257	OUTA1	1	Analog Output 1	mA	-20.0 ... +20.0	10.15.3.1
259	ERROR	1	Current Error	-	F0000 ... F9999	10.15.3.1
269	WARN	1	Warnings	-	W0000 ... W9999	10.15.3.1
275	CTRST	3	Controller Status	-	C0000 ... C9999	10.15.3.1
361	CHSUM	3	Checksum	-	OK ... NOK	10.15.6.2
362	ESUM	3	No. of Errors	-	0 ... 32767	10.15.5.3

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	10.15.3.3
232	PHIDC	3	Peak Value IxT-DC	%	0.00 ... 999.99	10.15.3.3
287	UDMAX	3	Peak Value Udc	V	0.0 ... 9999.9	10.15.3.3
288	UDAVG	3	Average Value Udc	V	0.0 ... 9999.9	10.15.3.3
289	TCMAX	3	Peak Value Tc	°C	0.0 ... 99.9	10.15.3.3
290	TCAVG	3	Average Value Tc	°C	0.0 ... 99.9	10.15.3.3
291	TIMAX	3	Peak Value Ti	°C	0.0 ... 99.9	10.15.3.3
292	TIAVG	3	Average Value Ti	°C	0.0 ... 99.9	10.15.3.3
293	IMAX	3	Peak Value Iabs.	A	0.0 ... 9999.9	10.15.3.3
294	IAVG	3	Average Value Iabs.	A	0.0 ... 9999.9	10.15.3.3
295	PMAXP	3	Peak Value Active Power pos.	kW	0.0 ... + 9999.9	10.15.3.3
296	PMAXN	3	Peak Value Active Power neg.	kW	0.0 ... - 9999.9	10.15.3.3
297	PAVG	3	Average Value Active Power	kW	0.0 ... 9999.9	10.15.3.3
301	ENRGP	3	Energy, positive	kWh	0.0 ... + 99999	10.15.3.3
302	ENRGN	3	Energy, negative	kWh	0.0 ... - 99999	10.15.3.3

12.2 ERROR MEMORY IN CONFIGURATION 410

Menu VAL (Actual value memory)

No.	Abbr.	Control level	Name / Meaning	Dim.	Display range	Chapter
310	ERR1	1	00000:00; Last Error	-	F0000 ... F9999	10.15.5.4
311	ERR2	1	00000:00; Last Error but one	-	F0000 ... F9999	10.15.5.4
312	ERR3	1	00000:00; Error 3	-	F0000 ... F9999	10.15.5.4
313	ERR4	1	00000:00; Error 4	-	F0000 ... F9999	10.15.5.4
314	ERR5	2	00000:00; Error 5	-	F0000 ... F9999	10.15.5.4
315	ERR6	2	00000:00; Error 6	-	F0000 ... F9999	10.15.5.4
316	ERR7	2	00000:00; Error 7	-	F0000 ... F9999	10.15.5.4
317	ERR8	2	00000:00; Error 8	-	F0000 ... F9999	10.15.5.4
318	ERR9	2	00000:00; Error 9	-	F0000 ... F9999	10.15.5.4
319	ERR10	2	00000:00; Error 10	-	F0000 ... F9999	10.15.5.4
320	ERR11	2	00000:00; Error 11	-	F0000 ... F9999	10.15.5.4
321	ERR12	2	00000:00; Error 12	-	F0000 ... F9999	10.15.5.4
322	ERR13	2	00000:00; Error 13	-	F0000 ... F9999	10.15.5.4
323	ERR14	2	00000:00; Error 14	-	F0000 ... F9999	10.15.5.4
324	ERR15	2	00000:00; Error 15	-	F0000 ... F9999	10.15.5.4
325	ERR16	2	00000:00; Error 16	-	F0000 ... F9999	10.15.5.4

12.3 ERROR ENVIRONMENT IN CONFIGURATION 410

Menu VAL (Actual error values)

