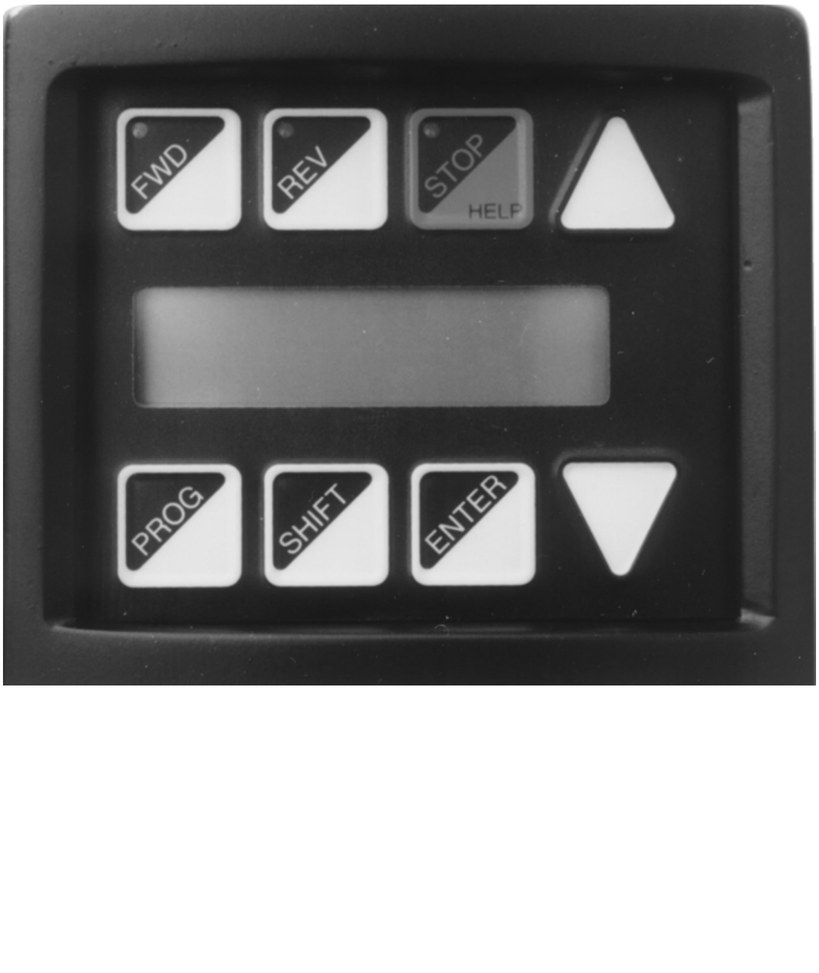
BERGES

# Parameter Description

**Version ≥ A19.07**
**Part 2**




UD UNIVERSAL Drive 7000

# Table of Contents (Operating Instructions [Part 1])

Page

# Table of Contents (Parameter Description [Part 2])

# 6 Commissioning

## 6.1 Prior to Switch-On

### 6.1.1 Entering Parameters

Familiarise yourself with the functions of the display and operator-control unit ABE (also referred to as keyboard and display below). Section 7.2.4, “Operating Examples”, explains, by way of examples, how a parameter is edited. Please note the information on the various keys and keyboard short-cuts in Tables 7.3, 7.4 and 7.5, so as to fully exhaust all capabilities of parameter assignment.

Normally, entry of a new parameter value is processed by the inverter directly after it is confirmed with SHIFT or ENTER and takes effect at the latest when message “Stored” disappears again. Parameters necessitating a restart are exceptions. This description contains a corresponding note in conjunction with these parameters.

### 6.1.2 Selection Parameters

**ATTENTION!**

Always ensure that **only the selection options documented in the Manual** are set.

Undocumented selection values may lead to unexpected and/or dangerous states (background: the UD 7000 features a wide variety of special applications with solutions for special problems in the field of drive engineering. Selection options are reserved for these applications). Our Sales Division will be more than willing to inform you of the currently available applications and can make available to you the corresponding application descriptions on request.

In the case of the so-called “selection parameters”, it is also possible to enter values which are not documented. Please note the following points so as to avoid danger to operating staff and the system itself:

1. After entering a parameter, check whether the selected value is correct and has been accepted.
2. If the entered value does not match the current operating state of the inverter (since, for instance, it is illegal for the active application), the UD 7000 may automatically change the value to the factory default setting, the value zero or the value active previously. These settings must then be checked:
   - What application is active?
   - LOCAL or REMOTE mode?
   - Have the output stages been enabled?
   - Is an error or fault pending?

### 6.1.3 Parameter Sets

The UD 7000 features three equivalent parameter sets. Entered parameters and the results of measurements in the test mode are always only ever stored in the active parameter set (parameter **E9 – Customer parameter set**). Set 1 is active by default.

The active parameter set can be changed over either with the parameter **E9 – Customer parameter set** or with the aid of **binary inputs.** To this end, one of the binary inputs R/J, PS1–PS3 must be programmed to the corresponding function (see parameters 98–9B). Parameter sets can only be changed over in the stop state.

As one parameter set will be adequate for the majority of applications, it is possible to use the second or third one to back up the optimized settings. For further information, refer to the description of the parameters **E9 – Customer parameter set** and **EA – Application-dependent defaults** in Section 8.14 of this parameter description.

The parameter sets may contain diverse applications (parameter 2C). If, in the event of a parameter set change-over, the unit detects that the new set contains a different application, the inverter is restarted directly after the set change-over in order to adapt the inverter environment.

**ATTENTION!**

If the change in the parameter set also results in a change in the motor data, the application number or other important motor quantities (stator and rotor resistance or controller parameters etc.), this may lead to a situation in which the inverter loses control of the motor. This is why a safety function is integrated (parameter 8B) which deactivates the inverter output stages in any case after a stop command once a certain time has elapsed.

**Display of the active parameter set**

In the “stop state”, the active parameter set is shown in the standard display 1:

| | | |
|---|---|---|
| **REM** | **Stop** | **Set: 2** |
| **Set 23.45 Hz** | | **0%** |

When the parameters are displayed, the active parameter set is recognizable by the character between the parameter number and the value.

| PARAMETER SET | CHARACTER |
|---|---|
| 1 | **:** |
| 2 | **=** |
| 3 | **#** |

**EXAMPLE:**

| ... in customer parameter set 1 | ... in set 2 | ... in set 3 |
|---|---|---|
| **Maximum frequency** | **Maximum frequency** | **Maximum frequency** |
| **PROG 23: 100.0 Hz** | **PROG 23= 100.0 Hz** | **PROG 23# 100.0 Hz** |

The active parameter set is also correspondingly recognizable in standard display 2 (example with parameter set 2 active):

| | |
|---|---|
| **VIEW D5=** | **88.5 %** |
| **VIEW 9=** | **45.6 Hz** |

### 6.1.4 Volatile and Power-Failsafe Storage of Parameter Changes

There are two possible ways of saving changed parameter values:

1) Key SHIFT accepts changes but these changes are not power-failsafe (i.e. they are saved only in the RAM). If the unit is disconnected from the power supply, the change is lost (this is a way of trying out settings and restoring the previous setting by switching the unit off and back on again).
2) Key ENTER saves the entered value in power-failsafe manner, both in the RAM and in the Z-RAM (non-volatile even in the event of power-off).

If a parameter contains at least one parameter which has been saved in non-power-failsafe manner, this is indicated by an exclamation mark “!” after the group name.

### 6.1.5 Hexadecimal and Binary Notation

Most parameters are displayed as decimal numbers. The value range indicates whether places after the decimal point and signs are used. In the case of certain parameters, entry and status displays are implemented with the aid of bit-serial (binary) assignment. Functions can be activated and deactivated by setting (value 1) or resetting (value 0) individual bits. Since the number of places on the display does not suffice, binary numbers are entered and displayed as hexadecimal numbers. Groups of four bits in each case are combined to form one hexadecimal number, e.g. bit pattern 0101 corresponds to value $5_{hex}$. Leading zeros are displays and the word “hex” is displayed after each hexadecimal parameter. The table on Page 2-123 will assist to you to convert the binary numbers to hexadecimal numbers.

### 6.1.6 Error Messages

If the PROG, SHIFT or ENTER key is pressed, the message is reset on the ABE (display and operator-control unit). Acknowledgement of the error message does not cancel the cause of the error. Errors may be also still be pending after reset (see also Chapter 8.17, “Error States”).

## 6.2 What Happens on Switch-On

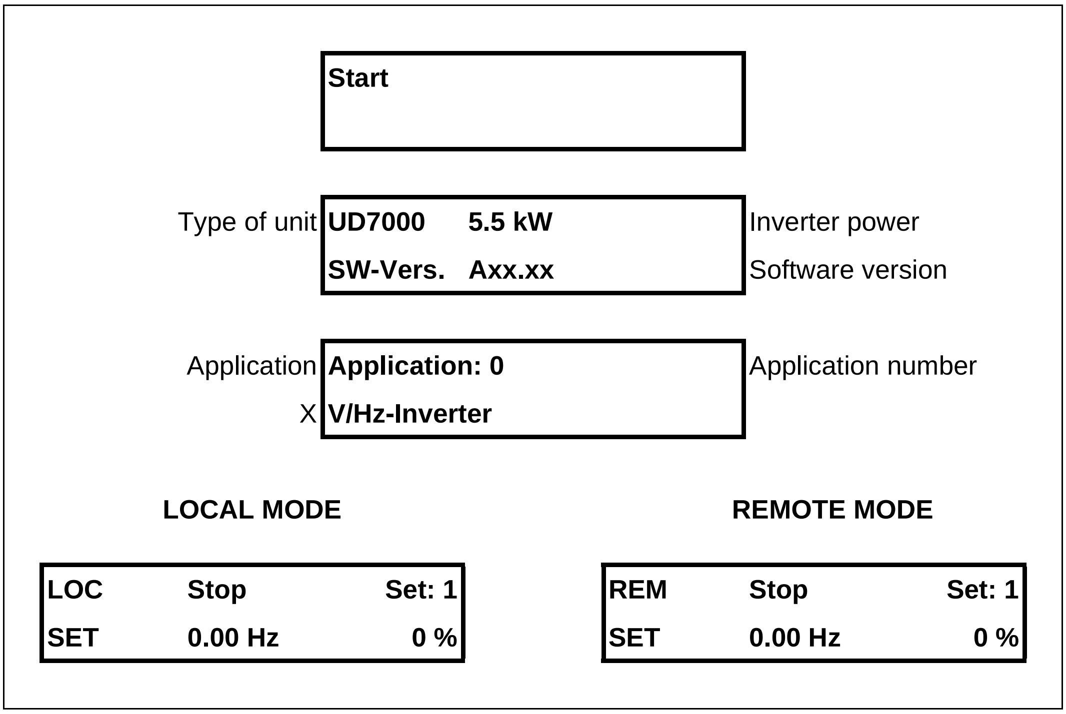
- **Observe the general safety notes in the UD 7000 Operating Instructions (07_GB_T1) before commissioning the inverter.**
- Please read through Chapter 4, “Drive Variants” in order to better understand the UD 7000 inverter technology.
- If you should not yet be acquainted with how to operate the inverter, you will find the menu structure and the key functions of the keypad on Pages 2-124 and 2-33 up to 2-38.
- Check that the inverter's supply voltage (nameplate) and line voltage agrees.
- Check the installation of the converter, referring to the notes given in Chapter 2.
- Connect the line voltage (as a test, the device-internal fans switch on briefly when the line voltage is connected (the inverter up to 22 kW). The fans are then controlled temperature-dependently). As of a nominal inverter output of 30 kW, the device-internal fans run continuously.

The inverter checks the output stage size during the initialisation phase and defines the default values of diverse parameters that are dependent on it. The display then successively shows the following:

1. “Start” (for a short time).
2. Type of unit, inverter power and software version.
3. Application. The application numbers that can be selected are described under parameter **2C – Application**. X stands for:
   V/Hz-Inverter / EC-speed ctrl. / EC-torque ctrl. / EC-El. Gearbox / FO-speed ctrl. / FO-torque ctrl. / FO-El. Gearbox / RL-speed ctrl. / RL-torque ctrl. / RL-El. Gearbox / SLV-speed ctrl. / SLV-sp. ctrl. II / SLV-torq.ctrl

   The default setting for the application (X) and the application number is “V/Hz-Inverter”, “0”.

The inverter is then in the operation mode and shows the default display 1 or 2 (see Chapters 7.2.1 and 7.2.2).




**HINT!** The parameters in “Group 1 – Motor data” must be adapted to the local situation prior to commissioning the drive so as to ensure optimum motor/unit coordination.

## 6.3 Further Steps

According to the works settings, the inverter can be controlled by keyboard (LOC) or via the terminal inputs (REM). You can switch over between both control sources via the input PS3. The frequency setpoint (SET) and the inverter load in % are displayed in the bottom display line.

To adapt to the signal source used locally, parameters are available for the individual inputs (outputs). You will find the parameter allocations of the typical control terminal assignments on Page 1-27.

Adapt, i.e. which control source, e.g. speed setpoint or left/right starting, is to be used depending on the selected operating mode, by means of parameter 31.

## 6.4 Assignment of the Control Terminals

Page 1-27 shows a typical connection configuration of the inverter control terminals. The description of function of the functions available at the relevant **i**nputs/**o**utputs corresponds to the various setting options of the inverter. The function of the relevant **I**/**O**s can, of course, be adapted to the application using parameters scheduled for this. A reference in parentheses to the parameter responsible for the relevant I/O is provided in order to make it easier to locate the parameters. The inverter interface is shown in brief at the left-hand side of the terminals in order to provide the operator with an insight into the input wiring. The inverter's binary inputs are set to HIGH-active when the inverter is delivered (in the case of European factory default settings) (see also Parameter 9F).

## 6.5 Parameter List/Help

Pages 2-125...2-129 list the parameters accessible to the customer. This list contains space for entry of the customer-specific settings besides the factory default parameter values. In order to achieve a satisfactory drive result, it will be necessary to adapt a number of parameters to the application (see Chapter 6.6 (Commissioning Application 0 – Inverter), 6.7 (Commissioning of a Field-Orientated-Controlled Asynchronous Motor (FO) or of a Permanent-Field Synchronous Drive (EC)) or 6.8 (Commissioning an SLV Application)). Please refer to the Parameter Description (Chapter 8) for a precise description of the parameters.

The recommended step-by-step procedure for commissioning an SL, FO, ***SLV***② or EC drive [(1)] is listed in the following chapters. Adaptation of the I/Os is not discussed here. The steps described in short form merely serve to adapt the inverter to the motor. These settings should be made with extreme caution because an optionally functioning drive will only be guaranteed if the inverter is harmonised correctly to the motor.

## 6.6 Commissioning Application 0 – Inverter

### 6.6.1 Preparation

- Ensure that the software version in the unit corresponds to the Operating Instructions and the Parameter Description. During the initialisation phase, you will see the software version (e.g. A19.xx) in the second line on the display.
- The currently activated application is displayed briefly after power-on of the inverter during the initialisation phase. If any other applications than “0 – Inverter” has been selected in the unit, you can change this with parameter **2C – Application**.
- In order to ensure that all parameters in the inverter correspond to the factory default setting, you can reset all three or only one of the customer parameter sets to the factory default setting with the aid of parameter **EA – Application-dependent defaults**. Please note that this Reset only takes effect the next time the software is restarted. In order to do this, either briefly disconnect the unit from the line supply (until the text on the display disappears) or use parameter **2D – Software reset**.

### 6.6.2 Parameterisation

After you have opted for your preferred display language (parameter 78), you can then start parameterising the inverter:

- The motor data must always be entered first in parameter group 1.

  In order to do this, simply transfer the information from the rating plate of the connected motor to the corresponding parameters of group 1. This is the most important step for parameterisation of the inverter! This is the only way of ensuring that the drive functions correctly. The protection functions integrated in the inverter (e.g. current and rotational-speed monitoring) operate reliably only if the inverter is familiar with the correct motor data.

  The Autotuning functions (i.e. the commissioning aids, see parameter **2A – Test mode**) also require entry of the correct data.

(1) **Abbreviations used:**
SL Sensorless and V/f-controlled mode.
EC Operation with electronically commutated synchronous motor.
FO Asynchronous motor in field-orientated control.
SLV Asynchronous motor in sensorless vector control (without feedback).

- The next step is to check whether the parameter values in “Group 2 – Basic data” are correct for your application. Frequently, the acceleration and deceleration times or the maximum frequency needs to be adapted. It is also important that you check whether the settings of parameters **29 – Control mode** and **31 – Setpoint selection (frequency setpoint)** meet your requirements.
- Parameter **29 – Control mode** defines the sources for the Start/Stop signal and the setpoint for the two operating modes LOCAL (the inverter is controlled via the operator-control unit) and REMOTE (operation via the control terminals).
- If you opt for operating mode REMOTE, you must then, as the next step, inform the inverter of what signal source you wish to use for the frequency setpoint via parameter **31 – Setpoint selection (frequency setpoint)** and define, using parameters **71 – Start and Stop options** and **91 – Function of inputs FWD and REV**, how the binary inputs are to act.
- The parameters of “Group 6 – V/Hz characteristic” define how the voltage/frequency assignment is implemented in the inverter. In many cases, it is not necessary to adapt the parameters. However, if the drive is to be operated with customer-selected assignment of output voltage to output frequency, this can be done by entering the value 2 in parameter **62 – V/Hz characteristic selection**. In this case, further steps are required, and these are specified in the description under parameter **6A – V/Hz characteristic, voltage V3**.
- For all other cases, the inverter generates the V/f ratio on the basis of a “Sensorless Vector Motor Model” automatically. When doing this, it allows, amongst other things, for the resistance losses at output frequency f = 0 Hz and, with the aid of the Autoboost function (see parameter 61), adapts the motor's excitation to the load conditions.
- Entry of the correct motor data (group 1) and conducting Test mode are the preconditions for a functioning motor model in the inverter. Test mode 104 (parameter 2A) is recommended, but, at least, the stator resistance (Test 101) should be measured. This test run needs to be conducted successfully only once, i.e. no error message may be displayed during the test run. This completes the basic configuration of the inverter.

### 6.6.3 Precision Adjustment

The wide variety of other parameters also available for application “0 – Inverter” makes it possible to also adapt the UD 7000 to more complex drive configurations. To put it in brief, the following setting options are important:

- Adaptation of the torque limits in group 5 (factory default setting: 150% of the nominal motor torque in all four quadrants).
- Correction of the motor excitation via parameter **22 – Boost**.
- Adaptation of the ramps (e.g. use of S-shaped ramps) via parameters 72 and 73.
- Adaptation of the drive to the field attenuation via parameter **21 – Knee frequency** and parameter **62 – V/Hz characteristic selection**.
- Configuration of the DC brake with parameters 63–65.
- Increase in rotational-speed stability with the aid of parameter **76 – Slip compensation**.
- You can enhance the smooth-running characteristics at output frequencies less than approx. 5 Hz by activating PWM frequency correction (see parameter FB).
- Please consult Chapter 8.9, “Group 9 – Binary Inputs/Outputs” for the diverse functions of the binary inputs and outputs.

- Please note that application “0 – Inverter” is suitable only for “standard tasks”. This is why a wide variety of other applications is available, and commissioning for these is described separately. In some cases, additional functions can also be activated easily for application 0 (function “Motor potentiometer”, Step-by-step control, alarm functions of the binary outputs, Output of internal variables via the analogue outputs etc.).
- The option of parameterising and controlling the inverter via the serial RS 485 port is application-independent.

### 6.6.4 Solution to the Problem

As soon as all parameters have been entered, several parameters providing information on the current inverter status are available. In parameter group “0 – Service data I”, you can, for instance, display the actual values of the currents, voltages, frequencies and the inverter temperature. This allows you, for instance, to check the magnitude of the line input voltage, whether the DC link voltage ($V_{DC\ link} = \sqrt{2} \times V_{Line}$) is correct, whether the inverter is overheating or the magnitude of the no-load current. These parameters which are used simply for display purposes can be found in the parameter list on Pages 2-125...2-129. They are identified with r-o (read-only) in column Factory default setting.

The data of the motor model used and the current inverter-specific states are displayed in parameter groups “E – Service data II” and “F – Service data III” and some of them can also be adapted manually.

Frequently, it is not visible immediately whether the cause of the fault or error relates to the cabling of the installation, parameterisation of the inverter, incorrect rating or even defect components.

1. Check the motor cabling.
2. Check the motor data in parameter group 1.
3. Check the cabling of the control terminals.
4. Is the inverter in the required control mode (LOC or REM)?
5. How does the inverter respond to the setpoint inputs (**NOTE:** the applied setpoint is shown on the display)?
6. Is an error being displayed?
7. Has Test mode (parameter 2A) been conducted correctly and in line with the application (parameter 2C)?

## 6.7 Commissioning of a Field-Orientated-Controlled Asynchronous Motor (FO) or of a Permanent-Field Synchronous Drive (EC)

### 6.7.1 Hardware Precondition (Option Card and Wiring)

- Ensure that the software version in the unit corresponds to the Operating Instructions and the Parameter Description. The software version (e.g. A19.xx) is shown on the display during the initialisation phase in the second line.
- The application activated in each case after power-up and its application number (see description of parameter **2C – Application**) are also shown during the initialisation phase.

- An EC or FO version [1] requires tachogenerator feedback (synchro-generator). The unit must be extended with an option card for connection of the feedback signal. A card for a resolver connection or encoder connection is available. If the option card required for the selected application is not yet fitted in the unit, you will see message “Error 11 – Option”. Proceed as follows in order to install an option card:

1. Disconnect the unit from the line. Also ensure that there is no DC infeed (e.g. by a DC link coupling). Hazardous voltages are still present if lamp “BUS CHG” is still lit (up to 55 kW in the case of inverters).
2. Remove the upper and lower parts of the black plastic cover.
3. Place the inverter with right-hand side pointing upwards in front of you on the bench.
4. Open the right-hand side by undoing the cross-recessed-head screw at the top and bottom of the right-hand side cover. The cover can now be removed.
   **CAUTION:** the operator-control unit will now be hanging loosely from the ribbon cable which connects it to the control board.
5. The connection for the option card (50-pin socket connector) is located at the bottom right-hand edge of the control board. Hexagon symbols in Figure 6.1 indicate at what point the card must be installed.
6. Before you slide the optional card in, push on the two plastic spacers on the underside of the optional card.

**HINT!**

Different spacers and screws must be used depending on the size of the inverter (see the table below):

| Inverter size | Nylon spacers | Screws |
|---|---|---|
| BG II | 4.8 mm | 2.5 × 10 mm |
| BG III | 4.8 mm | 2.5 × 10 mm |
| BG IV | 9.5 mm | 2.5 × 16 mm |
| BG V | 12.5 mm | 2.5 × 20 mm |
| BG VI | 12.5 mm | 2.5 × 25 mm |

(1) **Abbreviations used:**
SL Sensorless and V/f-controlled mode.
EC Operation with electronically commutated synchronous motor.
FO Asynchronous motor in field-orientated control.
SLV Asynchronous motor in sensorless vector control (without feedback).

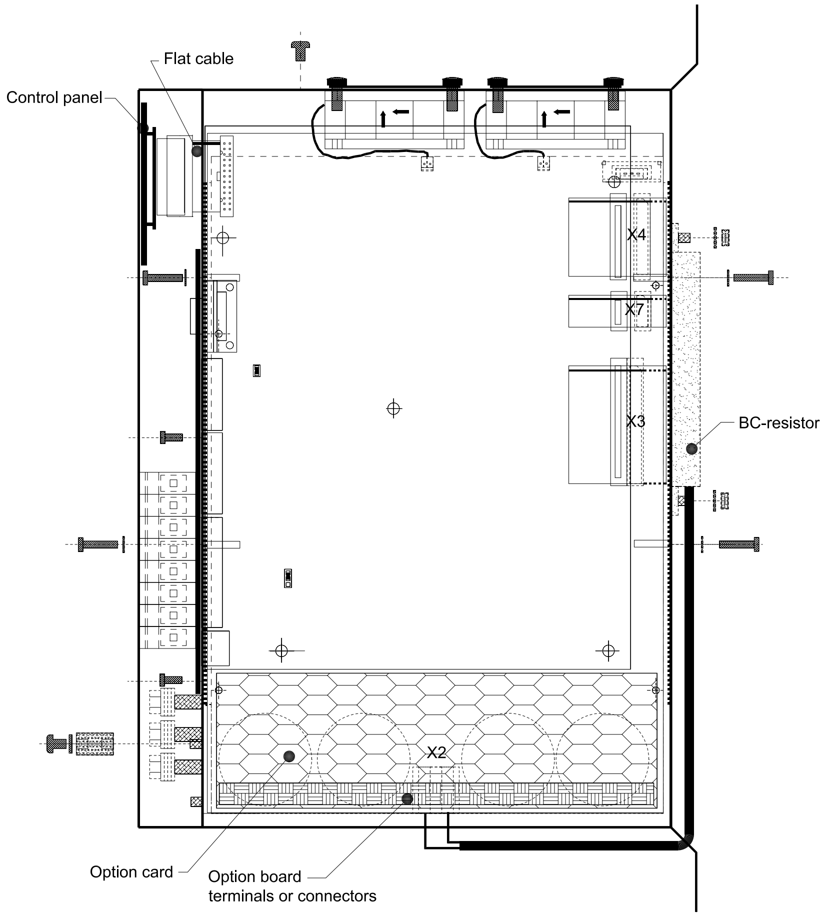



**Figure 6.1**

7. Plug the option card into the socket connector of the control board and screw the card to the shielding plate with two M2.5 screws. Ensure that the card is not inserted twisted into the connection socket for the optional card.
8. Using the supplied ribbon cable, make an additional connection between the pin connectors of the control board and the option card (see “Ribbon cable connection” in Figure 6.2). The side of the ribbon cable marked in colour must be plugged onto the PIN marked “1”.
9. Break out the required terminal or connector openings on the right-hand device cover so as to provide access to the connections if the cover is closed off.
10. Firmly screw the cover back onto the unit.
11. Connect the encoder or resolver. Please refer to the descriptions of the synchro-generator and the option cards for further details.
12. Reconnect the unit to the line power supply.

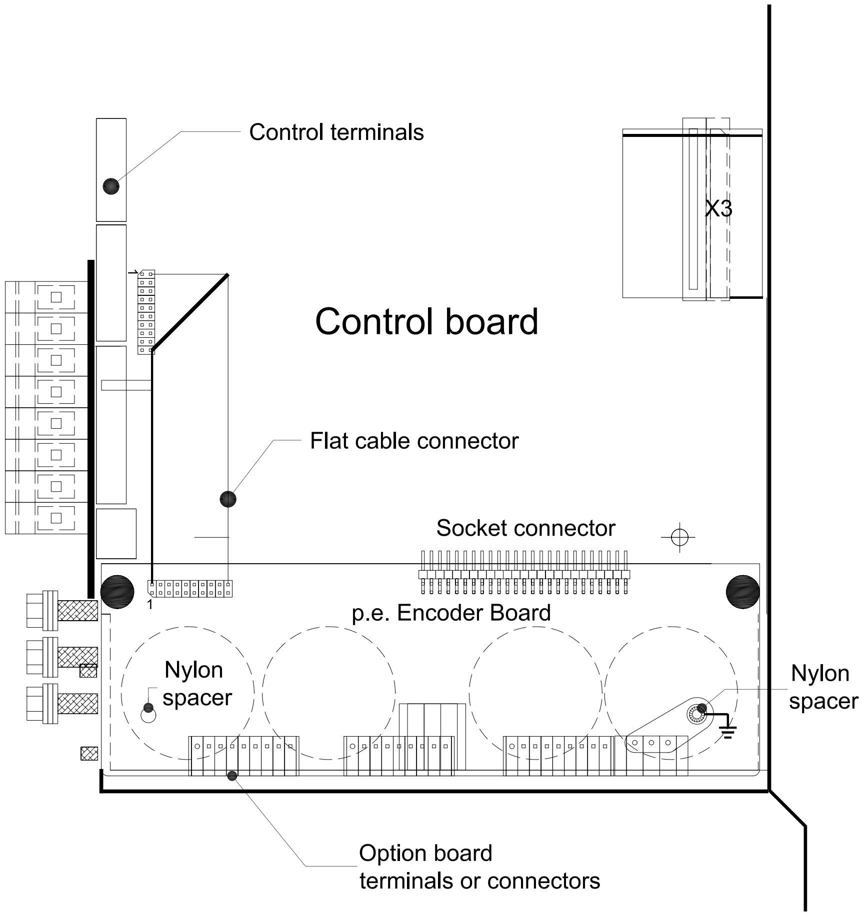



**Figure 6.2**

### 6.7.2 Parameterisation of the Speed Controller on Systems with Feedback (FO and EC Applications)

1. Configure parameter **2C – Application** for the required application (either one of the EC applications 10, 11, 12 or one of the FO applications 20, 21, 22).
2. Switch off the line power supply, wait until the display disappears and switch back on or set parameter 2D to 1. This restarts the software for application-specific parameters (e.g. the parameters in group B) which are only now displayed.
3. Enter the motor data in parameter group 1. Always enter the correct motor data so that the UD 7000 can compute the correct control limits and model variables.

   **NOTE:** the UD 7000 uses the power factor of the motor as the key value for motor control. If the power factor is not specified on the motor's rating plate, please determine a suitable value using the information specified for parameter **13 – Power factor**.
4. Next, you should check whether the parameter values in “Group 2 – Basic data” are correct for your application. Frequently, for instance, it is necessary to adapt the acceleration and ramp down times or the maximum frequency. It is also important that you check whether the settings of parameter **29 – Control mode** and **31 – Setpoint selection (frequency setpoint)** meet your requirements.
5. Parameter **29 – Control mode** defines the sources for the Start/Stop signal and the setpoint for the two operating modes LOCAL (the inverter is controlled via the operator-control unit) and REMOTE (operation via the control terminals).

6. If you opt for operating mode REMOTE, you must then, as the next step, inform the inverter of what signal source you wish to use for the frequency setpoint via parameter **31 – Setpoint selection (frequency setpoint)** and define how the binary inputs are to act with parameter **71 – Start and Stop options** and **91 – Function of inputs FWD and REV**.
7. Enter the specific data of the synchro-generator used. This will either be the number of lines of the encoder used in parameter BE or its number of pole pairs in parameter BA if a resolver is connected.
8. Select the Test mode 109 in parameter 2A. After the first Start command after power-on, the stator resistance, the leakage reactance $X\sigma$ and the direction of rotation of the position encoder are determined during a test run. On the basis of this, the inverter computes further model variables and controller parameters. After the test has been successfully conducted, parameter **2A – Test mode** is automatically set to value 0, i.e. no further tests are conducted at a later point.

**HINT!**

If the motor shaft is not free to move for the test run, conduct test 104 instead of test 109. Please refer to parameter **BD – Angle sensor direction of rotation** for further information.

9. Set the rotational speed setpoint to 0 Hz (or the torque setpoint 0% for closed-loop torque control).

**ATTENTION!**

If the setpoint is not set to ZERO, the inverter will respond to the set setpoint after the test run, i.e. the motor will start to turn and, under certain circumstances, under full torque.

10. The test run commences with the first Start command. Conducting the tests with no errors is the precondition for trouble-free operation and is the basis for the optimization steps which follow.

    **NOTE:** if an error occurs during the test, switch off the line power supply, switch it back on again and repeat the test. If there is still an error message, please always follow the information in Section 6.7.4, “Solution to the Problem”.

### 6.7.3 Controller Optimization

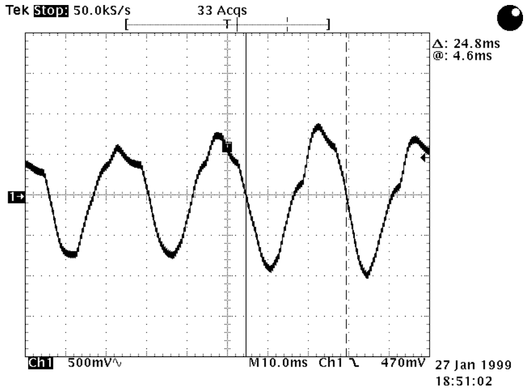
If you have successfully completed configuration of the basic setting, the UD 7000 is configured with a moderate response time. If you require higher performance, the speed controller must be optimized by adapting parameters B1 and B2 accordingly. The following procedure will help you to establish the best settings:

1. Note down the values of the current controller parameters **F8 – Current controller gain** and **F9 – Specific current controller reset time**, as determined automatically by the test run 109 (or 104).

   $F8_{\text{(self-regulated)}}$ = _ _ _._ _  (in the example, F8 = 15.61 Ω)
   F9 = _ _ _ _ _  (F9 = 10)

2. Set parameter F8 to 1.
3. Set parameter A7 to 2. This sets the low-pass filter time for the measurement terminal.
4. Now start to optimise the velocity control loop:
   Set parameter **B2 – Reset time of speed controller** to the maximum value which it is possible to set. Set parameter **B1 – Speed controller gain** to (a lower value, i.e.) 20 or below.
5. Set parameter **A1 – Analog output MET1 selection** to 19. The torque-generating current is output signed at analogue output MET1. Connect an oscilloscope to terminals COM and MET1 and set a resolution of 500 mV/division.
6. Set a setpoint of approx. 50% of the nominal motor frequency. Start the motor.

7. Increase the setting of parameter **B1 – Speed controller gain** step-by-step until the motor starts to oscillate. See the illustration below.




8. Note down the period T (in this case 25 ms) of the oscillation and the value of parameter B1 at the instant at which the proportional gain k entered the critical band.
   **EXAMPLE:**
   T = 25 ms
   k = 1700

9. Calculate the correct value for B1 and enter this value:

$$B1 = \frac{(k \times 0.45)}{F8_{(\text{self-regulated})}} = \frac{1700 \times 0.45}{15.61} = 49$$

10. Calculate the correct integral-action time:

    B2 = 0.85 × T = 0.85 × 25 ms = 21 ms.
    Enter this value in parameter B2.

11. Set parameter **F8 – Current controller gain** to the value which you noted down in step 1 (e.g. 15.61 Ω).

12. Set parameter **A1 – Analog output MET1 selection** to 0. Move on to parameter 09 and press SHIFT + ENTER (parameter **09 – Actual frequency** is shown on the standard display 2). These two steps transfer the actual motor velocity to output MET1.

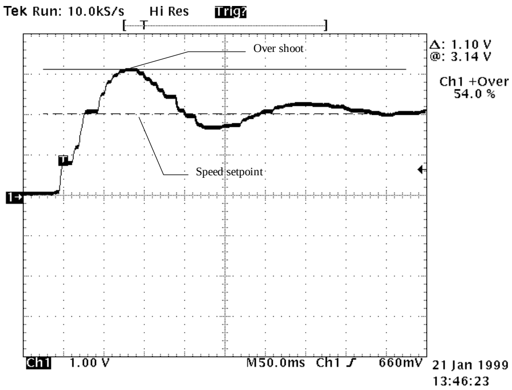
13. Standardise the output at MET1 output to twice the nominal motor frequency.

    Parameter **A6 – Reference value for the analog output** can be calculated as follows:

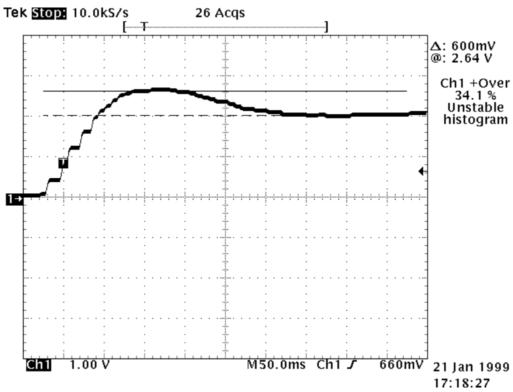
$$\text{Parameter A6} = \frac{2 \times \text{Nominal motor frequency}}{\text{Resolution parameter 09}} \qquad \text{e.g. A6} = \frac{2 \times 60\ \text{Hz}}{0.1\ \text{Hz}} = 1200$$

14. Use an oscilloscope at output MET1 in order to display the wave velocity. Set the frequency setpoint to half the nominal frequency (cf. parameter 12) and increase the speed of the drive from 0 to the setpoint. Use short ramps (parameters 25–28) if the process allows this or deactivate the ramps entirely (parameter 72).

15. The settings established in steps 9 and 10 are the values for the critically damped control loop (see the illustration below). Starting from this setting, you can now begin to optimise the control loop so that it behaves in the manner required.

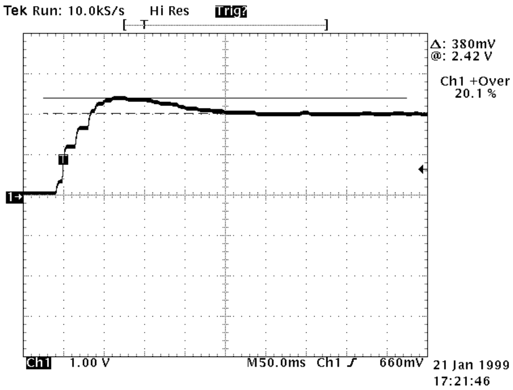



16. The above illustration shows the transient response of a drive whose speed controller has been optimized using the method described. If you restrict overshoot, you must increase parameter **B2 – Reset time of speed controller**. The next illustration shows the acceleration if B2 is increased from 21 to 64.

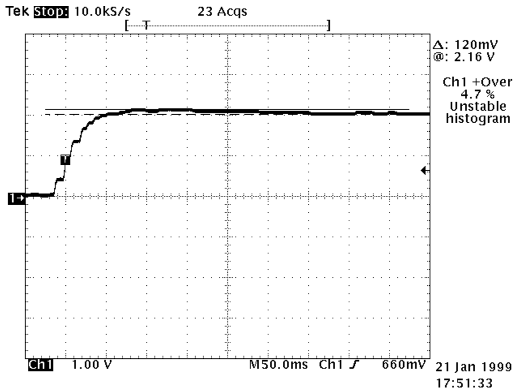



In the above illustration, you can see that start time is now longer and that coasting is shorter. The start time can be shortened by increasing the proportional gain B1.

17. The next illustration shows the transient response if B1 is increased to 100.



18. It is difficult to establish the correct setting for the speed controller since it depends on the application. Theoretically, the correct setting will have been established if the overshoot is 4.3%. In order to achieve this response behaviour, parameter **B2 – Reset time of speed controller** must be increased again to 236. See the illustration below.




**HINT!**

If you use a transmission in your application, the mechanical components cause transmission backlash. It is advisable to use higher values in parameter **B2 – Reset time of speed controller** in order to avoid premature wear of the transmission.

### 6.7.4 Solution to the Problem

As soon as all parameters have been entered, several parameters are available providing information on the current inverter status. In parameter group “0 – Service data I”, you can, for instance, display the actual values of the currents, voltages, frequencies and the inverter temperature. For instance, this allows you to check the magnitude of the line input voltage, whether the DC link voltage ($V_{DC\ link} = \sqrt{2} \times V_{Line}$) is correct, whether the inverter is overheating or the magnitude of no-load current.

The data of the motor model used and the current inverter-specific statuses are displayed in parameter groups “E – Service data II” and “F – Service data III” and some of them can also be adapted manually.

Since it frequently cannot be seen immediately whether cause of an error or fault relates to the cabling of the installation, parameterisation of the inverter, incorrect rating or even defective components, the following procedure is recommended for systems with rotational speed feedback:

1. Switch the unit on and select parameter BB. This allows you to read off the mechanical angle of rotation of the feedback shaft. If the parameter setting for the feedback data (parameter **BA – Resolver pole pair number** if using a resolver or parameter **BE – Number of encoder lines** with attached encoder) is correct, the display will run through an angle of 0–360° with each mechanical revolution of the motor shaft precisely once.
2. Reduce the PWM frequency (parameter 79) to 2.00 kHz.
3. Reset the parameters (B1 and B2) of the speed controller back to the default values specified in the Parameter Description.
4. Run the Test mode suitable for the application (see description, parameter **2A – Test mode**) again.
5. If the problem persists:

- Check the motor data in parameter group 1.
- Check the motor cabling:
  – Earth connection.
  – Actual motor cabling.
  – Connection for feedback cables.
  – Never lay the feedback cable together with the motor cabling.

6. If the problem has been solved:

- Run the optimization procedure described in section “Controller optimization” (again).
- Once again increase the PWM frequency step-by-step in steps of 0.5 kHz.

## 6.8 Commissioning an SLV Application

**HINT!** This description applies to inverters as of software version A19.01.

### 6.8.1 Introduction

The “Sensorless Vector Control” procedure ***SLV***② has been integrated in the UD 7000. ***SLV***② stands for “**S**ensor**L**ess **V**ector”. This is a method for field-orientated control of the asynchronous motor without rotational speed feedback.

Commissioning on the basis of application “50 – ***SLV***② rotational speed control” is described at this point. Special application descriptions are available for the other ***SLV***② applications (51, 52 and 53). For instance, application 51 offers the option of operating with torque control (within the framework of the restrictions of a sensorless method). It is advisable to place application “51 – ***SLV***② torque control” into operation precisely in the same way as the ***SLV***② application with rotational speed control described at this point. The only difference is that, as the last step, one must change parameter **2C – Application** from 50 to 51 and reboot the software (see parameter **2D – Software reset**), after which it is then possible to operate with torque control.

The ***SLV***② rotational speed control has a time-proven structure with speed controller and current controller as will also be known from field-orientated drive with feedback.

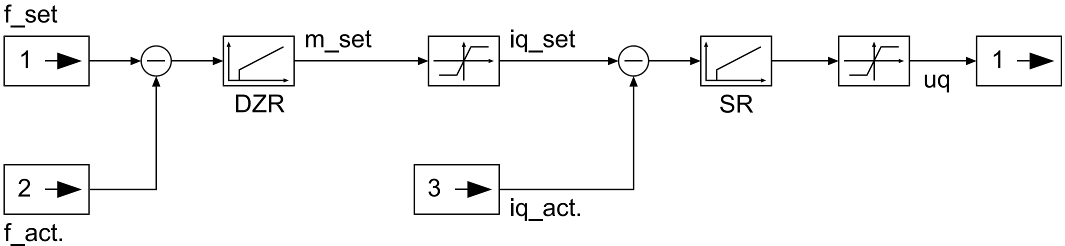



**Figure 6.3**
**Structure with speed controller (DZR) and current controller (SR)**

As of software version A19.01, the dynamic response covers the entire rotational speed range. The dynamic response is comparable with that of the FO in the moderate rotational-speed range (see Figure 6.4).

During Test mode, the current controller can now be preset with the same values as field-orientated drive with feedback (FO). This results in improved in compensation of the torque-generating current which, in turn, means that the speed controller is easier to set. Normally, all that needs to be done after Test mode is to optimise the speed controller.

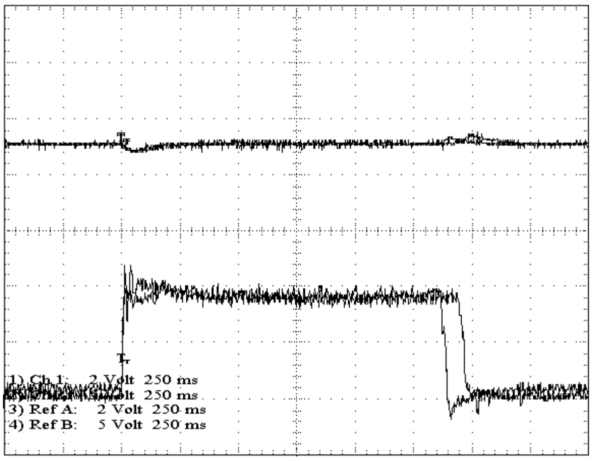



**Figure 6.4**
**Comparison of FO and *SLV*② load connection 100% at 40 Hz. The torque-generating current and the actual rotational speed are plotted in each case.**

### 6.8.2 Commissioning Application 50 (SLV Rotational Speed Control)

Ensure that the software version in the unit corresponds to the Operating Instructions. A prompt indicating the software version (e.g. A19.xx) is displayed in the second line on the display during the initialisation phase.

1. In order to place application "50 – *SLV*② rotational speed control" into operation, the best way is to use parameter **EA – Application-dependent defaults**. Enter value 50 at this point and then reboot the inverter software (by switching the unit off and back on again or using parameter **2D – Software reset**). After this, essential parameters in the UD 7000 will have been preset with the values required for the *SLV*② application.

   Otherwise, you must enter value 50 in parameter **2C – Application** and reboot the software so that the application-specific parameters are overlaid.

2. Always enter the motor data first in parameter group 1. In order to do this, simply transfer the information from the rating plate of the connected asynchronous motor to the corresponding parameters of group 1. This is the most important step for parameterising the inverter. This is the only way of ensuring correct operation of the drive. The protection functions integrated in the inverter (e.g. monitoring of current, rotational speed and torque) will operate reliably only if the inverter is familiar with the correct motor data. The Autotuning function (i.e. the commissioning aids, see parameter **2A – Test mode**) also necessitate entry of the correct data.

3. If step 1 has not been performed, parameter **2A – Test mode** must be set manually to value 104, i.e. the stator resistance R1 and the leakage reactance $X\sigma$ are measured after the first Start command after power-up of the inverter during a test run. The inverter then computes further model variables and controller parameters.

4. The next step is to check whether the other parameter values in "Group 2 – Basic data" are correct for your application. Frequently, for instance, it is necessary to adapt the acceleration and deceleration times or the maximum frequency. It is also important that you check whether the settings of parameters **29 – Control mode** and **31 – Setpoint selection (frequency setpoint)** correspond to your requirements.

5. Parameter **29 – Control mode** defines the sources for the Start/Stop signal and the setpoint for the two operating modes LOCAL (the inverter is controlled via the operator-control unit) and REMOTE (operation via the control terminals).

6. If you opt for operating mode REMOTE, you must then, as the next step, inform the inverter of what signal source you wish to use for the frequency setpoint using parameter **31 – Setpoint selection (frequency setpoint)** or by programming the binary inputs PS1 to PS3 (parameters 99 to 9B). Please follow note 4) given for parameter **29 – Control mode**.

7. Define in what manner the binary inputs are to act using parameters **71 – Start and Stop options** and **91 – Function of inputs FWD and REV**.

8. Set the rotational speed setpoint to 0 Hz (or the torque setpoint to 0% for closed-loop torque control).

**ATTENTION!**

If the setpoint is not set to ZERO, the inverter will respond to the set setpoint after the test run, i.e. the motor will start to turn and, under certain circumstances, under full torque.

9. Issue the Start command (via the terminals or keys FWD resp. REV depending on the selected control mode). The Autotuning functions of the UD 7000 are performed – “Test” is shown on the standard display. For this purpose, the inverter independently conducts measurements on the energised motor. In this case, the motor may not be driven externally but may be locked by braking for the operation.

   Test mode can be interrupted at any time with a STOP command. In this case, you will see a “Warning ... measurement” warning.

   When the test run is complete (i.e. display “Test” on the standard display disappears again), issue the STOP command.

**HINT!**

The Autotuning function performs its purpose only if all tests have been run through fully once. If an error message or warning is issued during the measurement, Test mode must be repeated by restarting the unit. If an error message occurs again, check the motor data in group 1 and correct cabling of the installation. Difficulties may also arise if the nominal power values of inverter and motor differ greatly.

If the Autotuning function can, once again, not be performed with no errors, it will be necessary to manually adapt parameters **F3 – Stator resistance R1**, **F4 – Rotor resistance R2** and **F5 – Leakage reactance Xσ**. Ideally, you can obtain the information from the motor manufacturer. Otherwise, the UD 7000 Manual contains a table with the factory default settings for resistances and leakage reactance (in the description of parameters in group F). In this case, the selection must be made on the basis of the nominal motor output and not the nominal inverter output.

If the Autotuning function is performed successfully, parameter **2A – Test mode** is set automatically to value 0, i.e. no further tests are performed at a later point.

10. The dynamic behaviour of the drive depends very greatly on the setting of the controllers. Application “50 – ***SLV***② rotational speed control” also features a speed controller (see Figure 6.3) besides the current controller. Whilst the current controller has already been adjusted using the Autotuning function, this must be done manually for the speed controller. The speed controller must be adapted to the load conditions using parameters **B1 – Speed controller gain** and **B2 – Reset time of speed controller**. Parameters B1 and B2 must be adapted step-by-step and alternately until the drive displays the required behaviour in relation to dynamic response and overshoot. In principle, optimization can also be performed for ***SLV***② speed control using the same method already described in Section 6.7.3, “Controller Optimization”.

**HINT!**

If excessively high gain values are entered, it is possible the drive will show display "Torque limit" immediately after the Start command (even at low loads). After the STOP command, the "Auto-Stop" error may be displayed. The associated "Monitoring function for stopping" is described in the section on parameter **8B – Maximum permissible ramp extension in the event of stop**.

If the process allows, the following optimization steps may be performed:

11. Parameter **D5 – Actual value of the field-generating current component $i_d$** allows conclusions to be drawn as regards the accuracy of the motor data used in group F to a certain extent. Firstly, you can adapt the value for parameter **F3 – Stator resistance R1**. Parameter **D5 – Actual value of the field-generating current component $i_d$** whose value should then be around 90%, is monitored at a setpoint of 0 Hz. Otherwise, it will be necessary to adapt parameter **F3 – Stator resistance R1**.

    Normally, higher values for the resistance R1 also lead to higher values for parameter **D5 – Actual value of the field-generating current component $i_d$**. If this not the case, the value of R1 must first of all be greatly reduced (halve the value), after which it should be increased again in small increments.

12. A value of approx. 50% of the nominal frequency must then be selected as the setpoint (e.g. 25 to 30 Hz in the case of a 50 Hz motor); the machine runs under no load or at minimum possible load. Check parameter **D5 – Actual value of the field-generating current component $i_d$** whose value should be near to 100% at the frequencies specified. Otherwise, you must adapt parameter **F7 – Main reactance $X_h$** until D5 indicates values around 100% under the conditions described above.

    Normally, higher values for the magnetising reactance will also lead to higher values for parameter **D5 – Actual value of the field-generating current component $i_d$**. If this is not the case, the value of F7 must first of all be greatly reduced (halve the value), after which it must then be increased again in small increments.

13. The changes to the *SLV*② structure specified at the start lead to new parameters which are described below:

| Parameter | Description |
|---|---|
| **13D – Filt.Freq.Calc.** | Various actual variables are used to compute the frequencies in the *SLV*② model. In some cases, in order to avoid unstable states in the control loops, it will be necessary to pass specific variables through a filter prior to computation. You can enter the time constant of the filter at this point. The factory default setting 4 ms will need to be changed only in rare cases.<br><br>Case A:<br>After performing steps 1 to 10, the drive does not achieve the required dynamic response despite high gain (parameter B1) and short integral-action time (parameter B2). The time constant must now be reduced: first to 2 ms and, if this has no effect, smoothing is deactivate with value 0 ms.<br><br>Case B:<br>After performing steps 1 to 10, the drive tends to oscillate or "hums" markedly (parameter D7 jumps to and fro constantly between the allowed torque limits, e.g. ±150%) despite no gain (B1) and long integral-action times (B2). Increase the time constant in 4 ms increments until stable conditions are achieved.<br><br>Value range: 0–32000 ms Default: 4 ms |

| Parameter | Description |
| --- | --- |
| **13E – T. const. Rotor** | The rotor time constant of the motor is also included in the slip computation in the *SLV*② model. This rotor time constant is computed from the motor data determined with the aid of the Autotuning function. This provides the option of manually adapting the rotor time constant.<br><br>Value range: 0–32000 ms Default: 100 ms |
| **13F – Adjust Ud,dyn** | In the field-attenuation range, the inverter may reach its voltage limits before the set current or torque limits are reached. This parameter influences how the available voltage is split over field and torque generation.<br><br>Value 1 (default setting is 0) ensures that the maximum possible voltage is used for torque generation when the voltage limit is reached.<br><br>**NOTE:** the parameter is displayed only if an *SLV*② application is active and if the selected maximum frequency is at least 110% of the nominal motor frequency.<br><br>Value range: 0 or 1 Default: 0 |

14. An optimum voltage utilisation can be achieved by entering the value 0 in parameter **62 – V/Hz characteristic selection** so that voltage control is activated. Then, in the field-attenuation range, the magnitude of the excitation is stabilised at the maximum possible value depending on the available voltage.

    If problems occur when using voltage control (e.g. the drive tends to oscillate in the field-attenuation range), reset parameter 62 back to the factory default setting (setting 3). Field attenuation is then performed controlled as of the break-point frequency (parameter 21) indirectly proportional to the output frequency. In such cases, it is important to enter the right break-point frequency (parameter 21). The entered value should be approx. 86% of the nominal motor frequency $f_{nom}$:

    $f_{knee} <= 0.866 \times f_{nom}$

    In the event of parameter **12 – Rated frequency** being 50 Hz and step 1 being performed, the default at 43 Hz is already correct.

15. If the speed of rotation at the motor shaft is not compensated precisely enough when connecting loads (through to the nominal load), it may be necessary to adapt the rotor time constant with the aid of parameter **F6 – Rotor time constant setting**.

16. Parameter **FB – PWM frequency slaving**. In order to improve the running characteristics of the machine at low rotational speeds, the PWM frequency can be automatically corrected to the frequency setpoint. This may cause louder noise at low rotational speeds. PWM frequency correction is also recommended for heavy starting.

17. Parameter **7F – Control method**. Trapezoidal modulation (parameter 7F = 2) should be used at maximum frequencies of high rated frequency since this method achieves optimum voltage utilisation.

18. Parameter **76 – Slip compensation**. If step 1 has been performed, slip compensation (parameter 76) will be activated by default, i.e. the speed controller stabilises the rotor frequency at the selected frequency setpoint. If there are no problems using slip compensation, the function should always remain activated. It has been observed that the non-feedback drive moves more dynamically into the field-attenuation range under certain circumstances if slip compensation is deactivated (e.g. if the motor data, both the data entered and the data determined by the Autotuning function, is not adequately precise).

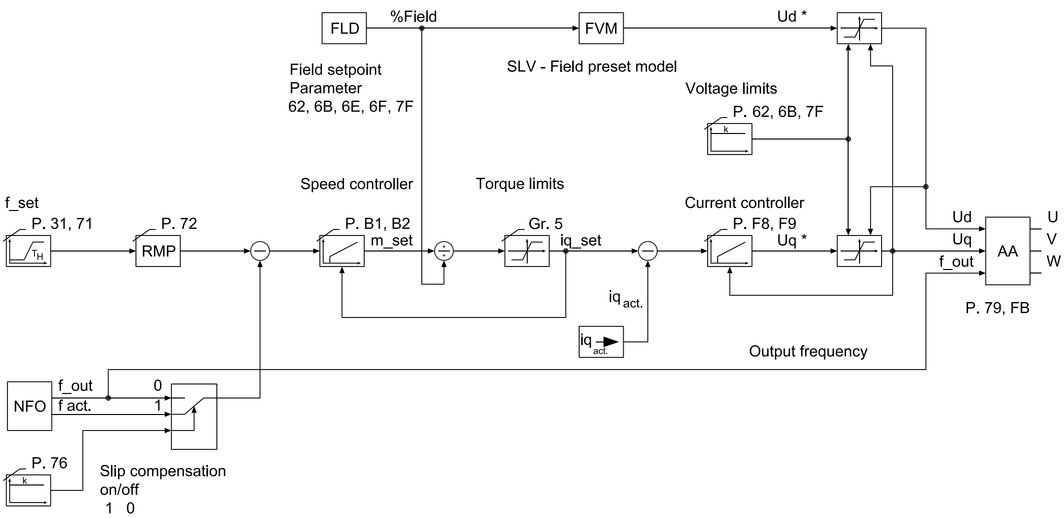
19. The following adaptation may be necessary for operation of application 50 in the field-attenuation range:

- At all events, the ramp times must be adapted to the load conditions.
- The gain of the speed controller should be reduced.
- Compensation with the aid of gain boosting (parameters B3 and B4) is possible in order to achieve a good dynamic response nevertheless at “normal” speeds of rotation.

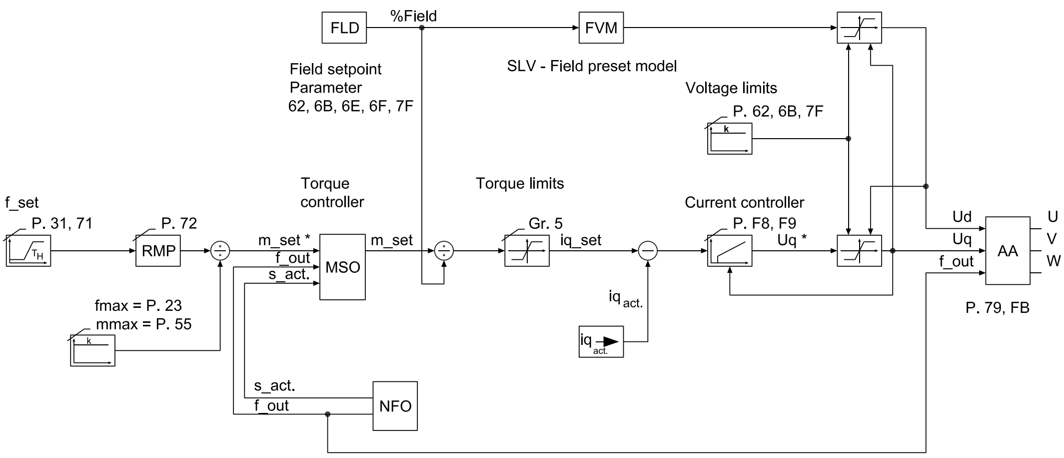
## 6.9 Note on Commissioning further to Application 51

It is advisable to place application “51 – *SLV*② closed-loop torque control” into operation precisely in the same way as *SLV*② speed control (see Section 6.8.1, “Introduction”). The only difference is that, as the last step, you must change parameter **2C – Application** from 50 to 51 and reboot the software (see parameter **2D – Software reset**), after which it is possible to operate with torque control.

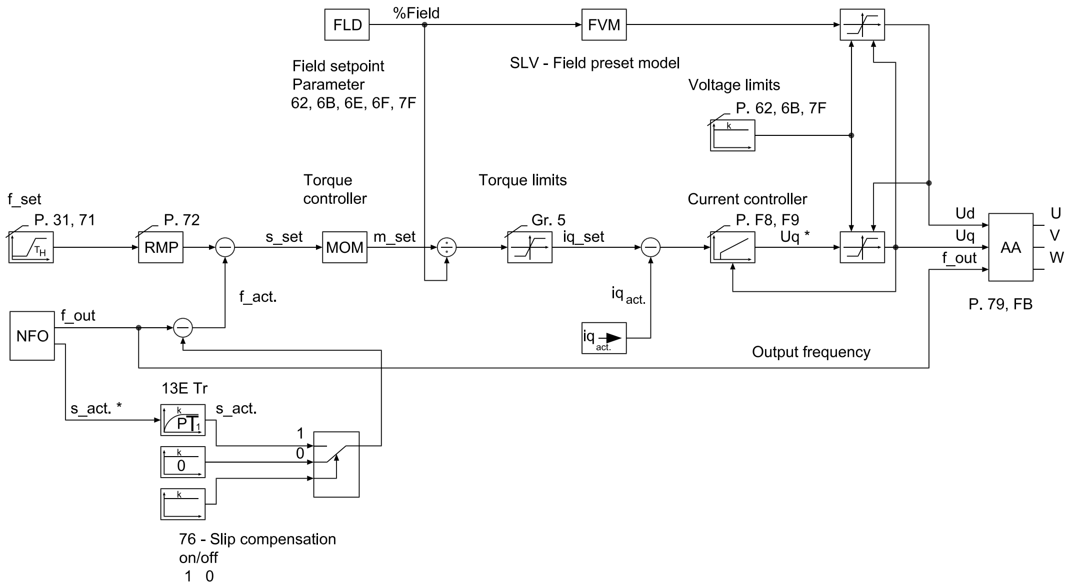
### 6.9.1 Signal Flow Diagrams




**Application 50: *SLV*② speed control**




**Application 51: *SLV*② torque control**




**Application 52: *SLV*② speed control II**
**Application 53: *SLV*② in the field-attenuation range**

The application 52 shown here represents a step towards simplified commissioning with a "single-controller solution". Application 53 supplements the *SLV*② variants with a solution for the field-attenuation range. Please refer to the application description "*SLV*② applications in the UD 7000" for details on applications 52 and 53.