330	EUDC	3	DC-Link Voltage	V	0.0 ... 800.0	10.15.6.2
331	EURMS	3	Output Voltage	V	0.0 ... 460.0	10.15.6.2
332	EFS	3	Stator Frequency	Hz	0.00 ... 999.99	10.15.6.2
333	EEC1	3	Speed Sensor 1 Frequency	Hz	0.00 ... 999.99	10.15.6.2
334	EEC2	3	Speed Sensor 2 Frequency	Hz	0.00 ... 999.99	10.15.6.2
335	EIA	3	Phase Current Ia	A	0.0 ... I _{max}	10.15.6.2
336	EIB	3	Phase Current Ib	A	0.0 ... I _{max}	10.15.6.2
337	EIC	3	Phase Current Ic	A	0.0 ... I _{max}	10.15.6.2
338	EIRMS	3	Effective Current	A	0.0 ... I _{max}	10.15.6.2
339	EISD	3	Isd / Reactive Current	A	0.0 ... I _{max}	10.15.6.2
340	EISQ	3	Isq / Active Current	A	0.0 ... I _{max}	10.15.6.2
341	EIMR	3	Rotor Magnetizing Current	A	0.0 ... I _{max}	10.15.6.2
342	ET	3	Torque	Nm	± 9999.9	10.15.6.2
343	EINA1	3	Analog Input 1	V	-10.0 ... +10.0	10.15.6.2
344	EINA2	3	Analog Input 2	V	-10.0 ... +10.0	10.15.6.2
345	EINA3	3	Analog Input 3	mA	-20.0 ... +20.0	10.15.6.2
346	EOUT1	3	Analog Output 1	mA	-20.0 ... +20.0	10.15.6.2
347	EOUT2	3	Analog Output 2	mA	-20.0 ... +20.0	10.15.6.2
348	EOUT3	3	Analog Output 3	mA	-20.0 ... +20.0	10.15.6.2
349	EFO	3	Repetition Frequency Output	Hz	0.00 ... 999.99	10.15.6.2
350	EIND	3	Status of Digital Inputs	-	00 ... FF	10.15.6.2
351	EOUTD	3	Status of Digital Outputs	-	00 ... 07	10.15.6.2
352	ETIME	3	Time since Release	h.m.ms	00000:00:00.000	10.15.6.2
353	ETC	3	Heat Sink Temperature	°C	0.0	10.15.6.2
354	ETI	3	Inside Temperature	°C	0.0	10.15.6.2
355	EC	3	Controller Status	-	C0000 ... CFFFF	10.15.6.2
356	EW	3	Warning Status	-	W0000 ... W9999	10.15.6.2
357	EI1	3	Int Value 1	-	± 32768	10.15.6.2
358	EI2	3	Int Value 2	-	± 32768	10.15.6.2
359	EF1	3	Long Value 1	-	± 2147483647	10.15.6.2
360	EF2	3	Long Value 2	-	± 2147483647	10.15.6.2



Note:

The error environment can be read out over the control unit KP100 for the last occurred error. The optionally available PC user interface (Chapter 7) enables the selection to the error environment of the last four errors in the available data sets.

VECTRON

12.4 COMMISSIONING PARAMETERS IN CONFIGURATION 410

Production data

No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
0	SN	2	Serial Number	-	Character	10.15.1	-	
1	OPT	2	Optional Modules	-	Character	15.2.2	-	

Specific data

10	BAUD	2	Baud Rate	-	1 ... 4	10.12.8	3	
12	VERS	2	Inverter Software Version	-	Character	10.15.2.3	Fl type	
27	PASSW	1	Set Password	-	0 ... 999	10.14.2	0	
28	MODE	1	Control Level	-	1 ... 3	10.14.1	1	
29	NAME	2	User Name	-	33 Character	10.15.1	-	










Configuration data

30	CONF	1	Configuration	-	Selection	10.1	110	
33	LANG	1	Language	-	0: Germany 1: English	10.14.4	0	
34	PROG	1	Program	-	123: Reset 4444: Fact. setting	10.14.3	-	
39	TVENT	2	Switch-On Temperature	°C	0 ... 75	10.12.6	0	

Actual value memory

237	PHCLR	3	Reset Memory	-	Selection	10.15.3.3	0	
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Motor data

370	MUR	 1	Rated Voltage	V	100.0 ... 800.0	10.6	400.0	
371	MIR	 1	Rated Current	A	$0.1 \cdot I_{FIN}$... $10 \cdot 0 \cdot I_{FIN}$	10.6	I_{FIN}	
372	MNR	 1	Rated Speed	1/min	96 ... 60000	10.6	1490	
373	MPP	 1	No. of Pole Pairs	-	1 ... 24	10.6	2	
374	MCOPR	 1	Rated Cosinus Phi	-	0.01 ... 1.00	10.6	0.85	
375	MFR	 1	Rated Frequency	Hz	10.00 ... 1000.00	10.6	50.00	
376	MPR	 1	Rated Mech. Power	kW	$0.1 \cdot P_{FIN}$... $10 \cdot P_{FIN}$	10.6	P_{FIN}	
377	RS	 2	Stator Resistance	mΩ	0 ... 6000	10.6	Fl type	
378	SIGMA	 3	Leakage Coeff.	%	1.0 ... 20.0	10.6	7.0	

Pulse width modulation

400	FT	1	Switching Frequency	kHz	1 ... 8	10.12.7.1	Fl type	
402	PWCOM	2	Switching Compensation	%	0 ... 200	10.12.7.2	50	






.....Can be switched over in the data set

VECTRON

General functions

No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
405	WIXTD	3	Warning Limit IxT-DC	%	6 ... 100	10.13.1	80	
406	WIXT	3	Warning Limit IxT	%	6 ... 100	10.13.1	80	
407	WTC	3	Warning Limit Tc	°C	-25 ... 0	10.13.1	-5	
408	WTI	3	Warning Limit Ti	°C	-25 ... 0	10.13.1	-5	
409	CTMSG	3	Controller-Status Message	-	Selection	10.13.5	1	
412	REMOT	3	Local/Remote-Flag	-	0,1	10.12.8	0	
413	WDOG	3	RS232/RS485 Watchdog Timer	s	0 ... 10000	10.12.8	0	
415	DCCMX	3	IDC Compensation Limit	V	0 ... 1.5	10.13.4	1.5	
416	IEOFF	3	Earth Fault Switch-Off Limit	A	0.0 ... $0 \cdot I_{FIN}$	10.13.3	0.25 $\cdot I_{FIN}$	

Frequencies / Ramps




417	F OFF	2	Frequency Switch-off Limit	Hz	0.00 ... 999.99	10.13.2	999.99	
418	FMIN	 1	Minimum Frequency	Hz	0.00 ... 999.99	10.2.2.1	3.50	
419	FMAX	 1	Maximum Frequency	Hz	0.00 ... 999.99	10.2.2.1	50.00	
420	RACCR	 1	Acceleration Clockwise	Hz/s	0.00 ... 9999.99	10.10	1.00	
421	RDECR	 1	Deceleration Clockwise	Hz/s	0.01 ... 9999.99	10.10	1.00	
422	RACCL	 1	Acceleration Anticlockwise	Hz/s	0.00 ... 9999.99	10.10	1.00	
423	RDECL	 1	Deceleration Anticlockwise	Hz/s	0.01 ... 9999.99	10.10	1.00	
424	RDNCR	 1	Emergency Stop Clockwise	Hz/s	0.01 ... 9999.99	10.10	1.00	
425	RDNCL	 1	Emergency Stop Anticlockwise	Hz/s	0.01 ... 9999.99	10.10	1.00	
426	RFMX	 3	Maximum Leading	Hz	0.01 ... 999.99	10.10	5.00	
430	RRTR	 1	Ramp Rise Time Clockwise	ms	0 ... 65000	10.10	100	
431	RFTR	 1	Ramp Fall Time Clockwise	ms	0 ... 65000	10.10	100	
432	RRTL	 1	Ramp Rise Time Anticlockwise	ms	0 ... 65000	10.10	100	
433	RFTL	 1	Ramp Fall Time Anticlockwise	ms	0 ... 65000	10.10	100	
447	FB1	 2	1st Blocking Frequency	Hz	0.00 ... 999.99	10.12.3	0.00	
448	FB2	 2	2nd Blocking Frequency	Hz	0.00 ... 999.99	10.12.3	0.00	
449	FBHYS	 2	Frequency Hysteresis	Hz	0.00 ... 100.00	10.12.3	0.00	








..... Can be switched over in the data set

VECTRON

Analog inputs								
No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
450	TBLOW	2	Zero-Point Tolerance Band	%	0.00 ... 25.00	10.2.3	2.00	
451	TBUPP	2	End-Point Tolerance Band	%	0.00 ... 25.00	10.2.3	2.00	
452	A1SEL	2	Op. Mode Analog Input 1	-	Selection	10.2.1	1	
453	A1SET	2	Upp. End Point A1	V	-6.00 ... 10.00	10.2.4	10.00	
454	A1OFF	2	Zero Point A1	V	-8.00 ... 8.00	10.2.4	0.00	
460	A2SEL	2	Op. Mode Analog Input 2	-	Selection	10.2.1	1	
461	A2SET	2	Upper End Point A2	V	-6.00 ... 10.00	10.2.4	5.00	
462	A2OFF	2	Zero Point A2	V	-8.00 ... 8.00	10.2.4	0.00	

Temperature adjustment								
465	MTSEL	 3	Operation Mode Temp. Adjustment	-	Selection	10.12.2	0	
466	MTCAL	 3	Temperature Coefficient	%/100	xx.xx %/100°C	10.12.2	39.00	
467	MTCAT	 3	Adjusting Temperature	°C	-50.0 ... 300.0	10.12.2	100.0	