## Symbol Description further to the Signal Flow Diagrams

| Symbol | Significance | Gated UD 7000 parameters |
|---|---|---|
| **AA** | Automatic triggering.<br>That part of the inverter software which generates the pulse patterns from voltage and frequency setpoints. | **79 – PWM frequency**<br>**FB – PWM frequency slaving** |
| **DZR** | Speed controller | **B1 – Speed controller gain**<br>**B2 – Reset time of speed controller**<br>(B3, B4 – Gain boosting) |
| **$f_{act.}$** | Actual value of the motor rotational frequency | **09 – Actual frequency** |
| **%Field** | Percentage field setpoint | **FE – Excitation** |
| **FLD** | Field preset module (influencing the magnetising current and implementation of field attenuation) | **21 – Knee frequency**<br>**62 – V/Hz characteristic selection** |
| **$f_{max}$** | Maximum frequency | **23 – Maximum frequency** |
| **$f_{out}$** | Output frequency (stator frequency) | **01 – Output frequency** |
| **$f_{set}$** | Frequency setpoint | **31 – Setpoint selection (frequency setpoint)**<br>**3F – Frequency setpoint on the basis of ramp**<br>**71 – Start and Stop options** |

**Table 6.1**

| Symbol | Significance | Gated UD 7000 parameters |
| --- | --- | --- |
| **FVM** | *SLV*[2] field preset model | **D5 – Actual value of the field-generating current component $i_d$** |
| **$i_q$** | Actual value of the current component for torque generation | **D6 – Actual value of the torque-generating current component $i_q$** |
| **$i_{q,set}$** | Setpoint of the current component for torque generation | **D7 – Setpoint of the torque-generating current component $i_{q,set}$** |
| **$M_{Limits}$** | Torque limitation | Parameter group 5 |
| **$m_{max}$** | Maximum torque | **55 – Torque factor LIM input** |
| **MOM** | Torque setpoint input in the case of structure without speed controller (application 52).<br>The setpoint of the torque to be injected is computed directly from the slip setpoint $s_{set}$ | See Application Description |
| **MSO** | Torque setpoint input in the case of application 51.<br>Closed-loop torque control, allowing for the special cases as follows:<br>• Undershoot of the minimum frequency<br>• Reaching the maximum frequency<br>• Stop command | |
| **$m_{set}$** | Setpoint of the torque | |
| **SLV** | *SLV*[2]-Model.<br>• Computation of output frequency $f_{out}$, actual frequency $f_{act.}$ and slip $s_{act.}$ | |
| **RMP** | Ramp module | **72 – Ramp function selection** |
| **$s_{act.}$** | Actual slip | **76 – Slip compensation** |
| **SR** | Current controller | **F8 – Current controller gain**<br>**F9 – Specific current controller reset time** |
| **$s_{set}$** | Slip setpoint.<br>The slip injected in the motor in order to compensate for the load | |
| **$T_R$** | Rotor time constant | Parameter **13E – Rotor time constant** |
| **%Tr** | Percentage adaptation of the rotor time constant for slip compensation | **F6 – Rotor time constant setting** (Tr adaptation for slip compensation) |
| **$U_d$, $U_q$** | Voltage components in the fixed-stator coordinate system | |

**Table 6.1**

## 6.10 Stepper Control

The Berges inverter UD 7000 features a simple step-by-step control allowing simple function sequences to be implemented by the inverter itself as a function of programmable boundary conditions (e.g. as a function of the status of the binary inputs).

The step-by-step control is a special application and is thus not described in greater detail in this Manual.

# 7 Keys and Displays/Indicators

## 7.1 Display and Operating Unit (ABE)

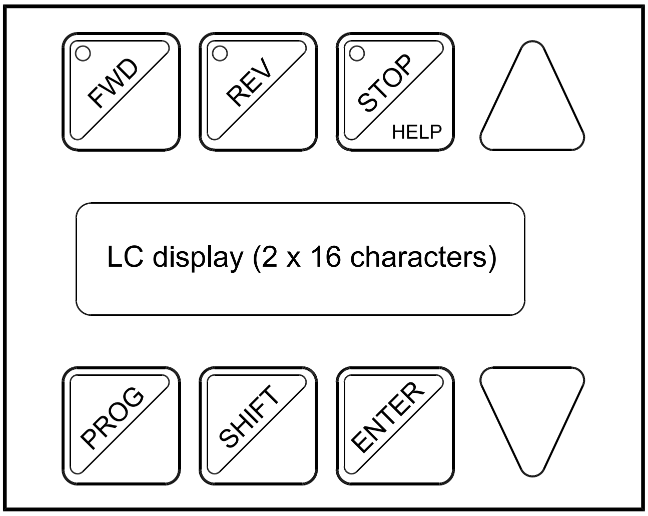



**Figure 7.1**
**Display and operating unit**

The inverter control can be switched between the operating mode and the program mode.

## 7.2 Display in the Operating Mode

For the operating mode, you can choose between standard display 1 or 2.

### 7.2.1 Standard Display 1

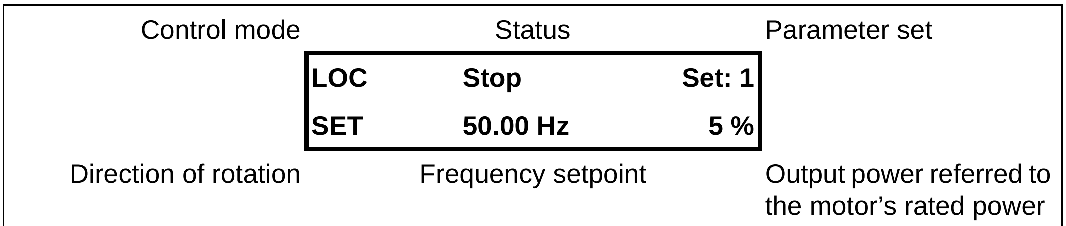



**Figure 7.2**
**Operating mode – standard display 1**

| DISPLAY | DESCRIPTION |
|---|---|
| **[Address]** | The address [address] is selected through the serial interface (RS 485) (SIO) (1) |
| **Accelerate** | The motor accelerates |
| **At speed** | The motor frequency is equal to the frequency setpoint |
| **Autostrt.off** | The start command has been issued, but the autostart condition is not met |
| **Control** | The inverter receives start/stop commands through the serial interface (RS 485) (SIO) (1) |
| **Decelerate** | The motor decelerates |

**Table 7.1**

| DISPLAY | DESCRIPTION |
|---|---|
| **Dyn. brake** | The braking chopper is in use |
| **Error** | Inverter in the error state |
| **FWD** | Right rotation selected |
| **Jog** | Jog mode only as long as the FWD or REV key is pressed. The inverter output is active |
| **LOC** | LOCAL mode, control by keypad |
| **Program** | The inverter is parameterised through the serial interface (RS 485) (SIO) (1) |
| **REM** | REMOTE mode, control through terminals |
| **REV** | Left rotation selected |
| **SET** | No direction of rotation selected (“STOP” status). The frequency setpoint is displayed as the frequency |
| **Set: 1**<br>**Set: 2**<br>**Set: 3** | Display of the actual active set of parameters.The set of parameters can be switched via binary inputs, for example. |
| **SIO** | Control through serial interface (RS 485). Special form of REMOTE mode. (1) |
| **Speed search** | The inverter synchronises the output frequency to the rotation frequency of the motor that is already rotating |
| **Stop** | The inverter output is inactive |
| **Test** | The inverter is in test mode |
| **Torque limit** | The motor is running at the torque limit |
| **Zero speed** | The inverter output is active, but the motor frequency is 0 |

**Table 7.1**

(1) Parameterising the inverter via the serial RS 485 port does not require SIO mode. “SIO mode” means only that the Start-Stop signals are supplied by the RS 485 interface in REMOTE mode.

## 7.2.2 Standard Display 2

You normally change from standard display 1 to 2 in the REM control mode by means of the ▲ or ▼ keys. In the LOC mode, you can change the display by means of the parameter EC.

The display can be switched over to the standard display 2 in order to display the read-only parameters (shown as X and Y here), for example the output frequency and motor current.

Parameter number
(e.g. output frequency)

| | | |
|---|---|---|
| Displayed item | **VIEW X:** | **1.0 Hz** |
| Displayed item | **VIEW Y:** | **5.0 A** |

**Figure 7.3**
**Operating mode – standard display 2**

**NOTE:**

Each read-only parameter may be transferred to the standard display 2. The required read-only parameter must be selected for this purpose. Pressing keyboard short-cut SHIFT + ENTER (press key SHIFT first, hold it then press key ENTER) transfers the parameter to the upper position of the standard display 2. This shifts the parameter which was previously in the upper position to the lower position. The settings of standard display 2 are stored automatically in power-failsafe manner.

## 7.2.3 Display in the Program Mode

| | |
|---|---|
| Parameter group | **Motor data** |
| Group number | **(1)** |

**Figure 7.4**
**Program mode – group menu**

Help symbol; one or several help texts to explain parameters

| | | |
|---|---|---|
| Parameter name | **Nominal voltage** | **?** |
| Access privilege | **PROG 11:** | **400.0 V** |

Parameter number

Parameter with unit of measure

**Figure 7.5**
**Program mode – parameter menu**

In the case of parameters that have help information, their program name is followed by a question mark (?).

| DISPLAY | DESCRIPTION |
|---|---|
| **PROG** | Parameter is editable |
| **VIEW** | Read-only parameter (not editable) |

**Table 7.2**
**Access privilege**

The following display appears when a parameter is edited and stored in non-volatile memory by pressing the “ENTER” key:

***** STORED *****

**Figure 7.6**
**Storage message**

You can work with a password as the operator privilege for editing parameters (see also parameter 87). In this case, the password is queried before you edit the first parameter.

| PASSWORD |
|---|
| → : |

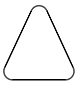
**Figure 7.7**
**Program mode**
**Password input**

The following message appears briefly when you enter the password correctly: “*** CODE OK. ***”.

## 7.2.4 Operating Examples

### Example 1: Incrementing the Frequency Setpoint in the LOCAL Mode

| LOC | Stop | Set: 1 |
|---|---|---|
| SET | 0.00 Hz | 0 % |

Press the  key 1× (additionally pressing key SHIFT once provides a higher rate of change of the data value).

| LOC | Stop | Set: 1 |
|---|---|---|
| SET | 0.01 Hz | 0 % |

### Example 2: Storing the Set Frequency Setpoint in the LOCAL Mode

| LOC | Stop | Set: 1 |
|---|---|---|
| SET | 0.01 Hz | 0 % |

Press the 

key.

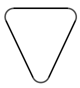
| *** STORED *** |
|---|
| |

The standard display 1 appears after approx. 3 seconds.

| LOC | Stop | Set: 1 |
|---|---|---|
| SET | 0.01 Hz | 0 % |

### Example 3: Switching from Standard Display 1 to 2 (in REMOTE Mode only)

| LOC | Stop | Set: 1 |
|---|---|---|
| SET | 0.01 Hz | 0 % |

Press the  key or  .

| | |
|---|---|
| VIEW X: | 0.01 Hz |
| VIEW Y: | 0.0 A |

### Example 4: Switching from the Operating Mode to the Program Mode

| | | |
|---|---|---|
| LOC | Stop | Set: 1 |
| SET | 0.01 Hz | 0 % |

Press the PROG key.

| |
|---|
| Motor data |
| (1) |

### Example 5: Switching to another Parameter Group

| |
|---|
| Motor data |
| (1) |

Press the ▲ key or ▼ .

| |
|---|
| Basic data |
| (2) |

### Example 6: Switching from the Parameter Group to Subparameter List

| |
|---|
| Motor data |
| (1) |

Press the PROG key.

| | |
|---|---|
| Nominal voltage | 400.0 V |
| PROG 11: | |

### Example 7: Editing the “Nominal voltage” Parameter

| | |
|---|---|
| Nominal voltage | 400.0 V |
| PROG 11: | |

Press the SHIFT key.

Parameter number 11 flashes.

Press the ▽ key: the value is counted down (additionally pressing key SHIFT once provides a higher rate of change of the data value).

Press the △ key: the value is counted up (additionally pressing key SHIFT once provides a higher rate of change of the data value).

| | |
|---|---|
| **Nominal voltage** | **380.0 V** |
| **PROG 11:** | |

Press the ENTER key.

| |
|---|
| ***** STORED ***** |
| |

The parameter number 11 no longer flashes.

| | |
|---|---|
| **Nominal voltage** | **380.0 V** |
| **PROG 11:** | |

## Example 8: Switching from the Subparameter List to the Parameter Group

| | |
|---|---|
| **Nominal voltage** | **380.0 V** |
| **PROG 11:** | |

Press the PROG key. Any changed parameter values are not stored in power-failsafe manner.

| |
|---|
| **Motor data** |
| **(1)** |

## Example 9: Switching from the Program Mode to the Operating Mode

| |
|---|
| **Motor data** |
| **(1)** |

Press the SHIFT key, keep it pressed and then press the △ or ▽ key.

| | | |
|---|---|---|
| **LOC** | **Stop** | **Set: 1** |
| **SET** | **0.01 Hz** | **0 %** |

## Example 10: Switching the Parameter Display to the Help Function

| | |
|---|---|
| **Reference-selec** | **?** |
| **PROG 31:** | **11** |

Press the 

key, keep it pressed and then press the 

key.

| | | |
|---|---|---|
| **0 - VIN:** | **0 ... 10 V** | **?** |
| **1 - VIN:** | **+/–10 V** | |

## Example 11: Confirmation of an Error

| |
|---|
| **Error 3** |
| **Overcurrent** |

Press the key 

, 

, 


| |
|---|
| **Start** |
| |

**or** switch off the line and switch on again.

## 7.3 On-Line Help

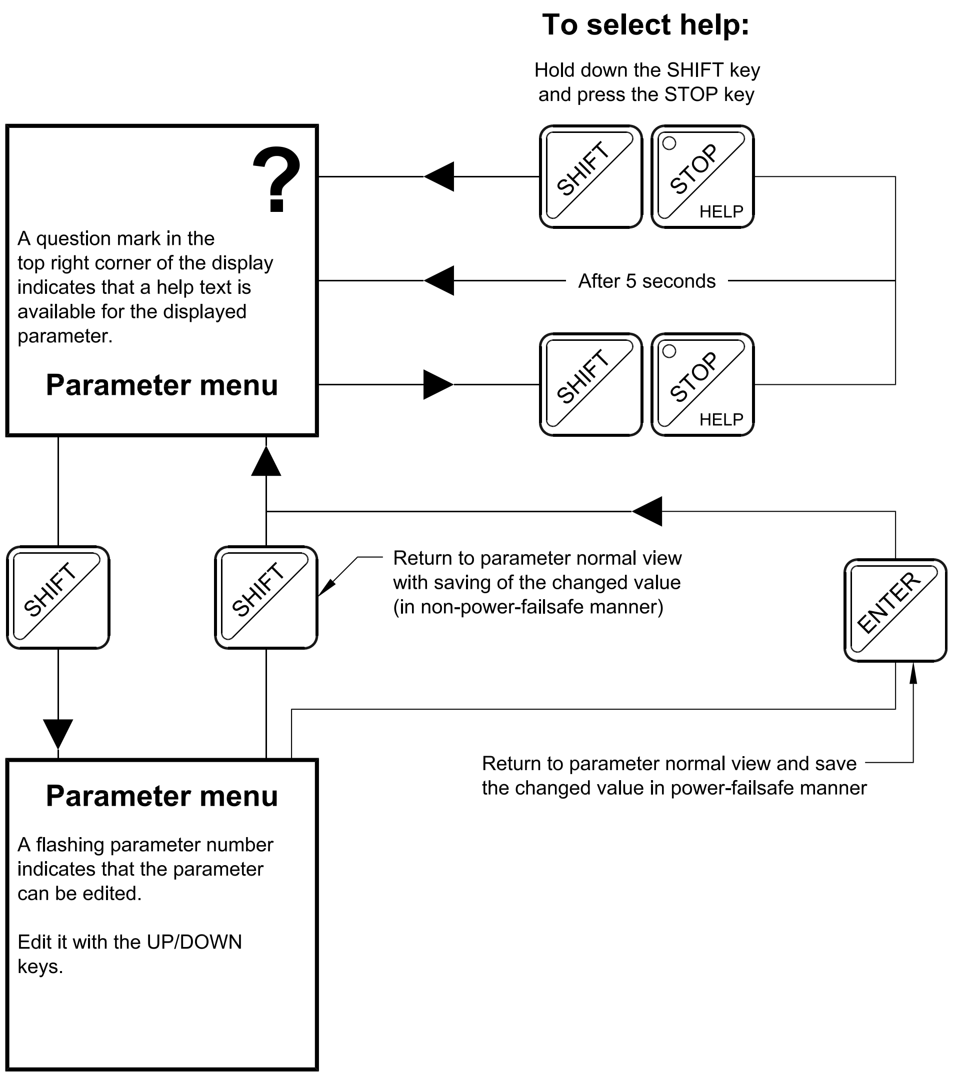



**Figure 7.8**

## 7.4 Key Functions

### 7.4.1 Control Keys

| KEY | FUNCTION IN THE OPERATION MODE | |
|---|---|---|
| | LOCAL MODE | REMOTE MODE |
| FWD | Start the motor with clockwise rotation allowing for the set ramps until the set setpoint is reached. If the motor is already turning counter-clockwise, it will decelerate through to rotational speed 0, change the direction of rotation and accelerate to the setpoint frequency set. | No function. |

**Table 7.3**
**Control keys**

| KEY | FUNCTION IN THE OPERATION MODE | |
|---|---|---|
| | LOCAL MODE | REMOTE MODE |
|  | Start the motor with counter-clockwise rotation allowing for the set ramps until the set setpoint is reached. If the motor is already turning clockwise, it will decelerate through to rotational speed 0, change the direction of rotation and accelerate to the frequency setpoint set. This key can basically be disabled via parameter **29 – Control mode**. | No function. |
|  | Depending on parameter **71 – Start and Stop options**, one of the following happens:<br>• Deceleration using the ramps or<br>• Inverter disable → free slowing-down of the motor. | Free slowing-down of the motor (EMERGENCY-STOP) if this function has not been deactivated in parameter 71. Error 0 “Emergency-Stop” is displayed and must be acknowledged with key PROG, SHIFT or ENTER and the Start command must be reissued. |

**Table 7.3**
**Control keys**

### 7.4.2 Control and Parameter Keys – Single Operation

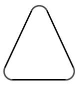
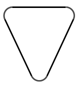
| KEY | FUNCTION | | | |
|---|---|---|---|---|
| | OPERATING MODE | PROGRAM MODE | | |
| | STANDARD DISPLAY 1 OR 2 | PARAMETER GROUP | PARAMETER LIST | DATA INPUT |
|  | ***LOCAL mode:***<br>Increments the frequency setpoint in 0.01 Hz steps (after 5 s, increase in the rate of change; see also Example 1). (1)<br>***REMOTE mode:***<br>Switches over between standard displays 1 and 2 (see also Example 3). | Skip to next parameter group resp. from the last parameter group to parameter group 0 (see also Example 5). | Skip to next parameter or from the last parameter to the first parameter. | Increments the parameter (increase in the rate of change after 5 s). (1) |
|  | ***LOCAL mode:***<br>Decrements the frequency setpoint in 0.01 Hz steps (after 5 s, increase in the rate of change). (1)<br>***REMOTE mode:***<br>Switches over between standard displays 1 and 2 (see also Example 3). | Skip to the previous parameter group resp. from parameter group 0 to the last parameter group. | Skip to the previous parameter resp. from the first parameter to the last parameter. | Decrements the parameter (increase in the rate of change after 5 s). (1) |

**Table 7.4**
**Control and parameter keys – single operation**

(1) Additionally pressing key SHIFT once provides a higher rate of change of the data value.

| | FUNCTION | | | |
|---|---|---|---|---|
| | OPERATING MODE | PROGRAM MODE | | |
| KEY | STANDARD DISPLAY 1 OR 2 | PARAMETER GROUP | PARAMETER LIST | DATA INPUT |
| △ + ▽ or ▽ + △ | No function. | No function. | No function. | The parameter just edited is reset to the factory default setting. *** Default! *** is displayed for one second on the display and the default value is then shown. The value can then be edited further until SHIFT or ENTER is pressed. |
| PROG | Skip to parameter group and switch to Program mode (see also Example 4). Acknowledgement of an error. (1) | Opens the parameter list relating to the selected parameter group (see also Example 6). Acknowledgement of an error. (1) | Skip back to the parameter group (see also Example 8). Acknowledgement of an error. (1) | Abort data entry (without saving any changes) and skip back to the parameter group. Acknowledgement of an error. (1) |
| SHIFT | Acknowledgement of an error. (1) | Acknowledgement of an error. (1) | Transition to data entry → parameter number blinks. It is then possible to set the required value with UP or DOWN. Acknowledgement of an error. (1) | Quitting data entry with the storage of the changed value but without storing the value in power-failsafe manner. It a software reset or restart of the inverter is now performed, the value prior to the change takes effect again. If a parameter group contains at least parameter which has not been stored in power-failsafe manner, this is indicated by means of an exclamation mark "!" after the group name. Acknowledgement of an error. (1) |
| ENTER | ***In LOCAL mode only:*** The set setpoint is stored in power-failsafe manner (see also Example 2). The inverter acknowledges the entry with ** Set Stored **. Acknowledgement of an error. (1) | Power-failsafe storage of all parameters of this group. The UD 7000 indicates that the entire group has been stored with display ** Gr. Stored **. Acknowledgement of an error. (1) | Acknowledgement of an error. (1) | Power-failsafe storage of the set parameter value. The UD 7000 acknowledges acceptance of the new value with display: *** Stored ***. Acknowledgement of an error. (1) |

**Table 7.4**
**Control and parameter keys – single operation**

(1) If the PROG, SHIFT or ENTER key is pressed, the message is reset on the ABE (display and operator-control unit). Acknowledgement of the error message does not cancel the cause of the error. Errors may be also still be pending after reset (see also Chapter 8.17, "Error States").

### 7.4.3 Control and Parameter Keys – Combinations with SHIFT

| | FUNCTION | | | |
|---|---|---|---|---|
| | OPERATING MODE | PROGRAM MODE | | |
| KEYS | STANDARD DISPLAY 1 OR 2 | PARAMETER GROUP | PARAMETER LIST | DATA INPUT |
| SHIFT + FWD | No function. | No function. | Transition to data entry → parameter number blinks. It is then possible to set the required value with UP or DOWN. (1) | Quitting data entry with the storage of the changed value but without storing the value in power-failsafe manner. It a software reset or restart of the inverter is now performed, the value prior to the change takes effect again. If a parameter group contains at least parameter which has not been stored in power-failsafe manner, this is indicated by means of an exclamation mark “!” after the group name. (1) |
| SHIFT + REV | No function. | No function. | Transition to data entry → parameter number blinks. It is then possible to set the required value with UP or DOWN. (1) | Quitting data entry with the storage of the changed value but without storing the value in power-failsafe manner. It a software reset or restart of the inverter is now performed, the value prior to the change takes effect again. If a parameter group contains at least parameter which has not been stored in power-failsafe manner, this is indicated by means of an exclamation mark “!” after the group name. (1) |
| SHIFT + STOP HELP | No function. | No function. | Calling the Help function (see also Example 10). ***On the Help display:*** Display of the next Help page or quitting the Help function (Help is also quit automatically after 5 seconds). (1) | Calling the Help function (see also Example 10). ***On the Help display:*** Display of the next Help page or quitting the Help function (Help is also quit automatically after 5 seconds). (1) |

**Table 7.5**
**Control and parameter keys – combinations with SHIFT**

| | FUNCTION | | | |
|---|---|---|---|---|
| | OPERATING MODE | PROGRAM MODE | | |
| KEYS | STANDARD DISPLAY 1 OR 2 | PARAMETER GROUP | PARAMETER LIST | DATA INPUT |
| △ + SHIFT | No function. | No function. | No function. | Maximum rate of change of the data value (Press key UP, keep it pressed and then press key SHIFT once). (3) |
| ▽ + SHIFT | No function. | No function. | No function. | Maximum rate of change of the data value (Press key DOWN, keep it pressed and then press key SHIFT once). (3) |
| SHIFT + △ | No function. | Quitting Program mode and switching over to the standard display 1/2. (2) | Incrementing the data values in steps of one, ten or one hundred, depending on value range and resolution (keep key SHIFT pressed and briefly press key UP). (2) | Incrementing the data values in steps of one, ten or one hundred, depending on value range and resolution (keep key SHIFT pressed and briefly press key UP). (2) |
| SHIFT + ▽ | No function. | Quitting Program mode and switching over to the standard display 1/2. (2) | Decrementing the data values in steps of one, ten or one hundred, depending on value range and resolution (keep key SHIFT pressed and briefly press key DOWN). (2) | Decrementing the data values in steps of one, ten or one hundred, depending on value range and resolution (keep key SHIFT pressed and briefly press key DOWN). (2) |
| SHIFT + PROG | Skip to parameter group and switch to Program mode but only the parameters which differ from the factory default setting are displayed in all parameter groups.<br>**NOTE:**<br>You must return to the operating mode from the menu with SHIFT + UP and start Program mode with PROG in order to display all parameters again. (1) | Only the parameters differing from the factory default setting are displayed in the current parameter group.<br>**NOTE:**<br>If the parameter group is not opened, there are no deviations from the factory default settings in this group. If the group is quit, all parameters are displayed again. (1) | Transition to data entry → parameter number blinks. It is then possible to set the required value with UP or DOWN. (1) | Transition to data entry → parameter number blinks. It is then possible to set the required value with UP or DOWN. (1) |

**Table 7.5**
**Control and parameter keys – combinations with SHIFT**

| | FUNCTION | | | |
|---|---|---|---|---|
| | OPERATING MODE | PROGRAM MODE | | |
| KEYS | STANDARD DISPLAY 1 OR 2 | PARAMETER GROUP | PARAMETER LIST | DATA INPUT |
| SHIFT + ENTER | ***REMOTE mode:*** Starting Test mode under specific preconditions (details as for parameter **2A – Test mode**). ***LOCAL mode:*** No function. (1) | No function. | ***Read-only parameters:*** Each read-only parameter can be transferred to the standard display 2. The required read-only parameter must be selected for this purpose. The parameter is transferred to the upper position of the standard display (power-failsafe) by pressing SHIFT + ENTER. This shifts the parameter which was previously in the upper position to the lower position. ***Editable parameter:*** As for ENTER. (1) | Transition to data entry → parameter number blinks. It is then possible to set the required value with UP or DOWN. (1) |

**Table 7.5**
**Control and parameter keys – combinations with SHIFT**

**NOTES:**

(1) In the case of SHIFT/FWD, SHIFT/REV, SHIFT/STOP, SHIFT/PROG and SHIFT/ENTER, you must first press the SHIFT key, keep it pressed and then press the other key in each case.

(2) In the case of SHIFT/UP and SHIFT/DOWN, always press key SHIFT first, keep it pressed and then briefly press key UP or DOWN.

(3) In the case of UP/SHIFT and DOWN/SHIFT always press key UP or DOWN first, keep it pressed and then briefly press key SHIFT once.

### 7.4.4 LED Status Display

| DISPLAY | MEANING |
|---|---|
| **Red LED in STOP key** | Stop state |
| **Green LED in FWD key** | Right-hand rotation |
| **Green LED in REV key** | Left-hand rotation |
| **Green LEDs in FWD and REV keys** | DC braking or Test mode |

**Table 7.6**
**LED status display**

# 8 Parameter Description

## 8.1 Group 1 – Motor Data

**HINT!**

**Before the drive is commissioned, the parameters in this group must be adapted to local conditions to ensure that the motor/device are tuned optimally.**

**The following calculations must be carried out in order to determine the correct data in the case of applications in which several motors are connected parallel:**

**ATTENTION!**

Motors with differing nominal rotational speed, number of poles, power factor, nominal output and nominal current may be operated only under application “0” and with controlled characteristic (parameter **62 – V/Hz characteristic selection**, setting 2). In all cases, the nominal motor voltage **must** be the same.

1. Rated voltage:

   Enter the motor voltage specified on the motor rating plate. The connected motors must all have the same nominal voltage. Ensure that they have the same vector group (⅄ or △).

2. Rated frequency:

   Enter the frequency specified on the rating plate.

   **EXAMPLE (special case):**

   Rating plate specification, e.g. 230/400 V, 50 Hz, delta/star. The motor should be operated in a “delta” circuit with a 400 V unit. The nominal frequency can then be calculated as follows:

   $$F_{nom} = \sqrt{3} \times 50\ \text{Hz} = 87\ \text{Hz}$$

   **CAUTION:** parameter **21 – Knee frequency** must also be set to this value.

3. Power factor:

   Enter the power factor specified on the rating plate.

4. Rated speed:

   Enter the nominal rotational speed specified on the rating plate.

   The motor is operated up to 87 Hz as described in “2.” above. The slip speed must then be determined first:

   $$n_{slip} = n_{sync} - n_{nom}$$

   The synchronous speed at 87 Hz is then calculated:

   $$n_{sync\ (87\ Hz)} = \frac{87\ \text{Hz} \times 60}{p}$$

   where p corresponds to the number of pole pairs. The rotational speed to be entered is then as follows:

   $$n_{nom\ (87\ Hz)} = n_{sync\ (87\ Hz)} - n_{slip}$$

5. Rated power:

   The outputs of the motors must be added.

   The motor is operated up to 87 Hz as described above in “2.”. In this case, the output issued by the motor at 87 Hz must be used for calculation. This means that it is calculated as follows in the example specified:

$$P\ (87\ Hz) = P\ (50\ Hz) \times \frac{87\ Hz}{50\ Hz}$$

6. Rated current:

   The nominal currents of the motors must be added. The currents of the vector group used must be used (⅄ or △).

**11 – Rated voltage** **SL / SLV**

Rated motor voltage as detailed on the motor name plate. If the motor allows different switching types (⅄ or △), the voltage that corresponds to the switching type used must be entered.

**NOTE:** this parameter is not relevant in versions with current control (EC/FO).

◊ Value range: 100.0–480.0 V

Default Europe: see Table 8.1
Default USA: see Table 8.2
(see also parameter EA)

**12 – Rated frequency** **SL / FO / SLV / EC**

Rated motor frequency as detailed on the motor name plate or frequency at which the motor must be operated in order to reach the rated speed under rated conditions.

◊ Value range: 10.0–1000.0 Hz

Default Europe: see Table 8.1
Default USA: see Table 8.2
(see also parameter EA)

**13 – Power factor** **SL / FO / SLV**

Power factor cos φ as detailed on the motor name plate.

**NOTES:**

1) This parameter is not relevant when using a brushless servo motor.
2) The power factor cos φ can also be computed using the following formula with known or estimated efficiency η:

$$\cos\varphi = \frac{P_{nom}}{1.73 \times I_{nom} \times V_{nom} \times \eta}$$

**Explanation of symbols:**

| | | |
|---|---|---|
| cos φ | – Power factor (parameter 13) | [1] |
| $P_{nom}$ | – Nominal motor output (parameter 15) | [W] |
| $I_{nom}$ | – Nominal motor current (parameter 16) | [A] |
| $V_{nom}$ | – Nominal motor voltage (parameter 11) | [V] |
| η | – Efficiency | [1] |

3) If US motors are used, the specification of the power factor may be missing on the rating plate. Should the text “N.L. Amps” be present instead, the power factor cos φ can be calculated to a good degree of approximation as follows:

Assumption:

$$N.L.\ Amps = \sin\varphi \times Rated\ current$$

$$\Rightarrow \sin\varphi = \frac{N.L.\ Amps}{Rated\ current} \Rightarrow \varphi = \sin^{-1}\left(\frac{N.L.\ Amps}{Rated\ current}\right)$$

$$\Rightarrow \cos\varphi = \cos\left(\sin^{-1}\left(\frac{N.L.\ Amps}{Rated\ current}\right)\right)$$

Using the table below, you can determine the power factor cos φ directly from the quotient $\frac{\text{N.L. Amps}}{\text{Rated current}}$:

| N.L. Amps / Rated current | 0.31 | 0.44 | 0.51 | 0.54 | 0.57 | 0.60 | 0.63 | 0.65 | 0.67 | 0.69 | 0.71 | 0.76 | 0.8 | 0.83 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cos φ | 0.95 | 0.9 | 0.86 | 0.84 | 0.82 | 0.80 | 0.78 | 0.76 | 0.74 | 0.72 | 0.70 | 0.65 | 0.6 | 0.55 |

4) If you also do not know the specification of the “N.L. amps” and efficiency η, please choose the value for cos φ from Table 8.1 or 8.2 as a function of the nominal motor output.

◊ Value range: 0.50–1.00 Default Europe: see Table 8.1
Default USA: see Table 8.2
(see also parameter EA)

**14 – Rated speed** **SL / FO / SLV / EC**

Rated motor speed as detailed on the motor name plate.

◊ Value range: 100–32500 rpm Default Europe: see Table 8.1
Default USA: see Table 8.2
(see also parameter EA)

**15 – Rated power** **SL / FO / SLV / EC**

Rated motor power as detailed on the motor name plate.

◊ Value range: 0.01–100.00 kW Default Europe: see Table 8.1
Default USA: see Table 8.2
(see also parameter EA)

**16 – Rated current** **SL / FO / SLV / EC**

Rated current as detailed on the motor name plate. If the motor allows different switching types (⅄ or △), the current that corresponds to the switching type used must be entered.

◊ Value range: 0.1–300.0 A Default Europe: see Table 8.1
Default USA: see Table 8.2
(see also parameter EA)

| **EUROPE (400 V/50 HZ)** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$P_{rated\ inverter}$ (kW)** | | **1.5** | **2.2** | **3.0** | **4.0** | **5.5** | **7.5** | **11.0** | **15.0** | **22.0** | **30.0** | **37.0** | **45.0** | **55.0** |
| **$V_{rated}$ [V]** | Parameter 11 | 400 | | | | | | | | | | | | |
| **$f_{rated}$ [Hz]** | Parameter 12 | 50 | | | | | | | | | | | | |
| **cos φ (%$_{eff}$)** | Parameter 13 | 0.82 | 0.82 | 0.82 | 0.82 | 0.83 | 0.83 | 0.85 | 0.85 | 0.81 | 0.86 | 0.86 | 0.87 | 0.87 |
| **$n_{rated}$ [rpm]** | Parameter 14 | 1410 | 1415 | 1415 | 1435 | 1450 | 1450 | 1455 | 1455 | 1460 | 1465 | 1475 | 1475 | 1475 |
| **$P_{rated}$ [kW]** | Parameter 15 | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 | 7.5 | 11.0 | 15.0 | 22.0 | 30.0 | 37.0 | 45.0 | 55.0 |
| **$I_{rated}$ [A]** | Parameter 16 | 3.7 | 5.2 | 6.8 | 9.2 | 11.7 | 15.6 | 22.5 | 30.0 | 43.0 | 58.0 | 71.0 | 85.0 | 102.0 |

**Table 8.1**

| USA (460 V/60 HZ) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_{rated\ inverter}$ (kW) | | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 | 7.5 | 11.0 | 15.0 | 18.5 | 22.0 | 30.0 | 37.0 | 45.0 | 55.0 |
| $V_{rated}$ [V] | Parameter 11 | 460 | | | | | | | | | | | | | |
| $f_{rated}$ [Hz] | Parameter 12 | 60 | | | | | | | | | | | | | |
| cos φ ($\%_{eff}$) | Parameter 13 | 0.78 | 0.785 | 0.787 | 0.79 | 0.72 | 0.76 | 0.76 | 0.75 | 0.79 | 0.82 | 0.86 | 0.85 | 0.86 | 0.86 |
| $n_{rated}$ [rpm] | Parameter 14 | 1750 | 1755 | 1755 | 1755 | 1765 | 1774 | 1770 | 1780 | 1775 | 1773 | 1775 | 1770 | 1775 | 1780 |
| $P_{rated}$ [kW] | Parameter 15 | 1.5 | 2.2 | 2.9 | 3.7 | 5.5 | 7.3 | 10.9 | 14.6 | 18.3 | 21.9 | 29.2 | 36.5 | 43.8 | 56.0 |
| $I_{rated}$ [A] | Parameter 16 | 3.0 | 4.2 | 5.5 | 6.7 | 10.7 | 13.5 | 20.0 | 27.0 | 32.5 | 36.5 | 46.0 | 58.0 | 69.0 | 84.3 |

**Table 8.2**

**NOTES:**

The default values depend on the power of the inverter.

The following parameters are automatically recomputed if changes are made to parameters in the “Motor data” group:

Parameter F7 – Main reactance $X_h$
Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

## 8.2 Group 2 – Basic Data

**21 – Knee frequency** **SL / FO / SLV / EC**

The motor is operated in the frequency range from Zero up to the knee frequency with rated excitation. This means that the inverter emits, at this frequency and rated load of the motor, its rated voltage.

This parameter needs to be specified only if parameter **62 – V/Hz characteristic selection** has been programmed for functions 2, 3, 4 or 5 (controlled field attenuation). In the other cases, the inverter automatically implements field attenuation as a function of the available voltage and the load conditions.

◊ Value range: 10.0–1000.0 Hz — Default Europe: 50.0 Hz; Default USA: 60.0 Hz (see also parameter EA)

◊ *SLV*② value range: 10.0–1000.0 Hz — Default Europe: 43.0 Hz; Default USA: 51.0 Hz (see also parameter EA)

**22 – Boost** **SL – OE**

Compensation factor for setting the excitation of the motor with regard to the V/Hz characteristic determined by the inverter on the basis of the motor data (parameter group 1 or measurement; see also parameter 2A). The compensation factor is active over the measured nominal range of the motor. A value of 100% corresponds to the characteristic determined by the inverter.

When this parameter is modified, the following parameters are recomputed automatically:

Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

This correction factor acts in the case of parameters **22 – Boost** and **61 – Autoboost**.

**ATTENTION!**

Setting excessive values may result in swift heating up of the motor at low speeds.

**NOTE:** this parameter is of no relevance in version with current control (EC/FO) and in the case of *SLV*②. No display in the case of *SLV*②.

◊ Value range: 0.0–600.0% Default: 100.0%

**23 – Maximum frequency SL / FO / SLV / EC**

Top frequency limit that is never exceeded by the inverter. The "Minimum frequency" and "Maximum frequency" parameters also serve to scale the analog setpoint inputs.

**NOTE:** for *SLV*② applications, the maximum frequency should not amount to more than twice the rated motor frequency. For operation in the field attenuation range, the speed controller must be optimized again.

◊ Value range: 1.0–875.0 Hz Default Europe: 50.0 Hz
Default USA: 60.0 Hz
(see also parameter EA)

**24 – Minimum frequency SL / FO / SLV / EC**

Bottom frequency limit, which the inverter does not fall below in a stationary fashion. The minimum frequency is evaluated differently depending on the setpoint source (see parameter 31, variants 1 and 2).

◊ Value range: 0.0–100.0 Hz Default: 0.0 Hz

**25 – Acceleration time 1 SL / FO / SLV / EC – OE**

Standard acceleration time. Period of time for acceleration from 0 Hz to the maximum frequency (parameter 23).

◊ Value range: 0.1–999.9 s Default: 3.0 s

**26 – Deceleration time 1 SL / FO / SLV / EC – OE**

Standard deceleration time. Period of time for deceleration from the maximum frequency (parameter 23) to 0 Hz.

◊ Value range: 0.1–999.9 s Default: 3.0 s

**27 – Acceleration time 2 SL / FO / SLV / EC – OE**

Alternative acceleration time. Period of time for acceleration from 0 Hz to the maximum frequency (parameter 23). The switchover possibilities are programmed with the parameter **72 – Ramp function selection**.

◊ Value range: 0.1–999.9 s Default: 5.0 s

**28 – Deceleration time 2 SL / FO / SLV / EC – OE**

Alternative deceleration time. Period of time for deceleration from the maximum frequency (parameter 23) to 0 Hz. The switchover possibilities are programmed with the parameter **72 – Ramp function selection**.

◊ Value range: 0.1–999.9 s Default: 5.0 s

**29 – Control mode SL / FO / SLV / EC – SC**

This parameter defines the sources for the Start/Stop signal and the setpoint in the two operating modes LOCAL and REMOTE. Switchover between LOCAL and REMOTE is performed via terminal input PS3 if this has been programmed for function x06 with parameter **9B – PS3 input function selection**. Operating mode LOCAL is displayed by LOC on the standard display 1 and display REM is shown in REMOTE mode.

**ATTENTION!**

If you switch over from LOCAL mode to REMOTE mode (see also parameter **9B – PS3 input function selection**), a Start command applied to the terminals is processed immediately if the motor is started. This may lead to death, injury or damage to equipment and installations.

| | LOCAL MODE | | REMOTE MODE | |
|---|---|---|---|---|
| | **Setpoint** | **Start/Stop signal** | **Setpoint** | **Start/Stop signal** |
| **x0** | Keypad 1) | Keypad 2) 6) | NA | NA |
| **x1** | see NOTE 4) | Keypad 2) 6) | see NOTE 4) | Terminals 5) |
| **x2** | see NOTE 4) | Keypad 2) 6) | see NOTE 4) | Keypad 2) |
| **x3** | Keypad 1) | Keypad 2) 6) | see NOTE 4) | Terminals 5) |
| **x4** | NA | NA | see NOTE 4) | Terminals |
| **x5** | see NOTE 4) | Keypad 2) 6) | see NOTE 4) | SIO (RS-485) 3) |
| **x6** | Keypad 1) | Keypad 2) 6) | see NOTE 4) | SIO (RS-485) 3) |
| **x7** | NA | NA | see NOTE 4) | SIO (RS-485) 3) |
| **0x** | REV key basically not active (applies only to LOCAL mode) | | | |
| **1x** | FWD and REV keys active (applies only to LOCAL mode) | | | |

◊ Value range: see Table

Default Europe: 13
Default USA: 3
(see also parameter EA)

**NOTES:**

1) Key ▲: Increases the setpoint.
   Key ▼: Reduces the setpoint.
   Key ENTER: Failsafe storage of the setpoint.

2) Key FWD: Right rotation.
   Key REV: Left rotation (if the REV key is enabled).
   Key STOP: Deceleration or free coasting (output stage disable) of the motor (see parameter **71 – Start and Stop options**).

3) SIO mode is a special form of REMOTE mode. Command FWD (“Start with clockwise rotating field”), REV (“Start with anticlockwise-rotating field”) and the STOP command are preset solely via the serial port RS 485 in this mode. Parameter **AD – Inverter control commands in SIO mode** is used for this. On the standard display 1, display “SIO XX” indicates that the inverter receives its control commands from the RS 485 bus and that it has address XX (XX stands for 00 to 31, see parameter **A9 – Slave address of the inverter for SIO operation**). The setpoint source is determined by parameter **31 – Setpoint selection (frequency setpoint)**).

**HINT!**

Parameterisation of the inverter via the serial port RS 485 does not require SIO mode. “SIO mode” means only that the Start-Stop signals are routed from the RS 485 interface in the case of REMOTE mode.

4) The setpoint source is determined with parameter **31 – Setpoint selection (frequency setpoint)** and by programming inputs PS1, PS2 and PS3 with parameters 99 to 9B and wiring these inputs according to the explanation below:

With valences PS1 – $2^0$, PS2 – $2^1$, PS3 – $2^2$, inputs PS1–PS3 form a numerical value which is used as the selection parameter for the terminal setpoint. The corresponding bit is set equal to 1 if the input is programmed for function x00 “Selection of a fixed frequency” with the relevant parameter 99 to 9B “Function selection of input PS1/PS2/PS3” and the input has been activated. If one of the two conditions is not met, the bit is set equal to zero. The following setpoint sources (see Table 8.3) are assigned to the possible values of the selection parameter thus generated. If all three bits are equal to zero, only parameter **31 – Setpoint selection (frequency setpoint)** determines the setpoint source.

5) In this mode, Start and Stop commands are preset only with terminals “FWD” and “REV”. Parameters **71 – Start and Stop options** and **91 – Function of inputs FWD and REV** define how these terminals respond precisely. Both parameters must be adapted in order to achieve safe operation of the installation. The keypad's STOP key is programmed as “Emergency-Stop” by default.

6) **Jog mode in LOCAL mode:**
The set value of fixed frequency 1 may also be used as a jog frequency. For this purpose, the binary inputs R/J and PS3 must be activated, parameter **98 – Run/Jog input function selection** must be programmed for function x00 “Jog mode selected” and LOCAL mode must be activated with parameter 9B (setting x06). The motor operates at the set fixed frequency 1 in the corresponding direction for as long as key FWD or REV is now pressed.

| PS3 | PS2 | PS1 | Frequency setpoint defined by: |
|---|---|---|---|
| 0 | 0 | 0 | Parameter **31 – Setpoint selection (frequency setpoint)** (1) |
| 0 | 0 | 1 | Parameter **41 – Fixed frequency 1** (2) (3) |
| 0 (4) | 1 (5) | 0 | Parameter **42 – Fixed frequency 2** (3) |
| 0 | 1 | 1 | Parameter **43 – Fixed frequency 3** (3) |
| 1 | 0 | 0 | Parameter **44 – Fixed frequency 4** (3) |
| 1 | 0 | 1 | Parameter **45 – Fixed frequency 5** (3) |
| 1 | 1 | 0 | Parameter **46 – Fixed frequency 6** (3) |
| 1 | 1 | 1 | Parameter **23 – Maximum frequency** |

**Table 8.3**

(1) The frequency setpoint is determined by parameter **31 – Setpoint selection (frequency setpoint)**.
(2) The set value of fixed frequency 1 can be used as a jog frequency. For this purpose, the binary inputs R/J and PS3 must be activated, parameter 98 (Selection function input Run/Jog) must be programmed for function “Jog mode selected” (setting x00) and LOCAL mode must be activated with parameter 9B (setting x06). The motor operates at the set fixed frequency 1 in the corresponding direction for as long as key FWD or REV is pressed.
(3) In the case of the fixed frequencies, parameters 41–46, only the setpoint which is not higher than the maximum frequency acts. In the case of higher values, the maximum frequency is used.
(4) “0” means: the setting of the data code for parameters 99–9B is greater than 0 **or** active level is not applied to the input.
(5) “1” means: selection of a fixed frequency (data code “0” in parameters 99–9B) **and** input PS1–PS3 is assigned active level.

## 2A – Test mode SL / FO / SLV / EC

This parameter determines what motor-specific data must be determined automatically by the inverter. This relates to parameters which are not specified on the motor rating plate.

**ATTENTION!**

Cables and motor are electrically live (risk of lethal injury) when Test mode is run. The motor turns in the case of certain test sequences.

Follow all commissioning steps before starting Test mode. It is particularly important that correct motor data (parameter group 1) has been entered.

After successful execution of the relevant measurement, parameters are computed whose values can be determined from the measurement results, e.g. the current controller parameters from the measured resistances and inductances.

A setting for 101 for the sensorless inverter (application 0), 104 for ***SLV***② and 109 or 119 for the EC/FO variant are recommended in order to achieve as precise coordination as possible between motor and inverter. At this point, it is also possible to determined what test is to be performed how frequently. For example, a test can be defined as “to be performed successfully once”, i.e. the measurements are normally conducted only one single time (with the first Start command). Thereafter, the parameter is reset automatically to the value zero. However, if an error occurs during the test (i.e. measurement unsuccessful), the test request remains pending for the next Start command. The factory default setting 101 starts a non-recurrent measurement of the stator resistance after the first Start command. The following functions may be selected:

| | Notes | Description |
|---|---|---|
| **0** | | No parameter determination |
| **1** | | Measurement of the stator resistance after the first start command following power-on |
| **2** | | Measurement of the stator resistance after every start command |
| **3** | (1) | Measurement of the stator resistance after the first start command following power-on and after execution of each stop command |
| **4** | | Measurement of the stator resistance and of the leakage inductance after the first start command following power-on (mainly for ***SLV***② mode) |
| **5** | (2) (3) | Determination of the installation offset and the direction of rotation of the position encoder after the first start command following power-on (only for applications with rotational speed feedback) |
| **6** | (2) (3) | Measurement of the stator resistance and determination of the installation offset and the direction of rotation of the position encoder after the first start command following power-on |
| **9** | (2) (3) | Measurement of the stator resistance and of the leakage inductance, determination of the installation offset and of the direction of rotation of the position encoder after the first start command following power-on |
| **10** | (2) (4) | Search for the Zero pulse when using an encoder in Master Slave |
| **11**<br>**14**<br>**15**<br>**16**<br>**19** | (4)<br>(4)<br>(2) (3) (4)<br>(2) (3) (4)<br>(2) (3) (4) | Same as 1, 4, 5, 6 and 9, but with a search for the Zero pulse when using an encoder |

| | Notes | Description |
|---|---|---|
| **101**<br>**104**<br>**105**<br>**106**<br>**109**<br>**110**<br>**111**<br>**114**<br>**115**<br>**116**<br>**119** | <br><br>(2) (3)<br>(2) (3)<br>(2) (3)<br>(2) (3)<br>(4)<br>(4)<br>(3) (4)<br>(3) (4)<br>(3) (4) | Like 1, 4, 5, 6, 9 (or 11, 14, 15, 16, 19) but as a **singular performance,** i.e. that the parameter is automatically set to 0 after the selected test has been performed **completely and without error message or warning.**<br>After the next starting instruction and also after a software re-start (5), there will be no further test run.<br><br>**Starting the test run with a key combination:**<br>A Test mode can be started only in REMOTE-Mode and in the standard display 1 with keyboard short-cut SHIFT + ENTER (press SHIFT key first and then key ENTER) and a set parameter value above 100 in the case of parameter **2A – Test mode**. You are then prompted to indicate whether Test mode is to be started, and this prompt can be confirmed by pressing key FWD or aborted with STOP. If you abort the prompt, you will see a warning message indicating that a measurement has not been conducted, the warning can be acknowledged with key PROG, SHIFT or ENTER. When Test mode is started, you will see display “LOC Test”. The drive is de-energised again and is stopped after completion of the measurements.<br><br>**The following remark is valid no matter whether the tests have been started through starting instruction or key combination:**<br>In case of errors or the user interrupting the test, the entered value is preserved until the autotuning function has been performed completely or until the user changes the value. |

**ATTENTION!**

(1) As the stator resistance is measured after the Stop command is issued in test mode 3, the drive **is not immediately de-energized** after braking! The inverter output stages are blocked only at the end of the resistance measurement.
(2) The motor must be able to turn freely during this test run.
(3) If application 10, 11 or 12 is selected (EC motor), the resolver's mounting offset relative to the rotor zero displacement angle is measured. A DC voltage vector which pulls the rotor magnet wheel to its zero position is connected in this case. This angle offset is important as regards commutation control of the output stages.
(4) The zero pulse is sought with the frequency entered under parameter **D2 – Zero pulse search frequency**.
(5) The inverter software is re-started when the inverter is switched on and when the software has been reset with the aid of parameter **2D – Software reset**.

◊ Value range: see Table Default: 101

A test run should always be conducted if

- the drive is being placed into operation for the first time.
- a parameter reset has been performed (parameter EA).
- a different motor is connected.
- the application is modified (parameter 2C).
- something has changed on the feedback system (new installation or exchange or installation of an encoder with a different number of lines or a different resolver etc.).
- a high rotational speed accuracy is required in application *SLV*②. Heating of the motor will automatically result in a change in the winding resistances. This influences the drive qualities. If the application allows, you should check whether Test mode 2 can be integrated practically in the application (resistance measurement after each Start command).

**HINT!**

The Autotuning function fulfils its purpose only if the selected test has been run through once fully with no error message or warning. If an error message or warning is displayed during the measurement, Test mode must be repeated by restarting the unit. If an error message occurs again, the motor data in group 1 and correct cabling of the installation must be checked. Difficulties may also arise if the nominal power values of inverter and motor are far apart.

The measured and computed parameters are stored permanently. Therefore, one-time measurements of the motor parameters, of the installation offset and of the angle sensor's direction of rotation are adequate in most cases. However, these values should be determined again following changes in installation of the motor or encoder or the wiring.

**Solutions to the problem:**

While carrying-out a test-run, none of the binary inputs R/J, PS1, PS 2, PS 3, may be driven. The data established by Autotuning may differ from the optimum motor data if

- nominal motor and inverter power values differ greatly.
- the motor data in Group 1 do not agree with the actual data of the connected motor (e.g. motor data for a star connection is input, but the motor is operated with a delta connection (or vice versa)).
- test operation does **not** take place at the PWM frequency (parameter 79) used subsequently.
- the nominal data of the inverter means that the inverter is not capable of providing the current required for operation of the motor at the nominal working point or of providing the nominal motor voltage (e.g. a motor with a nominal voltage of 600 V is operated connected to the inverter in a 380 V power system).

**Stator resistance measurement**

The stator resistance is measured by application of a fixed voltage vector for several seconds. In doing so, the motor is 0 Hz.

Newly computed parameters:

Parameter F3 – Stator resistance R1
Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

**Leakage inductance measurement**

The leakage inductance is measured by impressing an alternating field with the rated frequency of the motor. In doing so, the motor is 0 Hz.

Newly computed parameters:

Parameter F4 – Rotor resistance R2
Parameter F5 – Leakage reactance $X\sigma$
Parameter F7 – Main reactance $X_h$
Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

**Determining the installation offset and the direction of rotation of the angle sensor**

For operation with a encoder generator or angle sensor, the directions of rotation of the motor and angle sensor read in by the inverter must agree. The parameter **BD – Angle sensor direction of rotation** serves to define this.

For the control of brushless servo motors, the rotor displacement angle of the motor must be known to the inverter. To do this, the installation offset of the encoder (parameter BC) is defined. This specifies the value measured by the angle sensor for the rotor displacement angle 0°.

Both items of information are determined in one testing step. In doing so, the motor is rotated by a total of 300°. The determined installation offset can be ignored if this testing step is used to determine the direction of rotation of the angle sensor for an induction motor.

If an encoder is used as an angle or rotor displacement angle sensor, the encoder's Zero pulse should be sought before determining the installation offset in order to arrive at a reproducible value.

To carry out this testing step, the motor must be capable decoupled from the load. Discrepancies may arise if this is not the case. In this case, the correct value must be determined elsewhere and must be entered in the parameter **BC – Angle sensor installation offset**.

Newly computed parameters:

Parameter BD – Angle sensor direction of rotation
Parameter BC – Angle sensor installation offset

**Zero pulse search when using an encoder as the angle sensor**

When using an encoder as the rotor position sensor for a brushless servo motor or as a general angle sensor for operation of the inverter in position control mode (e.g. electronic gearbox), the Zero pulse can be used to reproducibly define an absolute starting position.

During the search, the motor is rotated at a programmable frequency (parameter **D2 – Zero pulse search frequency**) until the evaluation electronics registers the Zero pulse. The position of the front edge of the Zero pulse is determined with the parameter **D3 – Zero angle**.

Newly computed parameters:

None.

## Application Examples

**Application: Inverter**

Test mode 4, with which the motor parameters are measured, is used for start up. For further operation, the parameter is set to 0 (no parameter determination) or 1 (measurement of the stator resistance as a highly temperature-dependent value after every power-on).

**Application: EC motor – speed control with resolver**

Test mode 9, with which the motor parameters and the installation offset are determined, is used for start up. The parameters of the current controller are calculated on the basis of the measured motor parameters. For further operation, the parameter is set to 0 (no parameter determination).

**Application: EC motor – speed control with encoder**

Test mode 19, with which the motor parameters and the installation offset are determined, is used for start up. The parameters of the current controller are calculated on the basis of the measured motor parameters. Before determination of the installation offset, the Zero pulse of the encoder is sought in order to have an absolute Zero point. For further operation, the parameter is set to 10 (Zero pulse search). This is necessary because the absolute Zero point to which the stored installation offset refers must be sought again after every power-on.

**Application: FO (induction motor – electronic gearbox with encoder, master setpoint specified through encoder)**

Test mode 19, with which the motor parameters, the installation offset and the direction of rotation of the encoder are determined, is used for start up. The parameters of the current controller are calculated on the basis of the measured motor parameters. The installation offset is irrelevant to the induction motor. As the encoder's direction of rotation is determined simultaneously, however, this function should be executed. Before determination of the installation offset, the encoder's Zero pulse is sought in order to have an absolute Zero point.

The setpoint for the “Electronic gearbox” function is specified through an encoder channel. For this channel, the Zero pulse must also be sought in order to determine the Zero point of the setpoint reference system. To do this, use the “Zero pulse search, master setpoint” function, which is started by activating a binary input programmed to this function (parameters 98–9B). After activation, the master encoder must be rotated by at least one revolution so as to find the Zero point.

For further operation, the parameter is set to 10 (Zero pulse search). This is necessary because the absolute Zero point to which the stored installation offset refers has to be sought anew after every power-on. The same applies to the master setpoint Zero pulse. This also has to be sought anew after every power-on.

**Application: *SLV*② (induction motor with sensorless control)**

Test mode 4, with which the motor parameters are measured and on the basis of which the controller parameters and other important variables for the *SLV*② model are calculated, is used for start up. For further operation, the parameter should be set to 0 (no parameter determination), 1 (measurement of the stator resistance after every power-on) or 2 (measurement of the stator resistance after every start command if the inverter is seldom isolated from the line).

## 2B – Adjustment mode SL / FO / SLV / EC

This parameter must be used to adapt the incoming setpoint level to the control (if, for instance, the incoming setpoint level cannot be set to 0.0 or 10.0 V by an offset or by the setpoint potentiometer, this parameter is used to adjust the minimum and maximum setpoint). This parameter and the measurements conducted at this point run only once after a power-on and make no changes to the present state of the inverter. If the parameter is set to a value specified in the table and the inverter is then switched off and then back on again or a Software Reset (parameter 2D) is performed, the display shows “SET MIN”. After correction of the minimum and maximum value, the inverter must be switched off and back on again so that the changed values take effect. The parameter is automatically set to value 0 in this case.

| | |
|---|---|
| **0** | Normal operation |
| **1** | Adjustment of analog setpoint input (minimum and maximum) 1) |

◊ Value range: see Table Default: 0

**NOTE:**

1) The applied setpoint is shown on the display as a standardised value in the range 0.000–1.000. Switching between Minimum and Maximum adjustment can be done with the PROG button.

   **Minimum adjustment (display: SET MIN):** the applied analogue setpoint is set to the minimum possible value and stored with key ENTER key (display: LIMIT SET). Switch to maximum adjustment with key PROG.

   **Maximum adjustment:** the applied analogue setpoint is set to the maximum possible value and stored with key ENTER (display: LIMIT SET). The inverter must now be switched off and back on again so as to accept the new settings.

## 2C – Application SL / FO / SLV / EC

You are prompted for this parameter once after power-on. A change in the parameter makes no changes to the present state of the inverter. The parameter must be set to the corresponding value and the unit must then be switched off and back on again or a Software Reset (parameter 2D) must be performed in order to select a different application.