Analog inputs								
470	A3SEL	2	Op. Mode Analog Input 3	-	Selection	10.2.1	1	
471	A3SET	2	Upper End Point A3	mA	-12.00 ... 20.00	10.2.4	20.00	
472	A3OFF	2	Zero Point A3	mA	-16.00 ... 16.00	10.2.4	0.00	

Reference values								
474	MPOTI	2	Operation Mode	-	Selection	10.3.3.2	0	
475	RFSEL	 1	Reference Frequency Source	-	Selection	10.9	5	
480	FF1	 1	Fixed Frequency 1	Hz	-999.99 ... +999.99	10.3.3.1	5.00	
481	FF2	 1	Fixed Frequency 2	Hz	-999.99 ... +999.99	10.3.3.1	10.00	
482	FF3	 1	Fixed Frequency 3	Hz	-999.99 ... +999.99	10.3.3.1	25.00	
483	FF4	 1	Fixed Frequency 4	Hz	-999.99 ... +999.99	10.3.3.1	50.00	




Brake chopper								
506	UD BC	3	Brake chopper Trigger Threshold	V	425.0 ... 1000.0	10.12.5	725.0	



..... Can be switched over in the data set

VECTRON

Limit values

No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
510	FTRIG	 2	Setting Frequency	Hz	0.00 ... 999.99	10.5.1	3.00	
518	PRMIN	 1	Minimum Reference Percentage	%	0.00 ... 300.00	10.2.2.2	0.00	
519	PRMAX	 1	Maximum Reference Percentage	%	0.00 ... 300.00	10.2.2.2	100.00	


Digital and relay output

530	D1SEL	2	Op. Mode Digital Output 1	-	Selection	10.5	4	
531	D2SEL	2	Op. Mode Digital Output 2	-	Selection	10.5	2	
532	D3SEL	2	Op. Mode Digital Output 3	-	Selection	10.5	103	
540	C1SEL	2	Op. Mode Comparator 1	-	Selection	10.5.6	1	
541	C1ON	2	Comparator On above	%	-300.00 ... +300.00	10.5.6	100.00	
542	C1OFF	2	Comparator Off below	%	-300.00 ... +300.00	10.5.6	50.00	
543	C2SEL	2	Op. Mode Comparator 2	-	Selection	10.5.6	1	
544	C2ON	2	Comparator On above	%	-300.00 ... +300.00	10.5.6	100.00	
545	C2OFF	2	Comparator Off below	%	-300.00 ... +300.00	10.5.6	50.00	
549	DEVMX	2	Max. Control Deviation	%	0.01 ... 20.00	10.5.2	5.00	




Analog output

550	O1SEL	1	Op. Mode Analog Output 1	-	Selection	10.4.1	1	
551	O1OFF	1	Zero Adjustment A1	%	-100.0 ... +100.0	10.4.2.1	0.0	
552	O1SC	1	Amplification A1	%	5.0 ... 1000.0	10.4.2.2	50.0	




Motor protective switch

571	MSEL	 2	Operation Mode motor protective switch	-	Selection	10.12.4	0	
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Intelligent current limits

573	LISEL	 1	Operation Mode	-	Selection	10.11.1	31	
574	LIPR	 1	Power Limit	%	40.00 ... 95.00	10.11.1	80.00	
575	LID	 1	Limitation Time	min	5 ... 300	10.11.1	15	

Starting behaviour




623	STI	 1	Starting Current	A	$0.01 \cdot I_{FIN} \dots 0 \cdot I_{FIN}$	10.7	I_{FIN}	
624	STFMX	 2	Frequency Limit	Hz	0.00 ... 100.00	10.7	2.60	
625	STFHV	 2	Hysteresis Frequency	Hz	0.50 ... 10.00	10.7	2.50	



..... Can be switched over in the data set

VECTRON



Stopping behaviour

No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
630	DISEL	 1	Operation Mode stopping behaviour	-	Selection	10.8	11	
637	DIOFF	 3	Switch-Off Threshold	%	0.0 ... 100.0	10.8	1.0	
638	DI T	 3	Holding Time	s	0.0 ... 200.0	10.8	1.0	





Auto - start

651	ASSEL	1	Operation Mode Autostart	-	0: Off 1: On	10.12.1	0 (Off)	
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Current controller

700	CC V	 3	Amplification current controller		0.00 ... 2.00	10.11.2	0.13	
701	CC TI	 3	Integral Time current controller	ms	0.00 ... 10.00	10.11.2	10.00	