If, when the prompt for this parameter occurs, it is determined that the option board required for this application is not fitted, error message 11 “Option” is displayed. This represents a fatal error which can be remedied in two possible ways:

1. By switching off the unit, by installing the necessary option board and by connecting the unit again.

2. Acknowledge the error message with key PROG, SHIFT or ENTER. Select an application which does not require an option card. Switch the inverter off and back on again or perform a Software Reset (parameter 2D).

The UD 7000 features three equivalent parameter sets. The parameter sets may contain diverse applications. If, in the event of a parameter set change-over, the unit detects that the new set contains a different application, the inverter is restarted directly after the set change-over in order to adapt the inverter environment see “Note 1 – Changing the customer parameter sets:”, Page 2-97.

**HINT!**

The UD 7000 features a wide variety of special applications offering solutions to special problems of drive engineering. Our Sales Division will be more than willing to inform you of applications available for the UD 7000. Never activate an application for which you do not have an application description. All functions described in this Manual apply only to the applications listed in this Manual.

| VALUE | APPLICATION | REQUIRED OPTION |
|---|---|---|
| **0** | Inverter | None |
| **2** | Brushless servo inverter running [1)] | None |
| **10** | EC motor – speed control | Resolver or encoder evaluation |
| **11** | EC motor – torque control [2)] | Resolver or encoder evaluation |
| **12** | EC motor – electronic gearbox [3)] | Encoder evaluation |
| **20** | Induction motor – speed control | Resolver or encoder evaluation |
| **21** | Induction motor – torque control [2)] | Resolver or encoder evaluation |
| **22** | Induction motor – electronic gearbox [3)] | Encoder evaluation |
| **50** | Induction motor –<br>sensorless speed control ***SLV***② [4)] | None |
| **51** | Induction motor –<br>sensorless torque control ***SLV***② [2, 5)] | None |
| **52** | Induction motor –<br>sensorless ***SLV***② speed control II [6)] | None |
| **53** | Induction motor –<br>***SLV***② in the field-attenuation range [6)] | None |
| **90** | Velocity control [7)] | None |

◊ Value range: see Table Default: 0

**NOTES:**

1) The following setpoint source must be programmed for the “Brushless servo inverter running” application (parameter 31 “9 – LIM master setpoint”).

2) The setpoint is specified through the VIN or CIN terminals. The parameter **31 – Setpoint selection (frequency setpoint)** must be programmed accordingly. This mode serves to implement applications in which purely torque-controlled operation is required (e.g. tension controls).

**ATTENTION!**

The drive generates a specified torque independently of the speed, i.e. without load the motor accelerates up to the maximum frequency defined in parameter 23.

3) One of the following setpoint sources must be programmed (parameter 31) for the “Electronic gearbox” application:
“8 – Option encoder master setpoint channel 2” (the “Two-channel encoder evaluation” option is required for this purpose) or
“9 – LIM master setpoint”.

4) Sensorless speed control on the basis of the *SLV*② method functions with standard motors within the frequency band 1 Hz through to twice the nominal motor frequency (parameter 12). The speed controller must be re-optimized if operating in the field-attenuation range (frequencies above the break-point frequency (parameter 21)).
5) The sensorless torque control according to the *SLV*② method functions reliably above the slip frequency. To exclude problems in the range around 0 Hz, the minimum frequency (parameter 24) must be set to a value of around 3 Hz.
6) These applications are not described in further detail in this Manual. Special application descriptions are available for these applications.
7) Any setpoint (parameter 31) with the exception of setting “7” or “9” may be selected for application “Velocity control”. The control uses the LIM input which must be scaled using parameter **36 – Pulse number of LIM input**.

## Applications

**0 (Inverter)**

**FACTORY SETTING:** the connected motor is controlled through a V/Hz ratio. Induction motors (e.g. standard three-phase motors) can be connected.

**2 (Brushless servo inverter running)**

The following setpoint source must be programmed for the “Brushless servo inverter running” application: parameter **31 – Setpoint selection (frequency setpoint)** = 9 (LIM master setpoint).

**10 (EC motor – speed control)**

Speed-controlled operation of an EC machine (brushless servo motor). Commutation and speed registering of the machine are realised by way of a resolver or incremental encoder mounted on the motor shaft. The machine runs the specified speed regardless of the load.

**11 (EC motor – torque control)**

Torque-controlled operation of an EC machine. The machine is commutated by way of a resolver or increment encoder mounted on the motor shaft. A rotational speed-controlled deceleration is started when the Stop command is issued.

**ATTENTION!**

Dependent on the speed of rotation, the drive generates a given torque, i.e. the motor accelerates under no load under the maximum frequency defined in parameter 23.

**12 (EC motor – electronic gearbox)**

Angle-synchronous operation of the EC motor. The motor connected to the inverter follows a two-phase reference signal angle-synchronously. The reference signal and the motor feedback signal are connected to the resolver option card. Please refer to the description of the resolver card for detailed information.

The illustration below shows a schematic representation of application “Electronic transmission”:

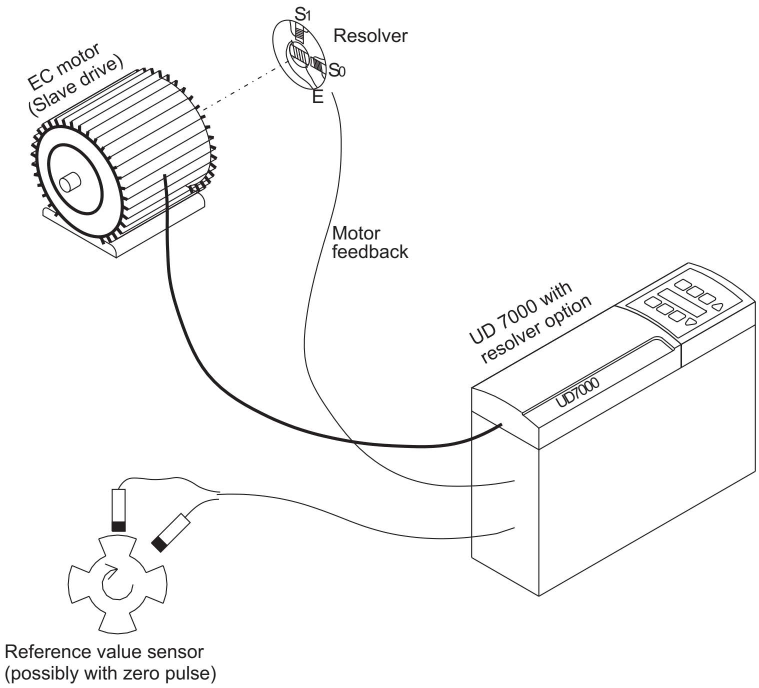



**Figure 8.1**

The motor follows the incoming control pulses phase-synchronously. Prior to commissioning, please follow the explanations for parameter **2A – Test mode**.

For Master-Slave mode using a resolver or encoder option card, it is important that the setpoint source 8 is selected. Please check the setting in parameter **31 – Setpoint selection (frequency setpoint)**. The rotational speed ratio between reference sensor and Slave drive is assigned on the basis of parameter **36 – Pulse number of LIM input**. The assignment of the direction of rotation is made with parameter **37 – Direction of rotation, master setpoint**.

There are two types of electronic transmission:

1. Angle-synchronous operation with any angle setting of the Slave and Master drive.

   After the drive has been switched on and the Start command has been issued, the Slave drive follows the Master drive starting from its current position. It is not necessary to evaluate a zero pulse.

2. Angle-synchronous operation with fixed angular position between Slave and Master drive.

   After the drive has been switched on, the zero pulse of the reference sensor must be sought before the Start command is issued (drive in STOP state). For this purpose, one of the PS inputs or the Run/Jog input is programmed for function 9 or 109 (Zero pulse search Master setpoint). If the function is selected, the reference sensor must be turned beyond the zero pulse. As of this point, the angle assignment between Master and Slave drive is always retained. This means that the zero pulses of Master and Slave drive coincide.

   The angle between the zero pulses can be adjusted with parameter **D3 – Zero angle**. Moreover, this angle may be varied via two PS inputs (PS1 and PS2, setting 13).

**20 (Induction motor – speed control)**

Speed-controlled operation of an induction machine. Field-oriented control and speed registering of the machine are realised by way of a resolver or an incremental encoder mounted on the motor shaft. The machine runs the specified speed independently of the load.

**21 (Induction motor – torque control)**

Torque-controlled operation of an induction machine. Field-oriented control of the machine is realised by way of a resolver or an incremental encoder mounted on the motor shaft. A rotational speed-controlled deceleration is started when the Stop command is issued if it has not been deactivated in parameter 71.

**ATTENTION!**

Dependent on the speed of rotation, the drive generates a given torque, i.e. the motor accelerates under no load under the maximum frequency defined in parameter 23.

**22 (Induction motor – electronic gearbox)**

Angle-synchronous operation of the field-orientated-controlled asynchronous motor. The motor connected to the inverter follows a two-phase reference signal angle-synchronously. The reference signal and the motor feedback signal are connected to the encoder option card. Please refer to the description of the encoder card for detailed information.

The illustration below shows a schematic representation of application “Electronic transmission”:

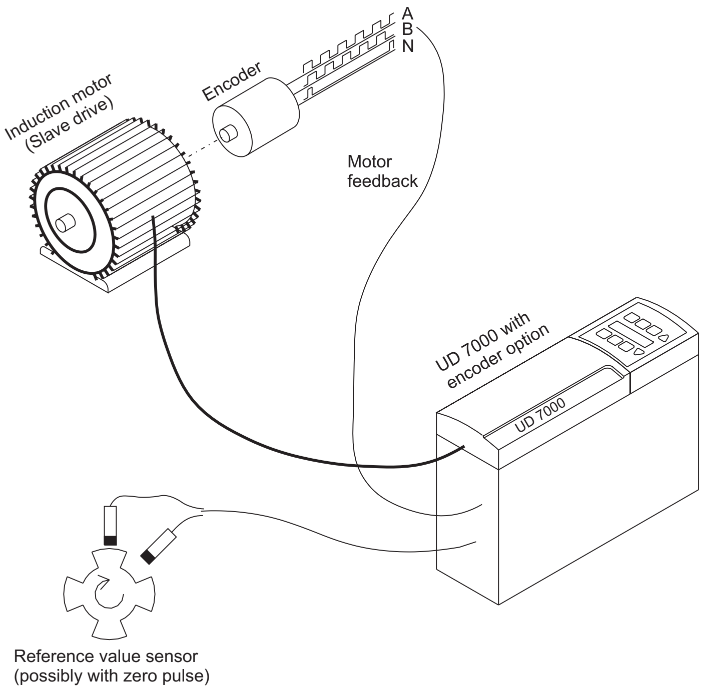



**Figure 8.2**

The motor follows the incoming control pulses phase-synchronously. Prior to commissioning, please follow the explanations for parameter **2A – Test mode**.

For Master-Slave mode using a resolver or encoder option card, it is important that the setpoint source 8 is selected. Please check the setting in parameter **31 – Setpoint selection (frequency setpoint)**. The rotational speed ratio between reference sensor and Slave drive is assigned on the basis of parameter **36 – Pulse number of LIM input**. The assignment of the direction of rotation is made with parameter **37 – Direction of rotation, master setpoint**.

There are two types of electronic transmission:

1. Angle-synchronous operation with any angle setting of the Slave and Master drive.

   After the drive has been switched on and the Start command has been issued, the Slave drive follows the Master drive starting from its current position. It is not necessary to evaluate a zero pulse.

2. Angle-synchronous operation with fixed angular position between Slave and Master drive.

   In the case of commissioning after connection of the line power supply and the Slave drive, ensure that a test mode which includes an encoder zero pulse search is used. In parameter **2A – Test mode**, this corresponds to settings 10, 15, 16 and 19. When searching for the zero pulse, the drive is rotated with the frequency entered in parameter **D2 – Zero pulse search frequency**.

   After the drive has been switched on, the zero pulse of the reference sensor must be sought before the Start command is issued (drive in STOP state). For this purpose, one of the PS inputs or the Run/Jog input is programmed for function 9 or 109 (Zero pulse search Master setpoint). If the function is selected, the reference sensor must be turned beyond the zero pulse. As of this point, the angle assignment between Master and Slave drive is always retained. This means that the zero pulses of Master and Slave drive coincide.

   The angle between two zero pulses (Master/Slave drive) can be adjusted using parameter **D3 – Zero angle**. Moreover, this angle may be varied via two PS inputs (PS1 and PS2, setting 13).

**50 (Induction motor – sensorless speed control *SLV*②)**

Speed-controlled operation of an induction machine. Field-oriented control and speed registering of the machine are realised without sensors by way of the *SLV*② motor model. The machine runs the specified speed independently of the load.

**51 (Induction motor – sensorless torque control *SLV*②)**

Torque-controlled operation of an induction machine. Field-oriented control of the machine is realised without sensors by way of the *SLV*② motor model. A rotational speed-controlled deceleration is started when the Stop command is issued.

**ATTENTION!**

Dependent on the speed of rotation, the drive generates a given torque, i.e. the motor accelerates under no load under the maximum frequency defined in parameter 23.

**52 (Induction motor – sensorless *SLV*② speed control II)**

Rotational speed-control *SLV*② mode as with application 50 but as “single-controller solution” (adjustment is performed via parameters F8 and F9 of the current controller). Good drive characteristics in the range of very low rotational speeds and easy commissioning (since only one controller needs to be set) are the advantages over application 50. The controller structure is shown in Section 6.9.1, “Signal Flow Diagrams”.

This application is not described in greater detail in this Manual. Special application descriptions are available for this application.

**53 (Induction motor – *SLV*② in the field-attenuation range)**

Application 53 supplements the *SLV*② variants with a solution for field-attenuation mode. If frequencies up to above three times the nominal motor frequency are to be used, this application offers advantages over application 50 owing to optimum utilisation of the voltage in the field-attenuation range. This means that the drive can be accelerated through to the field-attenuation range at the torque limit. As with application 52, this is a “single-controller solution”.

This application is not described in greater detail in this Manual. Special application descriptions are available for this application.

**90 (Velocity control)**

This application implements simple rotational speed feedback. This means that a rotational speed or velocity-proportional frequency signal is connected as the actual value to the inverter LIM input. Any setpoint (apart from the LIM setpoints) which can be selected via parameter **31 – Setpoint selection (frequency setpoint)** can be processed as the setpoint. In this application, the motor is operated in V/f-controlled mode (in accordance with application 0: Inverter).

The controller structure is shown in the illustration below:

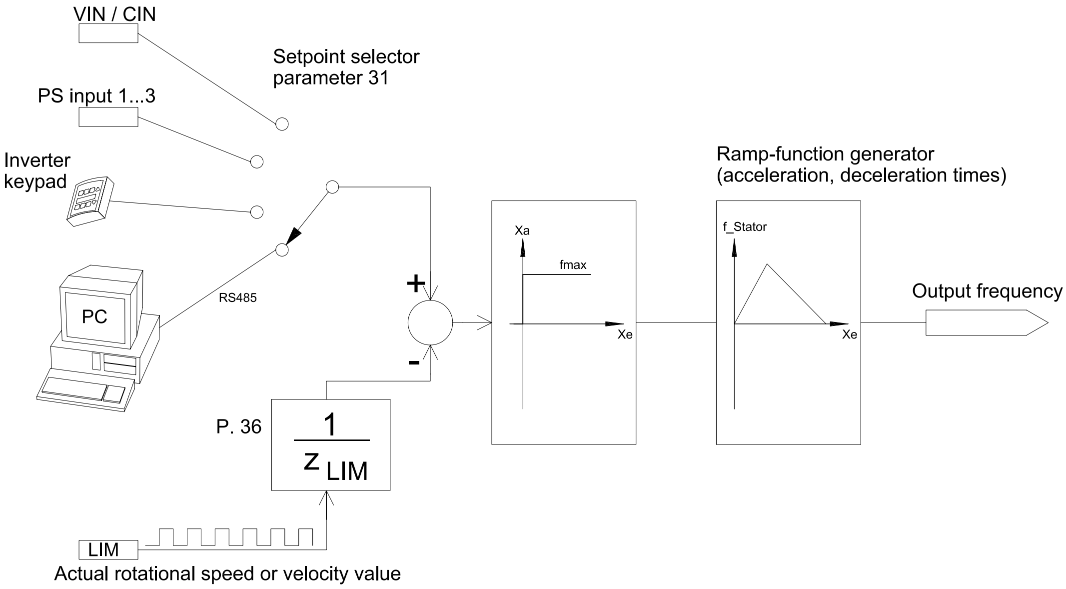



**Figure 8.3**

Firstly, you must enter the number of pulses arriving at the LIM input, in parameter **36 – Pulse number of LIM input**. Input frequencies up to maximum 100 kHz are processed.

**HINT!**

If the actual frequency is unknown, it is frequently helpful to initially place the drive into operation with parameter **2C – Application** = 0, to preset a frequency setpoint and then measure the actual frequency. On the basis of these measured values, it is possible to make an initial setting of parameter 35. Precise adjustment is then performed in controlled operation (application = 90).

The controller:

The rotational speed setpoint is compared with the actual value at the summing junction. Depending on the sign of the result, either the maximum frequency fmax or 0 Hz is preset for the setpoint generator. The ramp-function generator now changes the rotational speed until the frequency setpoint is equal to the actual frequency. The controller is optimized simply via the ramp dataset (acceleration and deceleration times in group 2). The times must be changed until the drive operates free of oscillation. In general, the same value should be entered for the acceleration and deceleration times.

## 2D – Software reset SL / FO / SLV / EC

Certain parameter settings (for example, activation of a different application with parameter 2C) require a software restart. This is achieved by switching the supply voltage off and back on again or by programming this parameter to value 1. When this value is saved, the software restarts once and the parameter once again has the value 0.

| | |
|---|---|
| **0** | No action |
| **1** | Software is rebooted |

**NOTE:**

Normally, all parameter changes are processed by the inverter immediately they are entered. If a restart of the software is required in order for the change to take effect, this is expressly stated in the parameter description.

◊ Value range: see Table Default: 0

## 8.3 Group 3 – Setpoint Selection

**31 – Setpoint selection (frequency setpoint) SL / FO / SLV / EC – SC**

A number of possibilities is available for specifying the rotation frequency. Adapt to the existing signal source by means of this parameter.

| | |
|---|---|
| **0** | VIN 0–10 V or CIN 0–20 mA (variant 1) 1) |
| **1** | VIN ±10 V or CIN ±20 mA |
| **2** | VIN 2–10 V or CIN 4–20 mA 7) |
| **3** | VIN 0–10 V or CIN 0–20 mA (variant 2) 1) |
| **4** | Reserved N/A |
| **5** | Reserved N/A |
| **6** | Keypad. Setpoint is entered via the keypad, FWD, REV and STOP control via the terminals. If the STOP key is pressed, error 0 (Emergency-Stop) is triggered by default 8) |
| **7** | LIM frequency input 100 kHz.<br>Scaling with parameter **35 – Calibration digital LIM input with factor $D_{LIM}$** 9) |
| **8** | Master-Slave mode (setting 12 and 22 in parameter **2C – Application**). This application is possible only in combination with the resolver or encoder option cards |
| **9** | LIM master setpoint $\frac{f_{LIM}}{Z_{LIM}}$ ; $Z_{LIM}$ = parameter 36 9) |
| **10** | Reserved N/A |
| **11** | External frequency setpoint 1 (parameter 3A) |
| **12** | External frequency setpoint 2 (parameter 3B) |
| **13** | Fixed frequency 1 (parameter 41) 2) 3) 6) |
| **14** | Fixed frequency 2 (parameter 42) 2) 6) |
| **15** | Fixed frequency 3 (parameter 43) 2) 6) |
| **16** | Fixed frequency 4 (parameter 44) 2) 6) |
| **17** | Fixed frequency 5 (parameter 45) 2) 6) |
| **18** | Fixed frequency 6 (parameter 46) 2) 6) |
| **19** | Maximum frequency (parameter 23) |
| **20** | LIM master setpoint $\frac{f_{LIM}}{Z_{LIM}} \times K$ ; $Z_{LIM}$ = parameter 36<br>The frequency setpoint measured at the LIM input is also weighted with factor K which is dependent on the voltage at the analogue input $V_{in}$ and on parameter 34 4) 9) |

| | |
|---|---|
| **21** | LIM master setpoint $\frac{f_{LIM}}{Z_{LIM}} \times K$ ; $Z_{LIM}$ = parameter 36<br>The frequency setpoint measured at the LIM input is also weighted with factor K which is dependent on the voltage at the analogue input $V_{in}$ and on parameter 34 5) 9) |

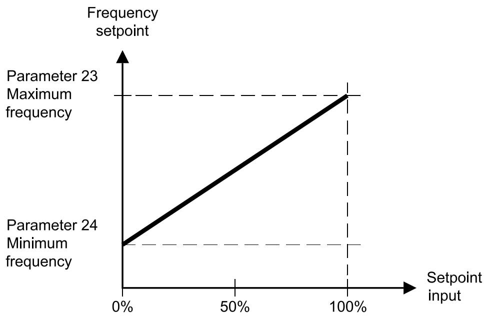
◊ Value range: see Table Default: 0

**NOTES:**

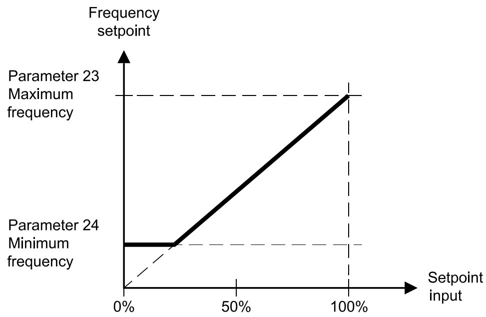
1) The parameter **24 – Minimum frequency** can be evaluated in two different ways:

**Variant 1:**
In the event of an increase in the setpoint value, the derived frequency setpoint also increases linearly. Interpolation is performed between parameter **24 – Minimum frequency** and **23 – Maximum frequency**.

**Variant 2:**
The minimum frequency must be exceeded before the inverter recognizes the setpoint increase. Interpolation is performed between 0.0 Hz and parameter **23 – Maximum frequency**.




**Variant 1**




**Variant 2**

It is possible to choose between the variants in the case of an analog setpoint input of 0–10 V or 0–20 mA. Only variant 2 is possible for all other setpoint sources. Both variants are equivalent if parameter **24 – Minimum frequency** is programmed to the value 0.0 Hz.

2) Fixed frequencies 1–6 (frequency setpoint for selection via the binary inputs). The binary inputs required (PS1/PS2/PS3) must be programmed for function “Selection of a fixed frequency” (setting x00) with parameters 99, 9A and 9B and the selected control mode (parameter 29) must use the setpoint from the terminals in the current operating mode (LOCAL/REMOTE).

Apart from direct selection of a fixed frequency as a setpoint with values 13 to 18, it is also possible to determine the fixed frequencies (regardless of the value of parameter 31) and the setpoint with the aid of the binary inputs. Please refer to the description of the fixed frequencies (parameters 41 to 46) for details of this.

3) Fixed frequency 1 (parameter 41) is used as a jog frequency if the terminal input R/J has been programmed for function “Jog mode selected” (setting x00) with parameter 98 and the binary terminal input PS3 has been set to setting x06 (activation LOCAL mode) with parameter **9B – PS3 input function selection**. Both binary inputs must be activated (High resp. Low signal). This switches over to LOCAL mode. Pressing key FWD or REV key on the keypad causes the motor to operate with the fixed frequency determined by parameter 41 for as long as the keys are pressed (acceleration and deceleration on the basis of the set ramps). The STOP key has no function.

4) The frequency setpoint measured at the LIM input is weighted with factor K. Factor K is as follows in the following cases:

   VIN = 0 Volt ⇒ K = (100% minus parameter 34)
   VIN = 5 Volt ⇒ K = 100%
   VIN = 10 Volt ⇒ K = (100% plus parameter 34)

5) The frequency setpoint measured at the LIM input is weighted with factor K. Factor K is as follows in the following cases:

   VIN = 0 Volt ⇒ K = (100% plus parameter 34)
   VIN = 5 Volt ⇒ K = 100%
   VIN = 10 Volt ⇒ K = (100% minus parameter 34)

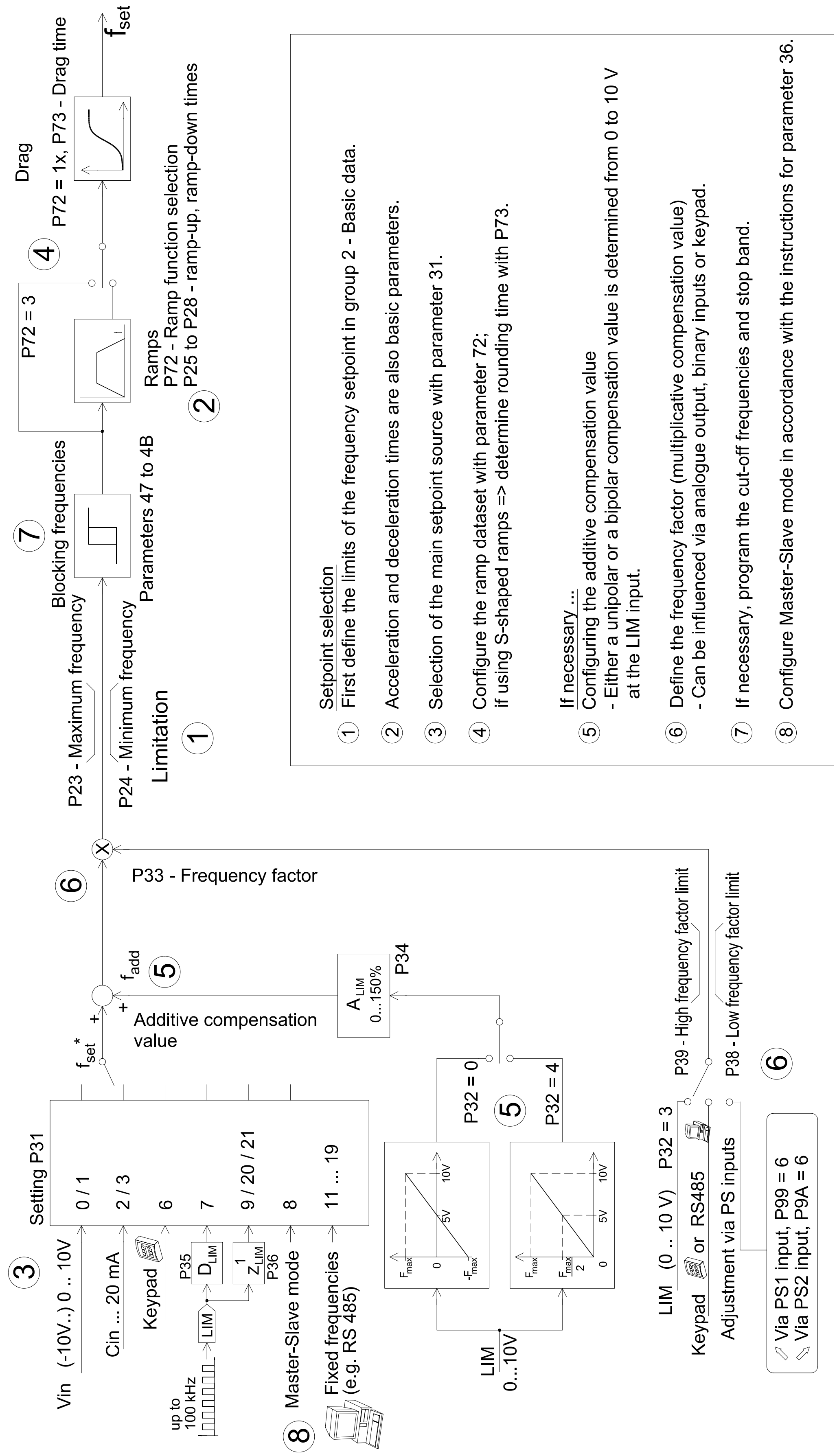
6) In the case of the fixed frequencies, parameters 41–46, only the setpoint which is not higher than the maximum frequency acts. In the case of higher values, the maximum frequency is used.

7) If the lower value is undershot, warning 27 “Set disconn” is displayed.

8) This selection offers the option of also entering the setpoint via the keypad in REMOTE mode. The Start/Stop commands are supplied by the terminals (binary inputs FWD and REV) or by the serial port. Key STOP is configured by default as EMERGENCY-STOP in Remote mode (see parameter 71).

9) Input levels:
   Low → Voltage at LIM input less than 5 VDC.
   High → Voltage at LIM input greater than 5 VDC.
   Maximum permitted voltage = 30 VDC.
   Maximum frequency = 100 kHz.