Additional motor parameters

716	MIMAG	 1	Rated Magnetizing Current	A	$0.01 \cdot I_{FIN} \dots 0 \cdot I_{FIN}$	10.6	$0.3 \cdot I_{FIN}$	
717	MFLUX	 3	Reference Flux	%	0.01 ... 300.00	10.11.5	100.00	
718	MSLIP	 3	Rated Slip Correction Factor	%	0.01 ... 300.00	10.6	100.00	
719	MSLMX	 3	Slip Frequency	%	0 ... 10000	10.2.2.1	500	

Speed controller

720	SCSEL	 2	Operation Mode speed controller	-	Selection	10.11.3	1	
721	SC V1	 2	Amplification 1	-	0.00 ... 200.00	10.11.3	5.00	
722	SCTI1	 2	Integral Time 1	ms	0 ... 60000	10.11.3	200	
723	SC V2	 2	Amplification 2	-	0.00 ... 200.00	10.11.3	5.00	
724	SCTI2	 2	Integral Time 2	ms	0 ... 60000	10.11.3	200	

Acceleration Pre-Control

725	ACSEL	 2	Operation Mode Acceleration Pre-Control	-	0: Off 1: On	10.11.4	0	
726	ACMIN	 2	Minimum Acceleration	Hz/s	0.1 ... 6500.0	10.11.4	1.0	
727	AC TM	 2	Mech. Time Constant	ms	1 ... 60000	10.11.4	10	



..... Can be switched over in the data set

VECTRON

Speed controller limits

No.	Abbr.	Ctrl. level	Name / Meaning	Dim.	Display range	Chapter	Fact. setting	Cust. setting
728	SCULI	2	Isq Upper Limit	A	0.0 ... 0·I _{FIN}	10.11.3.1	I _{FIN}	
729	SCLLI	2	Isq Lower Limit	A	0.0 ... 0·I _{FIN}	10.11.3.1	I _{FIN}	
730	SCUPT	2	Torque Upper Limit	%	0.00 ... 650.00	10.11.3.1	650.00	
731	SCLLT	2	Torque Lower Limit	%	0.00 ... 650.00	10.11.3.1	650.00	
732	SCUPT	2	P-Comp. Torque Upper Limit	%	0.00 ... 650.00	10.11.3.1	100.00	
733	SCLPT	2	P-Comp. Torque Lower Limit	%	0.00 ... 650.00	10.11.3.1	100.00	
734	SCSUI	2	Isq Upper Limit Source	-	Selection	10.11.3.2	110	
735	SCSLI	2	Isq Lower Limit Source	-	Selection	10.11.3.2	110	
736	SCSUT	2	Torque Upper Limit Source	-	Selection	10.11.3.2	110	
737	SCSLT	2	Torque Lower Limit Source	-	Selection	10.11.3.2	110	
738	SCSWP	3	Switch-Over Limit	Hz	0.00 ... 999.99	10.11.3	0.00	
739	SCULP	2	Upper Power Limit	kW	0.00 ... 2 o P _{FIN}	10.11.3.1	2 o P _{FIN}	
740	SCLLP	2	Lower Power Limit	kW	0.00 ... 2 o P _{FIN}	10.11.3.1	2 o P _{FIN}	

Field controller

741	FC V	2	Amplification	-	0.0 ... 200.0	10.11.5	4.0	
742	FC TI	2	Integral Time	ms	0.0 ... 200.0	10.11.5	200.0	
743	FC UL	2	Ref. Isd Upper Limit	A	0.1·I _{FIN} ... 0·I _{FIN}	10.11.5.1	I _{FIN}	
744	FC LL	2	Ref. Isd Lower Limit	A	- I _{FIN} ... I _{FIN}	10.11.5.1	0.0	

Modulation controller

750	MCREF	2	Reference Modulation	%	3.00 ... 98.00	10.11.6	95.00	
751	MC V	2	Amplification	-	0.00 ... 2.00	10.11.6	0.50	
752	MC TI	2	Integral Time	ms	0.0 ... 100.0	10.11.6	40.0	
753	MCSEL	2	Operation Mode	-	Selection	10.11.6	0	
755	MC LL	2	Reference Imr Lower Limit	A	0.01·I _{FIN} ... 0·I _{FIN}	10.11.6.1	0.05·I _{FIN}	
756	MCLCD	2	Control Deviation Limitation	%	0.00 ... 100.00	10.11.6.1	10.00	

Flux formation

780	FCTFF	3	Max. Flux-Formation Time	ms	1 ... 10000	10.7	1000	
781	FCIFF	3	Current during Flux-Formation	A	0.1·I _{FIN} ... 0·I _{FIN}	10.7	I _{FIN}	



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