The illustration below clearly shows the procedure when setting parameter 31:



Setpoint selection
① First define the limits of the frequency setpoint in group 2 - Basic data.
② Acceleration and deceleration times are also basic parameters.
③ Selection of the main setpoint source with parameter 31.
④ Configure the ramp dataset with parameter 72;
if using S-shaped ramps => determine rounding time with P73.
If necessary ...
⑤ Configuring the additive compensation value
- Either a unipolar or a bipolar compensation value is determined from 0 to 10 V at the LIM input.
⑥ Define the frequency factor (multiplicative compensation value)
- Can be influenced via analogue output, binary inputs or keypad.
⑦ If necessary, program the cut-off frequencies and stop band.
⑧ Configure Master-Slave mode in accordance with the instructions for parameter 36.
Setting P31
Vin (-10V..) 0 .. 10V
Cin ... 20 mA
Keypad
up to 100 kHz
LIM
P35
P36
Master-Slave mode
Fixed frequencies (e.g. RS 485)
0 / 1
2 / 3
6
7
9 / 20 / 21
8
11 ... 19
LIM 0...10V
P32 = 0
P32 = 4
Additive compensation value
P34
$A_{LIM}$ 0...150%
$f_{add}$
$f_{set}$*
P33 - Frequency factor
LIM (0 .. 10 V) P32 = 3
Keypad or RS485
Adjustment via PS inputs
Via PS1 input, P99 = 6
Via PS2 input, P9A = 6
P39 - High frequency factor limit
P38 - Low frequency factor limit
P23 - Maximum frequency
P24 - Minimum frequency
Limitation
Blocking frequencies
Parameters 47 to 4B
P72 = 3
Ramps
P72 - Ramp function selection
P25 to P28 - ramp-up, ramp-down times
Drag
P72 = 1x, P73 - Drag time
$f_{set}$


**Figure 8.4**

## 32 – Function of the LIM input SL / FO / SLV / EC – SC

By default, the control input LIM serves to set a torque limit (setting 1). It can also be programmed as an input for a digital frequency setpoint or as a setpoint compensation input.

| | |
|---|---|
| **0** | Frequency setpoint compensation by additive compensation value. LIM input is configured as analogue output 0–10 V (with the zero point at 5 V). 1) |
| **1** | 0–10 V torque limit (10 V = parameter 55). 2) |
| **2** | Frequency setpoint compensation by multiplicative compensation value. LIM input is configured as analogue output 0–10 V, with the zero point at 0 V. 3) |
| **3** | Digital frequency setpoint (is set automatically if selection parameter 31 = 7, 9, 10, 20, 21). |
| **4** | Frequency setpoint compensation by additive compensation value. LIM input is configured as analogue output 0–10 V (with the zero point at 0 V). 4) |
| **5** | Reserved (is set automatically by special applications). |

◊ Value range: see Table Default: 1

**NOTES:**

1) Frequency setpoint compensation by additive compensation value. The LIM input is configured as analogue input 0–10 V (with the zero point at 5 V). Adjustment is performed with parameter **34 – Scaling factor $A_{LIM}$ for analogue LIM input**:

$$f_{add} = F_{max} \times A_{LIM} \times \left(\frac{2 \times V_{LIM}}{10\ V} - 1\right)$$

This allows positive and negative setpoint compensations to be implemented:

There is a compensation value for $V_{LIM}$ = 0 V $f_{add} = -F_{max} \times A_{LIM}$ ;

by contrast, 10 V input voltage at input LIM ($V_{LIM}$ = 10 V) results in the positive maximum compensation value $+F_{max} \times A_{LIM}$ .

**NOTE:** explanation of symbols in Table 8.4.

2) The voltage $V_{LIM}$ (0 to 10 V) applied to analogue input LIM is used to preset the torque limit $m_{limit}$ in percent of the nominal motor torque. Scaling is performed by parameter **55 – Torque factor LIM input**. If a voltage of 10 V is applied to the LIM input, the torque limit $m_{limit}$ corresponds to the torque factor MF (parameter 55).

$$m_{limit} = MF \times \frac{V_{LIM}}{10\ V}$$

3) Frequency setpoint compensation by multiplicative compensation value. LIM input is configured as analogue input 0–10 V with zero point at 0 V.

The voltage $V_{LIM}$ (0–10 V) applied to the analogue input LIM is used to preset parameter **33 – Frequency factor** (this parameter defines a factor in percent by which any frequency setpoint is multiplied). Parameters **38 – Low frequency factor limit** (GU in [%]) and **39 – High frequency factor limit** (GO in [%]) are included in the calculation. The resultant frequency factor is calculated as follows:

$$\text{Frequency factor [\%]} = \frac{V_{LIM} \times (G_O - G_U)}{10\ V} + G_U$$

The current frequency factor can be read under parameter E3. If this function is programmed, the frequency factor cannot be changed manually via parameter **33 – Frequency factor**.

4) Frequency setpoint compensation by additive compensation value. LIM input is configured as analogue input 0–10 V (with the zero point at 0 V):

$$f_{add} = F_{max} \times A_{LIM} \times \frac{V_{LIM}}{10\ V}$$

This allows only positive setpoint compensations (frequency setpoint increases) to be implemented:

A compensation value $f_{add}$ = 0 Hz results for $V_{LIM}$ = 0 V; by contrast, $V_{LIM}$ = 10 V provides the maximum compensation value $f_{add} = +F_{max} \times A_{LIM}$.

| Symbol | Significance/gated parameter |
|---|---|
| $f_{add}$ | Additive compensation value for the frequency setpoint |
| $F_{max}$ | Maximum frequency (parameter 23) |
| $A_{LIM}$ | Scaling factor for analogue LIM input (parameter 34) |
| $V_{LIM}$ | The voltage applied to analogue input LIM in V |

**Table 8.4**

## 33 – Frequency factor SL / FO / SLV / EC – OE

Frequency setpoint compensation by multiplicative compensation value. This parameter defines a factor in percent by which any frequency setpoint is multiplied.

The function is required, amongst other things, if several inverters with the same frequency reference value are to operate at differing speeds of rotation. If an additive setpoint is selected via parameter **32 – Function of the LIM input**, the sum of the two setpoints is influenced via this parameter.

The frequency factor can be set in three different ways:

1. Direct entry by keypad via this parameter (this is the simplest method of setting fixed rotational speed ratios between the drives of a group).
2. The frequency factor can also be preset via the LIM input. For this purpose, parameter 32 must be programmed for function “Frequency setpoint compensation by multiplicative compensation value”. In this case, the frequency factor can **no** longer be changed by this parameter and **neither** can it be changed with the aid of inputs PS1 and PS2.
3. Moreover, the change in the frequency factor can be made with the aid of inputs PS1 and PS2 if they are programmed for one of the functions “Incrementing resp. decrementing the frequency factor” (parameters 99, 9A).

**NOTE:** the frequency factor can be changed only within the input limits stipulated by parameters **38 – Low frequency factor limit** and **39 – High frequency factor limit** in the case of all three variants (keypad input, preset via PS inputs or setting via LIM input). If the current selection of parameter 33 is no longer within the changed limits after the change to parameters 38 and 39, the frequency factor is immediately adapted to the new limits. Parameter 33 cannot be set higher than parameter 39.

The frequency factor can also be read in the read-only parameter E3. This provides the option of transferring the frequency factor to the standard display 2 or outputting it at one of the two analogue outputs.

◊ Value range: 0.00–150.00% Default: 100.00%

## 34 – Scaling factor $A_{LIM}$ for analogue LIM input — SL / FO / SLV / EC – OE

Scaling of the LIM input if use of the LIM input as an analogue input has been defined, i.e. if either

1) function “Frequency setpoint compensation by additive compensation value” (setting 0 or 4) has been selected in parameter 32.
   The parameter defines the percentage value of the maximum frequency to which 10 V at the LIM input corresponds. Please refer to the notes 1) and 4) for parameter 32 for the precise formulae. This function is helpful in the case of very simple jockey arm controls for instance so as to set the control influence of jockey arm deflection.

   or

2) the setpoint sources 20 or 21 “LIM Master setpoint f × n” have been selected in parameter 31.
   Please refer to the notes 4) and 5) for parameter 31 for the precise formulae.

◊ Value range: 0.0–150.0% Default: 10.0%

## 35 – Calibration digital LIM input with factor $D_{LIM}$ — SL / FO / SLV / EC

Scaling of the digital frequency setpoint input. The parameter defines the ratio of inverter frequency setpoint to frequency at the LIM input in Hz/kHz. Input frequencies up to max. 100 kHz are processed. The inverter frequency setpoint is calculated as follows:

$f_{Inverter} = f_{LIM} \times D_{LIM}$ where

| | |
|---|---|
| $f_{Inverter}$ | - inverter output frequency in Hz |
| $f_{LIM}$ | - frequency setpoint at the LIM input in kHz |
| $D_{LIM}$ | - factor digital frequency input in Hz/kHz |

The parameter takes effect only when programming parameter **31 – Setpoint selection (frequency setpoint)** for function LIM frequency input (selection parameter 31 = 7).

**EXAMPLE:**
$k_{LIM} = 2.0$ Hz/kHz → $f_{LIM} = 50$ kHz → $f_{Inverter} = 100$ Hz.

◊ Value range: 0.1–1000.0 Hz/kHz Default: 2.0 Hz/kHz

## 36 – Pulse number of LIM input — SL / FO / SLV / EC

See also the notes under “(1)” in order to facilitate understanding.

1) Master-Slave mode via LIM input [(1)]

   Scaling of the frequency at the digital LIM input if used as Master setpoint input (parameter 31 = 9).

   The parameter indicates the number of pulses arriving at the input per revolution. Input frequencies up to maximum 100 kHz are processed. The inverter frequency setpoint is calculated as follows:

$$f_{Inverter} = \frac{f_{LIM}}{Z_{LIM}}$$

where

| | |
|---|---|
| $f_{Inverter}$ | - inverter output frequency in Hz |
| $f_{LIM}$ | - frequency setpoint at the LIM input in kHz |
| $Z_{LIM}$ | - number of the pulses per revolution |

**EXAMPLE:**

The Master (Master driver) outputs ten times the current output frequency at output ST4 (parameter 95 = 115). The Slave (Slave drive) should receive the same frequency as the setpoint. For this purpose, the LIM input (parameter 32 = 3) with the setpoint source “LIM Master setpoint” (parameter 31 = 9) is used and the number of pulses per revolution is set to 10 in parameter 36 ($Z_{LIM}$).

| | | | | | | |
|---|---|---|---|---|---|---|
| The output frequency of the Master is 25.4 Hz and parameter 3E = 10. | ⇒ | 245 Hz is output at the ST4 output of the Master drive. | ⇒ | 254 Hz is measured at the LIM input of the Slave, $Z_{LIM}$ = 10. | ⇒ | The frequency setpoint of the Salve drive is 25.4 Hz. |

2) Master-Slave mode via Channel 2 of the encoder option card [(1)]

If using the option card with two-channel encoder evaluation, this parameter is interpreted as the number of lines of the Master encoder if parameter **31 – Setpoint selection (frequency setpoint)** has been set to value 8.

3) Using the setpoint source “LIM frequency input 100 kHz” (parameter 31 = 7) [(1)]

Parameter 36 ($Z_{LIM}$) is determined automatically by the program (possible values are 10 and 100) and **cannot** be changed in this case.

**NOTES:**

(1) Certain ratios (i) can be programmed with the aid of $Z_{LIM}$ by entering the product of $z \times i$ instead of the actual number of lines (z) of the Master at this point in parameter 36 for $Z_{LIM}$;

where $i = \frac{f_{Master}}{f_{Slave}}$

owing to the value range of $Z_{LIM}$ (only integers in the range 1–16384) however, only specific rotational speed ratios can be implemented in this way. “Non-linear rotational speed ratios” must be programmed with the aid of parameter **33 – Frequency factor**.

**EXAMPLE:**

For the example described above, let us program $Z_{LIM}$ so that the Slave drive turns only half as fast as the Master, i.e. the following applies:

$$f_{Slave} = \frac{f_{Master}}{2} \text{ or } i = \frac{f_{Master}}{f_{Slave}} = 2 .$$

This means $Z_{LIM} = z \times i = 10 \times 2 = 20$ for parameter 36.

| | | | | | | |
|---|---|---|---|---|---|---|
| The output frequency of the Master is 25.4 Hz, parameter 3E = 10. | ⇒ | 254 Hz is output at output ST4 of the Master drive. | ⇒ | 254 Hz is measured at the LIM input of the Slave, $Z_{LIM}$ = 20. | ⇒ | The frequency setpoint of the Slave drive is 12.7 Hz. |

◊ Value range: 1–16384 Default: 6

The illustration below clearly shows the Master-Slave modes:

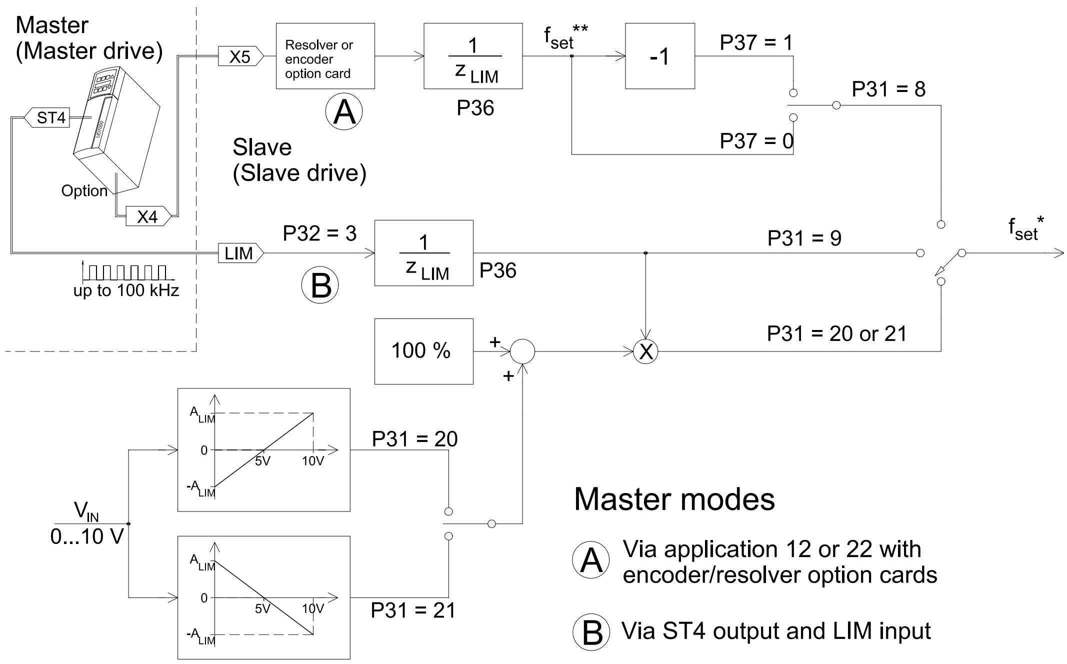



**Figure 8.5**

## 37 – Direction of rotation, master setpoint SL / FO / SLV / EC

The setpoint can be inverted through parameter 37 when "8" is selected as the setpoint source in parameter 31.

| | |
|---|---|
| **0** | Motor rotates in the same direction as the master |
| **1** | Motor rotates in the opposite direction to the master |

◊ Value range: see Table Default: 0

## 38 – Low frequency factor limit SL / FO / SLV / EC

The range in which parameter **33 – Frequency factor** can be varied can be restricted with parameters 38 and 39.

The frequency factor can be varied using three different methods (keypad input, preset via PS inputs or setting via LIM input) but only within the input limits stipulated by parameter **38 – Low frequency factor limit** and **39 – High frequency factor limit** in the case of all three variants.

If the present value of parameter 33 is no longer within the changed limits after changing parameters 38 and 39, the frequency factor is adapted immediately to the new limits.

If the frequency factor is preset via the LIM input (parameter 32, setting 2), the voltage range 0–10 V is mapped in linear fashion onto parameters 38 and 39, i.e. the frequency factor corresponds to the value of parameter **38 – Low frequency factor limit** with 0 V at the LIM input and the frequency factor is identical to the value entered for the frequency factor in parameter **39 – High frequency factor limit** with 10 V input voltage.

Overlap of the limits is not permitted by the unit so that the lower limit is always lower than the upper limit.

◊ Value range: 0.00–149.99% Default: 0.00%

## 39 – High frequency factor limit SL / FO / SLV / EC

See parameter 38.

◊ Value range: 0.01–150.00% Default: 105.00%

## 3A – External frequency setpoint 1 SL / FO / SLV / EC – OE / SC

Frequency setpoints for setting through the serial interface. The selection is made in parameter **31 – Setpoint selection (frequency setpoint)**.

◊ Value range: –325.00–325.00 Hz Default: 0.00 Hz

## 3B – External frequency setpoint 2 SL / FO / SLV / EC – OE / SC

Frequency setpoints for setting through the serial interface. The selection is made in parameter **31 – Setpoint selection (frequency setpoint)**.

◊ Value range: –325.00–325.00 Hz Default: 80.00 Hz

## 3C – Filtering time constant VIN/CIN input SL / FO / SLV / EC – OE

This parameter allows you to adapt the filtering time constant of the analog input VIN/CIN. The shorter the chosen time is, the faster the inverter reacts to setpoint changes.

The value is represented exponentially in the form $2^x$ ms.

◊ Value range: 0–10 Default: 4 (corresponds to $2^4$ ms = 16 ms)

## 3D – Filtering time constant LIM input SL / FO / SLV / EC – OE

The filtering time constant of the input VIN can be adapted by means of this parameter. The shorter the chosen time is, the faster the inverter reacts to changes. The time constant is used for analog as well as for digital signals.

The value is represented exponentially in the form $2^x$ ms.

◊ Value range: 0–10 Default: 4 (corresponds to $2^4$ ms = 16 ms)

## 3E – Pulse number ST4-output SL / FO / SLV / EC – OE

Scaling of the frequency output ST4. The parameter takes effect if programming parameter **95 – Output ST4 function selection** (setting 16, “Frequency output frequency setpoint × n”) ($f_{out} = f_{Motor} \times k_{Pulse}$).

The parameter defines the number of pulses to be issued at the output per electrical revolution (corresponds to the stator frequency). Output frequencies up to $f_{Pwm}/2$ (cf. also parameter **79 – PWM frequency**) are output. A jitter-free signal can be obtained up to an output frequency of $f_{Pwm}/4$. Above this, only the mean value of the highlighted frequency corresponds to the anticipated frequency value. The illustration shows these two signal waveforms.

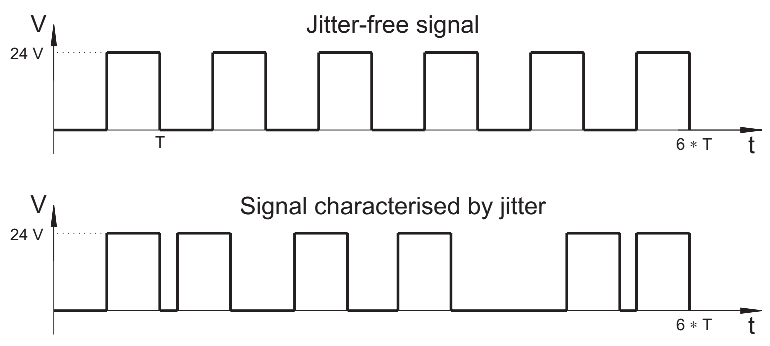



**Figure 8.6**

It can be seen that, after time 6 × T, the number of oscillations is the same but the flanks of the individual pulses are not equally spaced in the case of the signal characterised by jitter. The number of pulses, measured over a longer period, is identical in the case of both signal traces.

**HINT!** The mark-to-space ratio in the case of the jitter-free signal is always 50:50.

◊ Value range: 1–100 Default: 10

**3F – Frequency setpoint on the basis of ramp (read-only) SL / FO / SLV / EC**

Display of the frequency setpoint at the output of the up or down ramp. The frequency setpoint shown on the standard display 1 is processed directly by the inverter only if the ramp function (parameter 72 = 3) is deactivated. Otherwise, the parameterised acceleration resp. deceleration times (see parameter 25 to 28) are complied with.

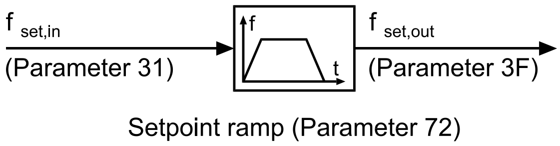



**Figure 8.7**

◊ Resolution: 0.1 Hz

## 8.4 Group 4 – Frequencies

Frequency setpoints for selection via the binary inputs (PS1–PS3; parameters 99, 9A and 9B). The required binary inputs must be programmed for function “Selection of a fixed frequency” (setting x00) and the selected control mode (parameter 29) must use the setpoint from the terminals in the current operating mode (LOCAL/REMOTE). Each fixed frequency can also be stipulated directly (i.e. regardless of the state of the binary inputs) as a frequency setpoint with the aid of parameter 31.

The set value of fixed frequency 1 can also be used as a jog frequency. For this purpose, the binary inputs R/J and PS3 must be activated, parameter **98 – Run/Jog input function selection** must be programmed for function “Selection Jog mode” (setting x00) and LOCAL mode must be activated with parameter 9B (setting x06). For as long as key FWD or REV is now pressed, the motor operates at the set fixed frequency 1 in the corresponding direction.

**41 – Fixed frequency 1 SL / FO / SLV / EC – OE**

**42 – Fixed frequency 2 SL / FO / SLV / EC – OE**

**43 – Fixed frequency 3 SL / FO / SLV / EC – OE**

**44 – Fixed frequency 4 SL / FO / SLV / EC – OE**

**45 – Fixed frequency 5 SL / FO / SLV / EC – OE**

**46 – Fixed frequency 6 SL / FO / SLV / EC – OE**

The frequency setpoint can also be determined by programming and wiring the inputs PS1, PS2 and PS3 with parameters 99 to 9B apart from using parameter **31 – Setpoint selection (frequency setpoint)**. With valences PS1 – $2^0$, PS2 – $2^1$, PS3 – $2^2$, inputs PS1–PS3 form a numerical value which is used as the selection parameter for the terminal setpoint. The corresponding bit is set equal to 1 if the input is programmed for function x00 "Selection of a fixed frequency" with the relevant parameter 99 to 9B "Selection function input PS1/PS2/PS3" and the input has been activated. If one of the two conditions is not met, the bit is set equal to zero. The following setpoint sources (see Table 8.5) are assigned to the possible values of the selection parameter thus generated. If all three bits are equal to zero, only parameter **31 – Setpoint selection (frequency setpoint)** determines the setpoint source.

| PS3 | PS2 | PS1 | Frequency setpoint defined by: |
|---|---|---|---|
| 0 | 0 | 0 | Parameter **31 – Setpoint selection (frequency setpoint)** (1) |
| 0 | 0 | 1 | Parameter **41 – Fixed frequency 1** (2) (3) |
| 0 (4) | 1 (5) | 0 | Parameter **42 – Fixed frequency 2** (3) |
| 0 | 1 | 1 | Parameter **43 – Fixed frequency 3** (3) |
| 1 | 0 | 0 | Parameter **44 – Fixed frequency 4** (3) |
| 1 | 0 | 1 | Parameter **45 – Fixed frequency 5** (3) |
| 1 | 1 | 0 | Parameter **46 – Fixed frequency 6** (3) |
| 1 | 1 | 1 | Parameter **23 – Maximum frequency** |

**Table 8.5**

(1) The frequency setpoint is determined by parameter **31 – Setpoint selection (frequency setpoint)**.
(2) The set value of fixed frequency 1 can be used as a jog frequency. For this purpose, the binary inputs R/J and PS3 must be activated, parameter 98 (Selection function input Run/Jog) must be programmed for function "Jog mode selected" (setting x00) and LOCAL mode must be activated with parameter 9B (setting x06). The motor operates at the set fixed frequency 1 in the corresponding direction for as long as key FWD or REV is pressed.
(3) In the case of the fixed frequencies, parameters 41–46, only the setpoint which is not higher than the maximum frequency acts. In the case of higher values, the maximum frequency is used.
(4) "0" means: the setting of the data code for parameters 99–9B is greater than 0 **or** active level is not applied to the input.
(5) "1" means: selection of a fixed frequency (data code "0" in parameters 99–9B) **and** input PS1–PS3 is assigned active level.

**ATTENTION!**

Depending on the parameter setting, the individual fixed frequencies also have the following further meanings:

1. Fixed frequency 1 is also used as a jog frequency (see Table 8.5).
2. Fixed frequencies 4, 5 and 6 are used to stipulate the V/f characteristic if parameter **62 – V/Hz characteristic selection** is programmed for "Specification of a fixed V/Hz characteristic" (setting 2).
3. Certain fixed frequencies have functions for the alarm outputs (binary outputs and relay outputs).

| Factory default setting | | | | | |
|---|---|---|---|---|---|
| **Fixed frequency 1** | **Fixed frequency 2** | **Fixed frequency 3** | **Fixed frequency 4** | **Fixed frequency 5** | **Fixed frequency 6** |
| 5.0 Hz | 20.0 Hz | 40.0 Hz | 60.0 Hz | 0.0 Hz | 0.0 Hz |

◊ Value range: 0.0–875.0 Hz

**47 – Hysteresis band for blocking frequencies** **SL / FO / SLV / EC – OE**

This parameter defines the width of the frequency bands whose frequencies are defined by the parameters 48, 49, 4A and 4B. The respective blocking frequency band is not active when the value of one of these parameters is Zero. No stationary operating point can be moved to within an active blocking frequency band.

**HINT!**

The defined frequency bands apply to both directions of rotation. Pay attention to the fact that the frequency bands must not overlap. Sorting is not necessary.

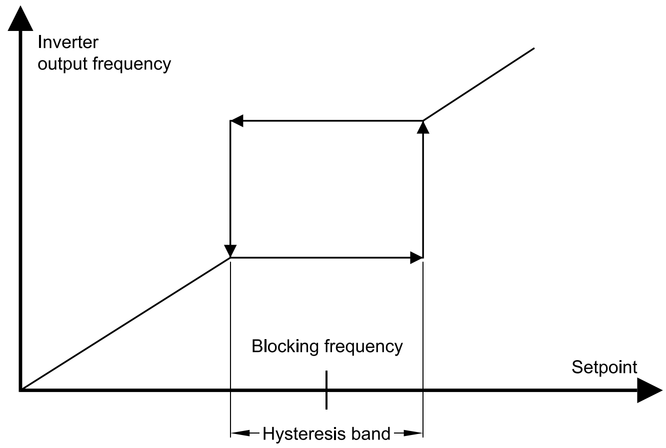



**Figure 8.8**

◊ Value range: 0.0–100.0 Hz Default: 1.0 Hz

**48 – Blocking frequency 1** **SL / FO / SLV / EC – OE**

**49 – Blocking frequency 2** **SL / FO / SLV / EC – OE**

**4A – Blocking frequency 3** **SL / FO / SLV / EC – OE**

**4B – Blocking frequency 4** **SL / FO / SLV / EC – OE**

See further explanations under parameter **47 – Hysteresis band for blocking frequencies**.

◊ Value range: 0.0–875.0 Hz Default: 0.0 Hz

## 8.5 Group 5 – Torque

**51 – Torque limit selection, right rotation, motor operation** **SL / FO / SLV / EC – OE**

**52 – Torque limit selection, left rotation, motor operation** **SL / FO / SLV / EC – OE**

**53 – Torque limit selection, right rotation, generator operation** **SL / FO / SLV / EC – OE**

**54 – Torque limit selection, left rotation, generator operation** **SL / FO / SLV / EC – OE**

Parameters 51–54 define the control source from which the torque limit for the individual quadrants can be set.

| | |
|---|---|
| **0** | 1.5 $M_{rated}$ |
| **1** | LIM input (10 V = parameter 55) *) |

| | |
|---|---|
| **2** | The torque limit is defined by means of the following parameters:<br>• Torque limit (parameter 51) through parameter 58.<br>• Torque limit (parameter 52) through parameter 59.<br>• Torque limit (parameter 53) through parameter 5A.<br>• Torque limit (parameter 54) through parameter 5B. |
| **3** | External torque limit parameter 5C (torque limit editable through SIO and device keypad (display)) |

*) The prerequisite for deriving the torque limit from the LIM input is that the parameter 32 must be set to “Torque limit”. If this is not the case, the value of the torque factor (parameter 55) is used as the torque limit (the voltage at the LIM input is assumed to be 10 V).

◊ Value range: see Table Default: 0

**55 – Torque factor LIM input SL / FO / SLV / EC – OE**

Scaling of the LIM input if “0–10 V torque limit” is selected as the function for the LIM input (parameter 32). This parameter defines the percentage with regard to the rated motor torque to which 10 V at the LIM input corresponds.

**EXAMPLE:**
Setting = 50%: a voltage of 10 V is applied at the LIM input. Then, the torque limit is 50% of the rated motor torque.

◊ Value range: 0.0–400.0% Default: 100.0%

**56 – Additional acceleration torque SL / FO / SLV / EC – OE**

**57 – Additional deceleration torque SL / FO / SLV / EC – OE**

In acceleration or deceleration events, these torques are provided in addition to the torque limit defined through the selection parameters and the limits. These values essentially correspond to the torques that are needed for acceleration or deceleration of the rotating masses.

◊ Value range: –500.0–500.0% Default: 0.0%

**58 – Torque limit, right rotation, motor operation SL / FO / SLV / EC – OE**

**59 – Torque limit, left rotation, motor operation SL / FO / SLV / EC – OE**

**5A – Torque limit, right rotation, generator operation SL / FO / SLV / EC – OE**

**5B – Torque limit, left rotation, generator operation SL / FO / SLV / EC – OE**

Torque limit for the quadrant when the respective parameter is selected as the source in the affiliated selection parameter (parameters 51–54).

**NOTE:** these parameters are displayed only if parameters 51 to 54 have been set to 2.

◊ Value range: 0.0–400.0% Default: 100.0%

**5C – External torque limit SL / FO / SLV / EC – OE / SC**

Torque limit when the external torque limit is selected as the source for the respective quadrant in the affiliated selection parameter (parameters 51–54).

This allows a uniform torque limit to be preset for all four quadrants (motor/generator/clockwise/anti-clockwise) either via the keypad or via the serial port.

◊ Value range: 0.0–400.0% Default: 100.0%

## 5D – Starting torque SL – OE

The value of this parameter with respect to the rated motor frequency is expected by the inverter as the load torque in the starting command. It is necessary to specify this parameter whenever a fast reaction to an applied load torque is to take place after the starting command in sensorless mode. If field build-up time (parameter 6D) is activated, the starting torque is inoperable and parameter 5D is masked.

**NOTE:** this parameter is not relevant to operation with speed control and ***SLV***②.

◊ Value range: 0.0–200.0% Default: 130.0%

## 5E – Torque setpoint factor SL / FO / SLV / EC – OE

Scaling of the VIN or CIN input when “Torque control” is programmed as the application (parameter 2C). The parameter defines the percentage with regard to the rated motor torque to which +10 V at the input corresponds. A setpoint of $-k_T...+k_T$ ($k_T$ – torque setpoint factor) can be set when VIN or CIN is programmed to specification of a bipolar setpoint (parameter **31 – Setpoint selection (frequency setpoint)**).

**NOTE:** this parameter is visible only in the case of application settings (parameter 2C) with closed-loop torque control.

◊ Value range: 0.0–150.0% Default: 100.0%

## 5F – Gain ($V_{Rm}$), acceleration control (ramp), torque SL – OE

Acceleration control is used to adapt the set acceleration ramp to the current load conditions. This control mode is used in applications which must be operated with as short a ramp as possible, e.g. with differing load conditions (one typical example is that of an extruder).

Proceed as follows when setting:

1. Set the minimum time for the acceleration and deceleration time at the minimum load. At this setting, the inverter should not yet reach its current or torque limits.
2. Then operate at maximum load and vary the gain $V_{Rm}$ until oscillation-free acceleration/deceleration is achieved.

   After connecting the load, optimise factor $V_{Rm}$ so that the inverter responds fast enough to the load change without tending to oscillate.

The diagram below shows an example of an operating cycle with differing load conditions.

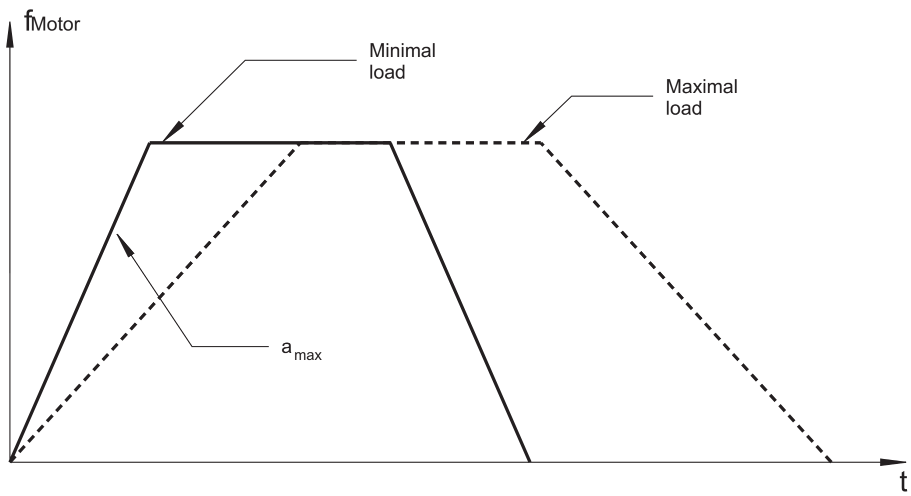



**Figure 8.9**
**Load-dependent operating profiles**

The new ramp can be calculated on the basis of the following formula as a function of the current torque:

$$a = a_{max} \times V_{Rm} \times \left[\frac{M_{Limit} - M}{M_{Limit}}\right]$$

$m_{Limit}$ = the torque limit defined by parameter 51 to 54 in the current quadrant.

A numeric example:

$a_{max}$ = 10 Hz/sec.
$M_{Limit}$ = 150%; torque limit set via parameters 51–54.
M = current torque, e.g. 100%.
$V_{Rm}$ = parameter 5F: e.g. 2.

This achieves a resultant ramp of:

$$a = 10 \text{ Hz/sec} \times 2 \times 0.5 = 10 \text{ Hz/sec}$$

This means that, at this setting, there is still no ramp change at nominal torque. By contrast, at 150%, the ramp would be changed by a factor of “0” (the ramp is stopped).

The acceleration “a” (acceleration/deceleration time) may consequently lie between values 0 and $a_{max}$.

Acceleration control can be deactivated and activated with parameter **FC – Ramp acceleration control (torque)**.

**NOTE:** this parameter has no significance when operating with speed control and ***SLV***②.

◊ Value range: 0.0–500.0% Default: 200.0%

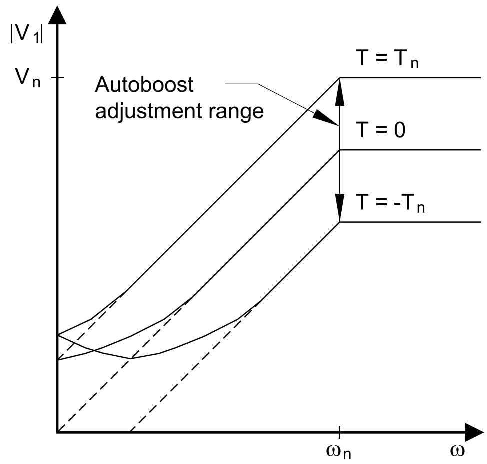
## 8.6 Group 6 – V/Hz Characteristic

**61 – Autoboost SL – OE**

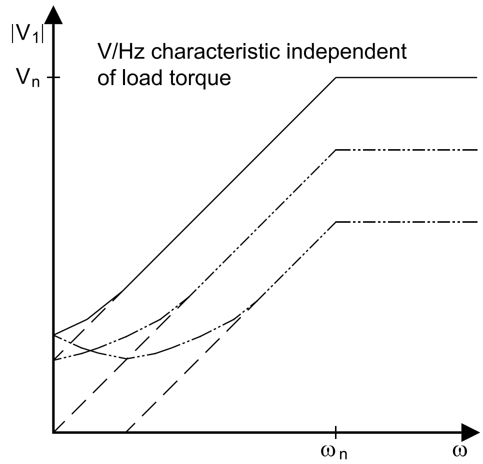
This parameter switches the Autoboost function off/on.

| | |
|---|---|
| **0** | Off |
| **1** | On |

The “Autoboost” function produces constant excitation of the motor independently of the load. The affect on the V/Hz characteristic is shown below:




**V/Hz characteristic with Autoboost**




**V/Hz characteristic without Autoboost**

The inverter computes the characteristic on the basis of the parameters in the “Motor data” group and the stator resistance (parameter F3). The amount of the voltage at low frequencies can be additionally influenced by the parameter **22 – Boost**. A 100% value of the “Boost” parameter corresponds to the characteristic determined by the inverter.

**ATTENTION!** Setting excessive values may result in swift heating up of the motor at low speeds.

**NOTE:** this parameter is irrelevant during operation with speed control. It is not visible in ***SLV***② applications.

◊ Value range: see Table Default: 1

**62 – V/Hz characteristic selection SL / FO / SLV / EC**

This parameter defines,

- whether the assignment of the output voltage to the output frequency is performed manually (setting 2) or
- how the field is preset in the case of automatic (controlled) assignment of voltage frequency (default setting for all applications SL/***SLV***②/EC/FO). Field preset defines how the motor is electrically excited. Excitation of the motor is normally performed with the nominal excitation determined automatically by the inverter from the motor parameters. At this value, assumed to be 100%, the drive operates with the greatest dynamic response and achieves its nominal torque. In certain operating states, it is necessary or required to reduce this excitation:
  - Energy-saving mode.
  - Operation at the voltage limits.
  - Asynchronous motors are operated above the nominal frequency at constant output.
  - $P_{mech} = M \times \omega$ (M – motor output torque, ω – rotor rotational frequency).

The frequency range in which the drive is operated with an excitation less than 100% (i.e. the field resp. the field strength is attenuated) is the so-called field-attenuation range.

| | |
|---|---|
| **0** | Realization of a V/Hz characteristic with constant excitation.<br>In the field attenuation range, the amount of excitation is controlled to the possible maximum value corresponding to the available voltage. |
| **1** | Energy saving mode.<br>The necessary excitation of an induction motor is adapted to the current load of the motor and the available voltage. This operating mode is not suitable for high dynamic requirements. The low limit of motor excitation is limited by parameter **6C – Minimum excitation**. 1) |
| **2** | Specification of a fixed V/Hz characteristic with different V/Hz ratios over the frequency range:<br>[0, $V_0$], [$f_{fix,4}$, $V_1$], [$f_{fix,5}$, $V_2$], [$f_{fix,6}$, $V_3$] and [$f_{knee}$, $V_n$]. 2) |
| **3** | Realization of a V/Hz characteristic with constant excitation up to the knee frequency (parameter 21). The ratio ($f_{knee}$/f) of excitation is reduced above the knee frequency (controlled operation); f is also dependent on parameter **6E – Filter field weakening** in the case of applications 51 and 53. |
| **4** | Realization of a V/Hz characteristic with constant excitation up to the knee frequency (parameter 21). The ratio $(f_{knee}/f)^2$ is reduced above the knee frequency (controlled operation); f is also dependent on parameter **6E – Filter field weakening** in the case of applications 51 and 53. |
| **5** | Realization of a V/f characteristic with constant excitation with configurable voltage control. Voltage control as with selection 0, but configurable using parameter **6B – Cut-in point of voltage limitation control** and **6F – Increment**. |

| | |
|---|---|
| **6** | Operation of a motor with permanent excitation.<br>This value is preset automatically by the program if an EC application is selected (parameter 2C). 2) |

**NOTES:**

1) No energy saving mode is possible for ***SLV***② applications. Any corresponding input is ignored by the inverter and a V/Hz characteristic with constant excitation is realised ("0" setting).
2) It is not possible to specify fixed V/Hz characteristics for FO, EC and ***SLV***② applications. Any corresponding input is ignored by the inverter and a V/Hz characteristic is realised with constant excitation up to the knee frequency ("3" setting). The voltage/frequency affiliation is defined by the following parameter relationships:

| **Frequency** | **0 Hz** | **Parameter 44** | **Parameter 45** | **Parameter 46** | **Parameter 21** |
|---|---|---|---|---|---|
| **Voltage** | Parameter 67 | Parameter 68 | Parameter 69 | Parameter 6A | Parameter 11 |

◊ Value range: see Table Default: 3

## 63 – DC brake current SLV / SL – OE

Magnitude of the current injected during "DC braking" state. The factory default setting of the DC braking current is dependent on the nominal current of the motor specified in parameter group 1.
Important: if the value of the parameter **16 – Rated current** is changed, this value (parameter 63) is also adapted:

$$\text{Default: Current of DC brake} = \frac{\text{Parameter 16 – Rated current}}{2}$$

| **Inverter** | **1.5 kW** | **2.2 kW** | **3.0 kW** | **4.0 kW** | **5.5 kW** | **7.5 kW** | **11.0 kW** | **15.0 kW** | **22.0 kW** | **30.0 kW** | **37.0 kW** | **45.0 kW** | **55.0 kW** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Value range: 0.0 A ...** | 3.0 A | 3.8 A | 3.8 A | 5.3 A | 5.3 A | 13.7 A | 13.7 A | 24.5 A | 35.1 A | 47.3 A | 57.9 A | 69.4 A | 83.2 A |

**NOTE:** this parameter has no relevance during operation with closed-loop speed control (EC/FO).

◊ Value range: see Table

## 64 – DC brake time SL / FO / SLV / EC – OE

Duration for which DC braking operation is active. The time starts when the frequency falls below the DC voltage on frequency (parameter 65) after a STOP command is issued. During the time of DC braking operation, the braking resistor is not used, i.e. the chopper transistor is generally not triggered.

◊ Value range: 0.0–60.0 s Default: 1.0 s

## 65 – DC brake switch-on frequency SLV / SL – OE

After issuing of a stop command, DC braking operation is activated when the frequency falls below the frequency that has been defined with this parameter.

**NOTE:** this parameter is not relevant during operation with speed control (EC/FO).

◊ Value range: 0.0–875.0 Hz Default: 0.5 Hz

## 66 – Field build-up time FO / SLV / SL – OE

Period of time during which the motor field is build up after a starting command. The frequency setpoint is kept at Zero during this time.

To activate the field build-up time set here, the parameter 6D must be set to "1".

**NOTE:** this parameter has no significance in conjunction with EC applications (brushless servo motor). If possible, the field build-up time should be activated for dynamic applications with ***SLV***② control.

◊ Value range: 0.1–10.0 s Default: 0.5 s

**67 – V/Hz characteristic, voltage V0 SL**

**68 – V/Hz characteristic, voltage V1 SL**

**69 – V/Hz characteristic, voltage V2 SL**

**6A – V/Hz characteristic, voltage V3 SL**

Together with the rated motor voltage $V_{nom}$ (parameter 11) and the knee frequency $f_{knee}$ (parameter 21), these parameters define a voltage/frequency characteristic that is used by the inverter when the parameter **62 – V/Hz characteristic selection** is programmed for function 2. The characteristic consists of up to four lines and is defined by the points [0, $V_0$], [$f_{fix, 4}$, $V_1$], [$f_{fix, 5}$, $V_2$], [$f_{fix, 6}$, $V_3$] and [$f_{knee}$, $V_n$]. See also the following table and figure.

Pay attention to the fact that the characteristic is generated from all participating parameters. It is omitted to assign identical values to parameters (e.g. the number of line segments is reduced by one with V1 = V2 **and** $f_{fix, 5}$ = $f_{fix, 6}$).

**NOTE:** these parameters have no significance on versions with closed-loop current control (EC/FO/***SLV***②) and are visible only if parameter **62 – V/Hz characteristic selection** is set to 2 (presetting a fixed V/f characteristic).

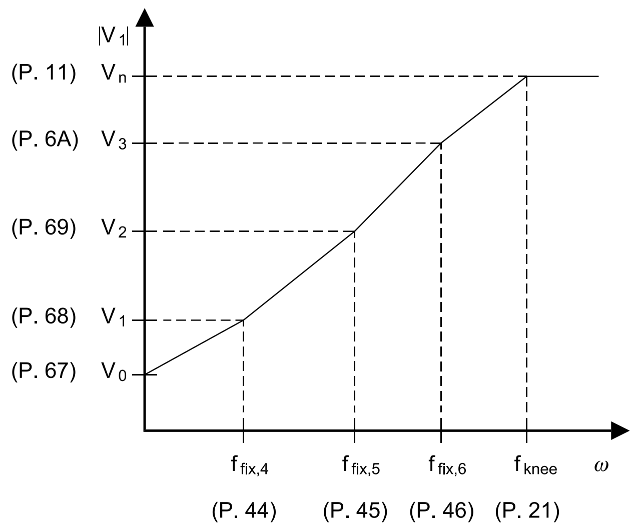



**Figure 8.10**

◊ Value range: 0.0–480.0 V Default: see following table

| **Frequency** | **0 Hz** | **Parameter 44 f_FIX4** | **Parameter 45 f_FIX5** | **Parameter 46 f_FIX6** | **Parameter 21 f_Knee** |
|---|---|---|---|---|---|
| **Voltage (default)** | Parameter 67 (0.0 V) | Parameter 68 (100.0 V) | Parameter 69 (150.0 V) | Parameter 6A (200.0 V) | Parameter 11 (rated motor voltage) |

## 6B – Cut-in point of voltage limitation control OE

The percentage value indicates at what voltage (referred to the maximum value) voltage control cuts in. Up to this value, the field is maintained constant at the nominal value. Under certain conditions (e.g. greatly fluctuating loads at high rotational speeds), it may be necessary to reduce this value.

**NOTE:** this parameter is visible only if parameter 62 is set to 5.

◊ Value range: 95.0–99.5% Default: 98.0%

## 6C – Minimum excitation OE

This parameter defines the minimum excitation with regard to the rated excitation for induction motors that the inverter does not fall below. The parameter is active during automatic realization of the field attenuation range by the inverter and in the energy saving mode (parameter **62 – V/Hz characteristic selection** programmed to “Realization of a V/Hz characteristic with constant excitation” or “Energy saving mode”). The “Minimum excitation” parameter is not active for the other settings of parameter 62.

In the energy saving mode, excitation of the motor is reduced as a function of the current load. Thus, a large part of the excited power is saved when operating the motor with a low load. However, excitation is not reduced below the value with respect to the rated excitation that is defined with this parameter.

As a certain time is needed when modifying the load before the field has build up again, and thus before the full torque is available again, this operating mode is **not** suitable for high dynamic requirements.

◊ Value range: 15.0–100.0% Default: 33.0%

## 6D – Field build-up time activation SLV / SL – OE

| | |
|---|---|
| **0** | Off |
| **1** | On |

“Off”: no field build-up time is taken into account.
“On”: the field build-up time specified in parameter 66 is kept to after every starting command.

**NOTE:** for dynamic applications with ***SLV***② control, as far as possible the field build-up time should be activated. For EC applications (synchronous machines), this parameter is set automatically to 0 (“OFF”).

◊ Value range: see Table Default: 1

## 6E – Filter field weakening SLV – OE

The output frequency is also included in the field preset calculation in applications 51 and 53. However, the output frequency is also routed via a PT1 filter and thus smoothed before it is used for calculation. The filter's time constant is entered in this parameter. The parameter is required in order to be able to accelerate into the field-attenuation range dynamically (with short ramps) in the specified applications. Higher values mean greater smoothing and attenuate any oscillation (the drive behaves more steadily in the field-attenuation range).

**NOTE:** this parameter is displayed only if applications 51 or 53 are active.

◊ Value range: 0–2000 ms Default: 100 ms

## 6F – Increment SLV – OE

The parameter determines the increment with which the field to be preset is reduced or increased when the voltage limit defined in parameter 6B is reached. The increment should be increased only slowly.

**NOTE:** this parameter is displayed only if parameter 62 is set to setting 5.

◊ Value range: 1–20 Default: 1

## 8.7 Group 7 – Inverter Functions

**71 – Start and Stop options** **SL / FO / SLV / EC**

This parameter defines the behaviour of the inverter after connection of the line and the function of the stop command.

**HINT!**

The entry for parameter 71 is routed via a filter which corrects illegally entered values so that the next legal value down (see table) is accepted as the entry (legal digits are only 0 or 1). If, for instance, value 102 is entered, the inverter corrects this value automatically to value 101.

| | | |
|---|---|---|
| **xxxx0** | Autostart Off. | **The units digit:**<br>Defines the starting behaviour of the inverter after connecting the line power supply. If Autostart is **activated** and the Start command is applied to the control terminals, the motor is automatically started after connecting to the line power supply. If Autostart is **deactivated**, the terminal input for START or FWD/REV must be switched over from Stop state to Start state after connection to the line power supply so that the Start command is executed (non-recurrent signal change).<br>**CAUTION:** if automatic start is activated by connecting to the line power supply, persons and systems will be at danger. Systems may need to be equipped with additional monitoring and safety devices in accordance with the valid safety regulations. |
| **xxxx1** | Autostart On. | |
| **xxx0x** | Catch Motor Off (1) (Rotational speed-control deceleration in torque controlled mode) | **The tens digit:**<br>This decides whether a check is conducted first as to whether the rotor is turning or not before energising the motor after a Start command. If the rotor is turning, the inverter first measures the speed of rotation and synchronises with this frequency. From this point, the inverter accelerates the motor to the required direction of rotation and frequency. If the function is deactivated, the drive is accelerated to its frequency setpoint after the Start command is issued. |
| **xxx1x** | Catch Motor On (2) (Switch-off when rotational speed zero is reached) (3) | |
| **xx0xx** | Deceleration of the motor in the case of Stop command | **The hundreds digit:**<br>Determines the inverter behaviour after a STOP command (from the keypad, SIO or via terminal inputs). |
| **xx1xx** | Free coasting of the motor in the case of Stop command | |

| | | |
|---|---|---|
| **x0xxx** | Ready function: Off | **The thousands digit:**<br>Activates automatic switch-on of the inverter and the function of the applied setpoint. Drive Enable (FWD/REV) must be activated permanently for this purpose. If the setpoint overshoots/undershoots the reference value programmed in parameter **65 – DC brake switch-on frequency**, the output stage is connected/disconnected automatically. Otherwise, the output stages of the inverter remain off until condition setpoint > parameter 65 is met. If the setpoint undershoots the stipulated value whilst the drive is already running, DC braking is commenced immediately and the output stages are then barred. |
| **x1xxx** | Ready function: On. | |
| **0xxxx** | "Emergency-Stop" | **The ten thousands digit:**<br>Determines the function of the Stop key in Remote mode. If the Stop key is evaluated as an Emergency-Stop key, an error message is generated in parallel with this (error 0) |
| **1xxxx** | No function of the Stop key in Remote mode | |

(1) **Special significance in Closed-Loop Torque Control mode (application 11, 21 or 51):**
In the case of a Stop command, the drive decelerates immediately with speed control at the set down ramp (parameter 26 resp. 28).

(2) The "Motor-speed detection and switch-off of frequency converter at detected point" function is not possible in the case of *SLV*® applications. Entering xxx1x is ignored.

(3) **Special significance in Closed-Loop-Torque Control mode (application 11, 21 or 51):**
The motor is not braked by a speed controller in the event of a Stop command. If a Stop command is issued, the inverter waits to disable the output stages until the actual rotational speed of the motor shaft has reached value 0 Hz. Until such time, the arriving torque setpoints are still fully processed, i.e. the motor must be decelerated with the aid of the torque setpoint (by a higher-level control).

◊ Value range: see Table Default: 0

**ATTENTION!**

If you switch over from LOCAL mode to REMOTE mode (see also parameter **9B – PS3 input function selection**), a Start command applied to the terminals is processed immediately if the motor is started. This may lead to death, injury or damage to equipment and installations.

## 72 – Ramp function selection SL / FO / SLV / EC

This defines the function of the up/down ramps and the assignment of the ramp datasets 1 and 2 to the operating states described in the table below. The two parameters parameter **25 – Acceleration time 1** and **26 – Deceleration time 1**, generate ramp dataset 1 and ramp dataset 2 is programmed via **27 – Acceleration time 2** and **28 – Deceleration time 2**.

| | |
|---|---|
| **x0** | Change-over to ramp set 2 depending on a binary input (the prerequisite is that one of the inputs has been configured for ramp set change-over: parameters 98–9B). |
| **x1** | Ramp set 1 in the case of FWD rotation, ramp set 2 in the case of REV rotation. |
| **x2** | Ramp dataset 1 is used if the output frequency is lower than the frequency set in parameter **46 – Fixed frequency 6**; Ramp dataset 2 takes effect at higher output frequencies. |
| **x3** | Ramp function off (no acceleration limiting). 1) |
| **x4** | Ramp set 1 in the case of frequencies <knee-point frequency, ramp set 2 in the case of frequencies >knee-point frequency (parameter 21). |
| **x5, x6, x7** | Same as 0, 1, 2, but optimum deceleration depending on the DC link voltage. 2) |
| **0x** | S-shaped ramps off (observe parameter 73). |
| **1x** | S-shaped ramps on (observe parameter 73). |

**NOTES:**

1) Possible only with speed control. The ramp function can be deactivated (setting x3) so that maximum dynamic response is achieved in applications FO, EC and ***SLV***②. For ***SLV***② applications, it is advisable to use short, non-S-shaped ramps (setting 0x).

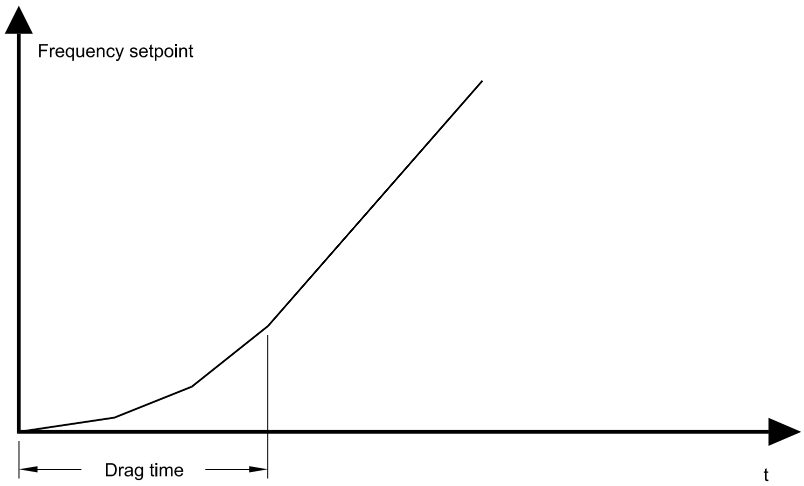
2) Parameter 75 is used to optimise the DC link voltage controller linked in this way.

◊ Value range: see Table Default: 0

**73 – Drag time SL / FO / SLV / EC – OE**

This parameter defines the duration of the rise or drop of acceleration when in parameter **72 – Ramp function selection** has been programmed as the ramp function.

It is advisable to connect S-shaped ramps in applications in which a high starting torque (break-away torque) is required. The higher the required torque is, the longer the drag time should be.




**NOTE:** this parameter is displayed only if using S-shaped ramps (parameter 72 is set to 1x).

◊ Value range: 0.1–5.0 s Default: 0.1 s

**74 – Power failure response SL / FO / SLV / EC – OE**

This parameter defines the behaviour of the inverter after a power failure.

| | |
|---|---|
| **0** | Motor stop [1)] |
| **1** | Optimum deceleration with control of the DC link voltage [1) 2)] |
| **2** | Coast to stop |

**NOTES:**

1) In this setting, parameter **F2 – Power failure filter** should be set to the minimum possible value so that braking of the motor can be commenced within the shortest possible time after a line power failure.

2) Optimization of the DC link voltage controller related to this function is realised with parameter 75.

◊ Value range: see Table Default: 2

## 75 – DC link voltage control gain $V_{DC\ link}$ SL / FO / SLV / EC – OE

This parameter does not become visible until parameter **74 – Power failure response** is set to 1 or until parameter **72 – Ramp function selection** is set to x5, x6 or x7.
DC link voltage control can be activated in the following situations:

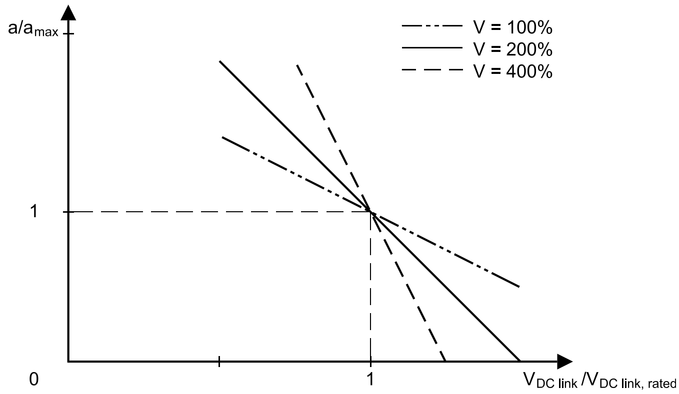
1) Optimum deceleration of the motor in the event of power failure. Programmed through the parameter **74 – Power failure response**.
2) Optimum deceleration of the motor without a connected braking resistor. Programmed by way of the parameter **72 – Ramp function selection**.

In the event of a power failure, the supply of the inverter is safeguarded from the kinetic energy of the load so as to enable controlled shutdown of the motor despite failure of the line voltage. In both cases, the deceleration ramp is set so that no more electric energy is recuperated from the kinetic energy of the load as can be consumed using the inverter's DC link.

At the same time, the acceleration is set on the basis of $a_{max}$. $a_{max}$ is the acceleration that results from the specified acceleration or deceleration time.

The gain $V_{DC\ link}$ defines the dependence on the DC link voltage and thus the control system's reaction speed:

$$a = a_{max} \times \left[1 + \left[V_{DC\ link} \times \left(1 - \frac{V_{DC\ link}}{V_{DC,\ rated}}\right)\right]\right],\ \text{Limiting of}\ \begin{matrix} a \geq 0 \\ a \leq 0 \end{matrix} \left\} \begin{matrix} \text{for}\ a_{max} \geq 0 \\ \text{for}\ a_{max} < 0 \end{matrix} \right.$$




◊ Value range: 0.0–2000.0% Default: 500.0%

## 76 – Slip compensation SLV / SL – OE

This parameter switches slip compensation off/on.

| | |
|---|---|
| **0** | Off |
| **1** | On |

When slip compensation is activated, the motor's rotor frequency is kept constantly at the value of the frequency setpoint, i.e. the motor's speed is independent of its load.

$$n = \frac{f_{set}}{p\ (p - \text{Number of pole pairs of the motor})}$$

Good functioning of the speed controller is only guaranteed if the motor parameters have been entered correctly in parameter group 1. Further optimization of the speed controller is realised by way of parameter **77 – Slip compensation setting**. The highest accuracy of the controller can be achieved over a speed range of 1:10. Below this frequency, the speed may increase between the relieved and loaded motor.

If the application 50 (*SLV*②  speed control) is active, the parameter has the following meaning:

| | |
|---|---|
| **0** | Speed control to $f_{Stator}$ |
| **1** | Speed control to $f_{Rotor}$ |

**NOTE:** this parameter is not relevant during operation with speed control (EC/FO).

◊ Value range: see Table — Default: 0

## 77 – Slip compensation setting — SL – OE

This parameter for setting electronic slip compensation (without tacho) only appears when the parameter 76 is set to 1.

The value defined by the inverter on the basis of the motor's rated data corresponds to 100% (default). If the drive should oscillate at this setting, this value must be reduced until stable running is guaranteed under load and when idling.

**ATTENTION!**

Drive oscillations may lead to overloading of the braking chopper or the current limit may be exceeded. Therefore, this parameter must be optimized conscientiously and must be checked for oscillation-free running over the entire speed and load range.

**NOTE:** this parameter is not relevant during operation with speed control and *SLV*② applications. For these applications, the speed controller is adapted by way of the parameter **F6 – Rotor time constant setting**.

◊ Value range: 0.0–500.0% — Default: 100.0%

## 78 – Language — SL / FO / SLV / EC – OE

The display can be adapted to the respective national language here.

| | |
|---|---|
| **0** | German |
| **1** | English |

◊ Value range: see Table — Default Europe: 0
Default USA: 1
(see also parameter EA)

## 79 – PWM frequency — SL / FO / SLV / EC – OE

Setting of the PWM frequency (clock frequency of the power output stages). The inverters are thermally designed for a rated clock frequency of 5 kHz. Depending on local cooling conditions, higher clock frequencies may lead to excess temperature deactivation (observe display messages). A setting is possible in 0.01 kHz increments.

**NOTE:** particularly in the lower speed range, the PWM frequency is also influenced by the parameter **FB – PWM frequency slaving**. Above f = 4.50 kHz, a new voltage vector is now only computed in every second PWM cycle.

The following parameters are recomputed automatically when this parameter is changed:

Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

◊ Value range: 2.00–9.00 kHz — Default: 4.50 kHz

## 7A – Braking resistor power — SL / FO / SLV / EC

Continuous rating of the internal or external braking resistor. If the thermal limit is exceeded, a warning is issued initially followed by an error message. Controlled deceleration occurs as the response to the error.

**HINT!**

As standard, the inverters are equipped with 75 Ω (Sizes II–III) and also 20 Ω (Sizes IV–VI) braking resistors. The use of resistors with a lower resistance may lead to the “Overcurrent” fault. Resistors with a higher resistance do not make full use of the inverter's available braking power.

**Protection of the braking resistor:**

A thermal model of the braking resistor runs in the microcontroller. This model can, however, protect the resistor effectively only if the data of parameters 7A, 7D and 7E has been specified correctly. The thermal load limit ($W_{max}$ (maximum energy [W])) of the connected resistor is calculated from parameter **7D – Permissible heating time of braking resistor** ($T_{max}$), the DC link voltage ($V\_DC_{link}$ = 565 VDC nominal) and the braking resistance (parameter **7E – Connected braking resistor** ($R_B$)).

$$W_{max} = \frac{V\_DC_{nom}^{2}}{R_B} \times T_{max}$$

The transistor On time and the current DC link voltage are allowed for calculating the energy currently consumed.

The resistor must have the following **minimum** values for the individual inverter sizes:

| SIZE | MAXIMUM CURRENT OF BRAKE CHOPPER | BRAKE RESISTOR (MINIMUM VALUE) |
|---|---|---|
| II | 10 A | 75 Ω |
| III | 15 A | 50 Ω |
| IV | 50 A | 16 Ω |
| V | 75 A | 10 Ω |
| VI | 75 A | 10 Ω |

**ATTENTION!**

If unrealistically high continuous power loss values are specified or if the protection function is deactivated with parameter **7E – Connected braking resistor** despite the fact that a braking resistor is present or the value is specified incorrectly, protection of the resistor is not guaranteed and this entails the risk of overheating or fire.

◊ Value range: 0.00–50.00 kW Default: 0.08 kW

### 7B – Increment motor potentiometer speed SL / FO / SLV / EC – OE

This parameter determines the rate of change of the frequency factor (parameter 33) if input PS1 is programmed for one of the functions ×11 or ×12 (incrementing the frequency factor) via parameter 99. If the value 10 s is programmed for the parameter, for example, the input must be activated for 10 s in order to change the frequency factor by 100%.

◊ Value range: 0.1–640.0 s Default: 10.0 s

### 7C – Decrement motor potentiometer speed SL / FO / SLV / EC – OE

This parameter determines the rate of change of the frequency factor (parameter 33) if input PS2 is programmed for one of the functions ×11 or ×12 (decrementing the frequency factor) via parameter 9A. If the value 10 s is programmed for the parameter, for example, the input must be activated for 10 s in order to change the frequency factor by 100%.

◊ Value range: 0.1–640.0 s Default: 10.0 s

**7D – Permissible heating time of braking resistor** **SL / FO / SLV / EC**

Maximum time during which the connected braking resistor may be operated on a voltage of $V_{DC\ link}$ = 540 V (refer also to the description of the parameter **7A – Braking resistor power**).

**ATTENTION!**

If incorrect values are specified, protection of the resistor is no longer guaranteed and this entails the risk of overheating or fire (see also parameter **7A – Braking resistor power**).

If external resistors of other suppliers are used, please enquire as regards the maximum permitted heating time.

◊ Value range: 1–100 s Default: 2 s

**7E – Connected braking resistor** **SL / FO / SLV / EC**

Resistance value of the connected braking resistor. If no braking resistor is connected, the maximum value must be entered so as to preclude the possibility of error messages. The braking chopper monitoring function is then deactivated (see also description of parameter **7A – Braking resistor power**).

**ATTENTION!**

If incorrect values are specified or if the protection function is deactivated for this parameter despite the fact that a braking resistor is present, this entails the risk of overheating or fire. Setting 1000 Ohms corresponds to “braking resistor protection deactivated”.

**NOTE:** note the minimum values of the braking resistance (see parameter 7A).

◊ Value range: 15–1000 Ω Default: 75 Ω (for inverter power rating up to 11 kW)
20 Ω (for inverter power rating upwards of 15 kW)

**7F – Control method** **SL / FO / SLV / EC**

The sine vector method generates a sinusoidal output voltage that is largely devoid of harmonics and, in doing so, it makes the fullest possible use of the line voltage fed in. With trapezoidal control, even higher output voltages can be generated than when using the sine vector method, but with a simultaneously higher amount of harmonics. The subharmonic method supplies lower output voltages than the sine vector method. Here, the motor's star point is at a constant potential.

| | |
|---|---|
| **0** | Subharmonic method |
| **1** | Sine vector modulation |
| **2** | Trapezoidal control |

◊ Value range: see Table Default: 1

## 8.8 Group 8 – Protective Functions

**81 – MOL input function selection** **SL / FO / SLV / EC**

At the MOL input, the resistance connected to it is evaluated by the processor in two ways. On the one hand, the analog voltage drop is routed to an A/D converter input and, on the other hand, the voltage drop is evaluated using a comparator with a fixed reference voltage. This comparator then deactivates the output stages through hardware linking. To do this, the resistance between the MOL+ and MOL– inputs must exceed a value of 4.1 kΩ.

| | |
|---|---|
| **0** | Connection of relay:<br>The inverter is disabled (coast stop) when the relay is triggered. This disabling is realised by the hardware through hardware linking. The voltage drop through the MOL input is not evaluated by the program as an analog value (pure contact function). |

| | |
|---|---|
| **1** | Connection of a single PTC.<br>Controlled deceleration takes place if 1.5 kΩ is exceeded. 1) |
| **2** | Connection of a triple PTC.<br>Controlled deceleration takes place if 3.0 kΩ is exceeded. 1) |
| **3** | Same as 0, but: the “MOL contact open” error is not reported and need not be acknowledged. Thus, an EMERGENCY STOP can be wired through the MOL input by disconnecting the inverter output stages. |

**NOTE:**

**ATTENTION!**

1) If the resistance of 1.0 kΩ is exceeded, a warning message is always issued. Controlled deceleration occurs above 1.5 kΩ resp. 3.0 kΩ. If a resistance value of 4.1 kΩ is exceeded, pure hardware switch-off always occurs.

◊ Value range: see Table

Default Europe: 2
Default USA: 0
(see also parameter EA)

**82 – MOL input display (read-only) SL / FO / SLV / EC**

The voltage at the MOL input is displayed as a percentage of the maximum value. A 100% display corresponds to a voltage drop of ≈25 V or 5 kΩ at the terminals.

◊ Value range: 0–100%

**83 – Restart after fault definition SL / FO / SLV / EC**

Stipulation as to what errors are to result in a restart of the inverter. A restart means automatic restart of the inverter after an error occurs. For this purpose, the error which has occurred must be identified as a restart-enabled error (with the aid of this parameter), the Enable must have been issued (FWD resp. REV terminal is activated) and the maximum number of restarts (parameter 84) may not yet have been reached. The Restart function is possible only in REMOTE mode.

The notation is hexadecimal (see presetting example). Each fault is assigned one bit in the parameter value. See Chapter 8.17, Page 2-121, for details of allocation of the fault number and fault type.

**8240**

| Display $_{Hex}$ | 8 | | | | 2 | | | | 4 | | | | 0 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary $_{Bin}$** | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Bit No.** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Function** | Fault 15 | Fault 14 | Fault 13 | Fault 12 | Fault 11 (1) | Fault 10 | Fault 9 | Fault 8 | Fault 7 (1) | Fault 6 | Fault 5 | Fault 4 | Fault 3 | Fault 2 | Fault 1 | Fault 0 |

(1) If these errors occur, no restart is possible. The corresponding bits should thus be set to zero.

**PROGRAMMING EXAMPLE:**

A restart is to be performed after error 6, 9 and 15. A “0” or a “1” must now be inserted for each error (error 0 to error 15) in the order shown in the illustration above (starting at the left). The digit “0” means “do not perform restart” and the digit “1” means “perform restart”. Enter the hexadecimal value using a pocket calculator which can convert binary numbers to hexadecimal values or using a table (see the conversion table on Page 2-123 in this description). In this example, the binary number “1000 0010 0100 0000” (the “1” at the 1st position from the left stands for error 15 (bit 15), at the 7th position for error 9 (bit 9) and at the 10th position (bit 6) for error 6) and the hexadecimal value to be entered is “8240”.

**NOTE:**

**HINT!**

The values between $FFFF_{Hex}$ and $8000_{Hex}$ are reached by pushing the DOWN key ▼, departing from “0”. The values in between 0 and $7FFF_{Hex}$ are reached with the UP key ▲.

◊ Value range: $8000_H$–$FFFF_H$, $0000_H$–$7FFF_H$ Default: $0000_H$

**84 – Number of restarts** **SL / FO / SLV / EC**

Maximum number of restarts performed after occurrence of one of the errors stipulated in parameter 83. Programming the value zero means that no restart is attempted under any circumstances. The stored number of restarts performed to date is reset after 10 minutes of error-free operation.

◊ Value range: 0–8 Default: 0

**85 – Restart delay** **SL / FO / EC**

If the Restart function is activated (see parameter 83) and the maximum permitted number of restart attempts (parameter 84) has not yet been exceeded, an automatic restart of the inverter is attempted after expiry of the time stipulated in this parameter if an error defined in parameter 83 occurs.

◊ Value range: 0.1–60.0 s Default: 10.0 s

**87 – Password** **SL / FO / SLV / EC**

Entry of a password allows unauthorised access to the parameters to be prevented. After entry of a password, the user is prompted to enter the password the first time the PROG key is pressed after power-on – instead of reverting to Parameter Input mode. The password can now be set directly with keys UP/DOWN and acknowledged with key ENTER. If the password has been entered correctly, you will see “ *** CODE OK. *** “ on the display. Otherwise, you will see “ ** WRONG CODE ** “. Password zero deactivates the function.

If a password is entered (unequal to Zero), the character string ***** is displayed instead of the value when the parameter is selected.

◊ Value range: 0–9999 Default: 0

**88 – Thermal motor time constant** **SL / FO / SLV / EC**

With the aid of the time constant, the inverter computes a thermal motor model on the basis of a delay element. A warning or an error message is triggered if the thresholds are exceeded. Controlled slowing down is the reaction to the error message.

**ATTENTION!**

This function is unable to ensure 100 percent thermal motor protection since the individual ambient conditions are ignored. However, if this is required, use of a motor PTC thermistor detector is recommended.

◊ Value range: 1–120 min Default: 15 min

## 89 – $I^2t$ warning threshold — SL / FO / SLV / EC

See description under parameter 88.

◊ Value range: 10.0–200.0% Default: 115.0%

## 8A – $I^2t$ error threshold — SL / FO / SLV / EC

See description under parameter 88.

◊ Value range: 10.0–200.0% Default: 120.0%

## 8B – Maximum permissible ramp extension in the event of stop — SL / FO / SLV / EC

To enhance operating reliability, a monitoring function has been integrated for the stop operation which makes sure that a drive that has got out of control will stop after a finite time. The inverter checks whether the drive has stopped within a parameterisable time, as otherwise braking is initiated immediately after the expiry of this time by means of the DC brake and then the output stages are deactivated. The stop monitoring function is configured by way of this parameter.

- The ramp time $t_{ramp}$ that is used for checking is always the greater of the two run down times from ramp sets 1 and 2 (parameter 26 or 28).
- The current frequency setpoint is taken into account on calculation of the time-out $t_{out}$.

$$t_{out} = t_{ramp} \times \frac{\text{Parameter 8B \%}}{100\%} \times \frac{|f_{setpoint}|}{f_{max}}$$

| VALUE | MEANING |
|---|---|
| **0** | Monitoring function off.<br>For example, the function can be deactivated for applications in which braking is to take place at the moment limit. |
| **50–99%** | Only effective when the active ramp set contains the smaller of the two run down times; otherwise 100% is calculated internally. |
| **100–1000%** | Time-out $t_{out} = t_{ramp} \times \frac{\text{Parameter 8B \%}}{100\%} \times \frac{\lvert f_{setpoint}\rvert}{f_{max}}$<br>The time-out determined for the current setpoint can be checked in the parameter 8C.<br>**NOTE:** $t_{out}$ is calculated up to a time less than 31 seconds with a resolution of 100 ms; in the event of higher values it is rounded up to full seconds. |

**ATTENTION!**

It is possible that the motor can no longer be stopped if the monitoring function is deactivated and the parameterisation is incorrect. In any case, the monitoring function should only be deactivated at the end of a commissioning operation and, at the same time, an EMERGENCY STOP (inverter lock) should be wired at a binary input (parameter 98–9B) or the MOL terminals (parameter 81).

**EXAMPLE:**

The drive is currently running with 10 Hz, the maximum frequency is 50 Hz, ramp extension is set to 400%, the deceleration ramp 1 (parameter 26) is set to 2.5 s and the deceleration ramp 2 (parameter 28) is set to 5 seconds. Under normal conditions (no load limit), for coasting down from 10 Hz to standstill the drive needs

$$\text{Deceleration time}_{10\,Hz} = \frac{2.5\,s \times 10\,Hz}{50\,Hz} = 0.5\,s$$

The “Maximum permissible ramp extension” is set to 400%, i.e. the drive is given four times the time for stopping (**but calculation is based on the longer ramp 2**):

$$t_{out} = \frac{5\ s \times 400\% \times 10\ Hz}{100\% \times 50\ Hz} = 4\ s$$

If the motor has not yet stopped at this time, the inverter switches off the output stages and issues error message 12 (Auto-Stop).

**Definitions**

- The minimum time-out is set to 500 ms.
- When ramps are deactivated, a constant substitute ramp time $t_{ramp}$ = 5 s is used to calculate the time-out $t_{out}$.

**Error message**

- The error message 12 “Auto-Stop” is issued after deactivation of the output stages by the monitoring function.

**Remedy**

1) The drive's parameter settings are wrong:
   - Motor data incorrectly entered (Frequent error: when using an induction motor, users enter the synchronous speed).
   - Test mode not run (see parameter 2A).
   - Error during manual controller adjustment (speed, position, current controller), proportional gain frequently too high.
   - After change-over of the application (see parameter 2C), in any case the test mode must be run again; controllers must be readjusted; begin with the default values again! Starting the feedback-free ***SLV***② application with the controller settings that were optimized for the field-oriented drive (working feedback) is particularly problematic.
   - A further conceivable reason:
     Discrepancies in the active parameter set when using the “parameter set change-over” function.
2) If the drive has been commissioned properly:
   - It is overloaded and therefore no longer manages to stop the motor within the time-out $t_{out}$ set in the parameter **8B – Maximum permissible ramp extension in the event of stop**.
   - Check ramp times (group 2).
   - Check torque limits (group 5).
   - Depending on the application the parameter **8B – Maximum permissible ramp extension in the event of stop** must be set to max. 10000% or to 0% to deactivate the monitoring function.

**NOTE:** an entered value between 1 and 49 is overwritten automatically with 0.

◊ Value range: 0 **or** 50–10000% Default: 200%

**8C – Current time-out $t_{out}$ for stop ramp SL / FO / SLV / EC**

Time-out $t_{out}$ for stopping.

To enable a check, the time-out $t_{out}$ calculated with the aid of the parameter 8B is displayed here.

◊ Value range: 0.1–999.9 s

## 8D – Reference value for load-dependent switching of control outputs SL / FO / SLV / EC

Each of the UD 7000 control outputs (see description of parameters 92–96) can be programmed to the function “x31”. The parameter 8D determines the output torque (in percent of the rated torque) the output switches at. For example, this function makes it possible to give the signal that 120% of the motor torque have been reached to external control units, and additional protective functions can be realised.

Depending on the mode, the value for the output torque calculated by the inverter can vary. A filtered value is therefore taken as reference value for the above-mentioned comparison. The filtering is made with a value determined through the parameter **A7 – Filtering time constant of displayed values in parameter group 0**. This filtering avoids hypersensitivity of the output (short peaks on the calculated moment are filtered out).

**HINT!**

This parameter is only visible when at least one of the outputs has been programmed for this function.

◊ Value range: 0–500.0% Default: 100.0%

## 8E – Selection speed control FO / SLV / EC

With this parameter, the user can choose whether error 8 (speed control) is caused only by an excessive rotor speed or by as well an excessive speed as well as an excessive control error.

| | |
|---|---|
| **0** | Control of overspeed only, i.e. error 8 is caused only when the actual speed $n_{ist}$ is higher than the maximum permissible speed $n_{max}$. The maximum permissible speed $n_{max}$ results from the maximum frequency $f_{max}$ (parameter 23) multiplied by 1.2, considering also the number of motor pole pairs $z_p$: $n_{max} = 1.2 \times \frac{f_{max}}{z_p}$ |
| **1** | The overspeed (see selection 0) and the adherence to an adjustable control error are monitored. 1) |

**NOTE:**

1) Error “speed control” is caused when during speed control the control error between reference frequency and actual frequency is higher than a selected comparative value. This comparative value can be either parameter 47 (Hysteresis band for blocking frequencies) or (when parameter 47 is set to 0) the nominal slip $s_N$ of the motor multiplied by 2. The nominal slip of the motor is calculated as follows:

$$s_N = f_N - \frac{n_N}{60\frac{s}{min}} \times z_p$$

$s_n$ = nominal slip.
$f_N$ = (motor) nominal frequency (parameter 12).
$n_N$ = nominal speed (parameter 14).
$z_p$ = number of pole pairs.

**EXAMPLE:**

A quadripole standard motor ($z_p = 2$) with a nominal frequency $f_N = 50$ Hz has a nominal speed $n_N = 1425\ min^{-1}$. The maximum frequency (parameter 23) is 100 Hz. The value stored in parameter 8E is 1. Parameter 47 has been set to 0 Hz, i.e. the comparative value is the double nominal slip. The nominal slip is calculated as follows:

$$s_N = 50\ \text{Hz} - \frac{1425\ \text{min}^{-1}}{60\frac{\text{s}}{\text{min}}} \times 2 = 2.5\ \text{Hz}$$

$$n_{max} = 1.2 \times \frac{f_{max}}{z_p} = 1.2 \times \frac{100\ \text{Hz}}{2} = 60\ \text{Hz}$$

Error 8 “speed control” is thus caused when the control error is higher than 5 Hz or when the rotor speed is higher than 60 Hz.

**HINT!**

Parameter 8E appears only in applications with speed control (parameter 2C) and with ramps switched on (parameter 72, “Ramp function selection”). For synchronous motors, the nominal slip $s_N$ is always 0. Therefore, the value stored in parameter 47 (Hysteresis band for blocking frequencies) mustn't be 0 (for EC applications). Parameter 47 can also be used for other functions, as long as this particular value can be used for any function.

◊ Value range: see table — Default: 0

## 8.9 Group 9 – Binary Inputs/Outputs

**91 – Function of inputs FWD and REV** — **SL / FO / SLV / EC**

This parameter defines the functions of the FWD and REV terminal inputs.

| | |
|---|---|
| **0** | FWD: start/stop.<br>REV: selection of the direction of rotation (active: left rotation). |
| **1** | FWD: start/stop, right rotation.<br>REV: start/stop, left rotation. (1) |

(1) If both FWD and REV are active, this is interpreted as a STOP command.

◊ Value range: see Table — Default: 1

**92 – Output ST1 function selection** — **SL / FO / SLV / EC**

◊ Value range: see table under parameter 96 — Default: 3

**93 – Output ST2 function selection** — **SL / FO / SLV / EC**

◊ Value range: see table under parameter 96 — Default: 102

**94 – Output ST3 function selection** — **SL / FO / SLV / EC**

◊ Value range: see table under parameter 96 — Default: 10

**95 – Output ST4 function selection** — **SL / FO / SLV / EC**

◊ Value range: see table under parameter 96 — Default: 115

**96 – Relay output function selection** — **SL / FO / SLV / EC**

The following description applies to parameters 92–95 also.

| | | |
|---|---|---|
| **x00** | | Inactive |
| **x01** | | Inverter OK (Unit works faultless) |
| **x02** | ■ ● | Inverter output frequency higher than rated motor slip frequency; calculated on the basis of the rated speed specified in parameter 14 |

| | | |
|---|---|---|
| **x03** | ■ ● | Inverter output frequency greater than 0.5 Hz in the left or right-hand direction of rotation. Operation with feedback: motor shaft rotation frequency/motor pole pair number >0.5 Hz |
| **x04** | ■ ● | Inverter output frequency 0 Hz.<br>Operation with feedback: motor shaft rotation frequency/motor pole pair number = 0 Hz |
| **x05** | ■ ● | Stator frequency = frequency setpoint.<br>Operation with feedback: frequency setpoint = actual frequency |
| **x06** | ■ ● | Inverter output frequency greater than fixed frequency 2 (parameter 42) in the left or right-hand direction of rotation. Operation with feedback: motor shaft rotation frequency/motor pole pair number >fixed frequency 2 |
| **x07** | ■ ● | Inverter output frequency higher than fixed frequency 3 (parameter 43) in the left or right-hand direction of rotation. Operation with feedback: motor shaft rotation frequency/motor pole pair number >fixed frequency 3 |
| **x08** | ■ | Set torque limit reached (parameters 58–5B) |
| **x09** | | Output controlled through serial interface (SIO) |
| **x10** | | Motor temperature exceeded (MOL open / $i^2t$, error message 5) |
| **x11** | | Warning: motor temperature exceeded (MOL contact, warning message 17) |
| **x12** | ■ ● | Maximum frequency (parameter 23) reached |
| **x13** | ■ ● | Minimum frequency (parameter 24) reached |
| **x14** | ■ | Setpoint current loop has discontinuity (only in the case of setpoint input 2–10 V or 4–20 mA; is signalled if 2 V resp. 4 mA is undershot, warning message 27) |
| **x15** | | The Digital frequency output function is possible only in conjunction with ST4.<br>**In the case of applications without feedback:**<br>The output frequency corresponds to the stator frequency (in Hz) × n (n = parameter 3E).<br>**Operation with feedback:**<br>The output frequency corresponds to the rotor rotational frequency (in Hz) × n (n = parameter 3E) |
| **x16** | | The Digital Frequency Output function is possible only in conjunction with ST4.<br>The output frequency corresponds to the frequency setpoint × n (n = parameter 3E) |
| **x17** | ■ | Inverter is in LOCAL mode (LOC) |
| **x18** | ■ | Inverter is operating in speed control mode.<br>Inactive: inverter is operating unregulated |
| **x19** | ■ ● | Inverter generates REV rotation field |
| **x20** | | The inverter is carrying out a test mode (see also parameter 2A and parameter 98–9B, Setting 9 “zero pulse search”) |
| **x21** | ■ ● | Inverter output frequency greater than fixed frequency 3 (parameter 43) in right-hand rotation direction. Operation with feedback: motor shaft rotation frequency/motor pole number >fixed frequency 3 in right-hand direction of rotation |
| **x22** | ■ ● | Inverter output frequency is greater than fixed frequency 3 (parameter 43) in counter-clockwise direction of rotation. Operation with feedback: motor shaft rotation frequency/motor pole number >fixed frequency 3 in counter-clockwise direction of rotation |
| **x23** | | Top frequency reached. Acceleration / deceleration integrator has reached reference value |
| **x24** | | Reserved N/A |

| | | |
|---|---|---|
| **x25** | ■ ● | Set inverter frequency after ramp generator higher than fixed frequency 2 (parameter 42) in the left or right direction of rotation |
| **x26** | | Only for applications with a speed controller:<br>Control error between set and actual frequencies is higher than a selected comparison value. (1) |
| **x27** | | Output stage enabled |
| **x28** | | Reserved N/A |
| **x29** | | Reserved N/A |
| **x30** | | Function for control of a holding brake. The output becomes active if 75% of the field build-up time (parameter 66) has elapsed and it becomes inactive if 50% of the CD holding time has elapsed after a STOP command (parameter 64). |
| **x31** | ■ ● | The output shows that a certain output torque has been exceeded. The parameter **8D – Reference value for load-dependent switching of control outputs** determines the output torque (in per cent of the rated torque) the output switches at. For example, this function makes it possible to give the signal that a certain motor torque has been reached to external control units. |
| **0xx** | | Low active level |
| **1xx** | | High active level |
| **2xx** | | Output indicates that the selected condition is satisfied **and** that the inverter is OK; possible for all functions which are identified with ■ in the table (active level **Low**) |
| **3xx** | | Output indicates that the selected condition is satisfied **and** that the inverter is OK; possible for all functions which are identified with ■ in the table (active level **High**) |

**NOTES:**

● The control output is **not** set if the inverter is in the DC mode or in a test mode (cf. parameter 2A or parameter 98–9B “zero pulse search”), and in the field build-up time.

■ These functions of the control outputs can be logically combined with the condition “Inverter OK”, i.e. the output is set if the selected condition (the last two digits) is satisfied and if the inverter is functioning without faults. Enter 2xx or 3xx depending on the desired active level.

(1) This comparison value is either parameter **47 – Hysteresis band for blocking frequencies** or, if parameter 47 has be set to zero, twice the nominal slip $s_N$ of the motor. The nominal slip of the motor is calculated as follows:

$$s_N = f_N - \frac{n_N}{60\frac{s}{min}} \times z_p$$

**EXAMPLE:**

A four-pole standard motor ($z_p$ = 2) with a nominal frequency $f_{nom}$ = 50 Hz has a nominal rotational speed $n_{nom}$ = 1425 rpm. Parameter 47 has been programmed to 0 Hz. The nominal slip can be calculated as follows

$$s_{nom} = 50\ Hz - \frac{1425\ rpm}{60\frac{s}{min}} \times 2 = 2.5\ Hz$$

Comparison value = 2 × $s_{nom}$ = 2 × 2.5 Hz = 5 Hz.

This means that the output switches if the control error increases above 5 Hz.

**EXAMPLE:**

The value 225 is entered in parameter 96:

The relay output opens if the inverter is operating without faults and if the setpoint frequency is greater than the “fixed frequency 2” entered in parameter 42. However, the output does not open if a higher frequency is output by the inverter during measurement of the leakage inductance.

◊ Value range: see Table Default: 101

## 97 – Control of binary outputs through SIO SL / FO / SLV / EC – SC

To enable control of the binary outputs ST1–ST4 and REL through the serial interface, the respective output must be programmed to the “Control of the output through serial interface” function with the affiliated “Select function of output ...” selection parameter (parameters 92–96 set to x09).

**12**

| Display $_{Hex}$ | 1 | | | | 2 | | | |
|---|---|---|---|---|---|---|---|---|
| Binary $_{Bin}$ | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Function | Not used | Not used | Not used | REL | ST4 | ST3 | ST2 | ST1 |

**PROGRAMMING EXAMPLE:**

The binary outputs REL (parameter 96) and ST2 (parameter 93) should be controlled via the serial port. A “0” or a “1” must now be inserted for each selection option (bits 0–7) in the order shown in the table above (starting at the left). Digit “0” corresponds to “not activated” and digit “1” corresponds to “activated”. Value “0” must be inserted for bits 5 to 7 which are not used. The hexadecimal value must be entered using a pocket calculator which can convert binary numerical values to hexadecimal values or a table (see conversion table on Page 2-123 of this description). In this example, the binary number “0001 0010” (the “1” at the 4th position from the left stands for REL (bit 4) and at the 7th position stands for ST2 (bit 1)) and the hexadecimal value to be entered is “12”.

◊ Value range: $0_H$–$FF_H$ Default: $0_H$

## 98 – Run/Jog input function selection SL / FO / SLV / EC

| | |
|---|---|
| **x00** | Selection Jog mode (fixed frequency 1). The set value of the fixed frequency 1 can also be used as a Jog frequency. For this purpose, binary inputs R/J and PS3 must be activated, parameter **98 – Run/Jog input function selection** must be programmed for function “Selection Jog mode” (setting x00) and LOCAL mode must be activated with parameter 9B (setting x06). The motor now runs in the corresponding direction at the set frequency 1 for as long as key FWD or REV is pressed. |
| **x01** | Selection of ramp set 2 (acceleration and deceleration time 2); see also parameter 72 |
| **x02** | Selection of customer parameter set 1 (see note 1, Page 2-97) |
| **x03** | Selection of customer parameter set 2 (see note 1, Page 2-97) |
| **x04** | Inverter disabled (coast to stop) |

| | |
|---|---|
| **x05** | DC braking. The inverter reverts to a mode in which it injects into the motor a DC voltage which results in deceleration of the motor (DC braking). In this case, the corresponding direct current is monitored so that, at maximum, the current specified by parameter **63 – DC brake current** is able to flow. The DC brake functions only as long as the output stages are enabled. This function may be selected only if parameter **2C – Application** has been programmed to value "0" or "2" |
| **x06** | No function |
| **x07** | No function |
| **x08** | Deactivation of the position controller |
| **x09** | Zero pulse search master setpoint (only active in the stop state); see note 2, Page 2-98 |
| **x10** | No function |
| **x11** | No function |
| **x12** | No function |
| **x13** | No function |
| **x14** | Deactivation of the master encoder for the synchronous system |
| **x15** | Suppression of positive counting pulses of the master encoder for the synchronous system. Only negative counting pulses of the master are active |
| **x16** | Suppression of negative counting pulses of the master encoder for the synchronous system. Only positive counting pulses of the master are active |
| **x17** | Inversion of the counting pulses of the master encoder |
| **x18** | Reserved N/A |
| **x19** | Acknowledge error state (see note 5, Page 2-99) |
| **x20** | Reserved N/A |
| **0xx** | NO contact trips the selected function (see note 4, Page 2-99) |
| **1xx** | NC contact trips the selected function (see note 4, Page 2-99) |

**NOTE:**

The binary input R/J must not be triggered during execution of a test mode of operation (see parameter 2A).

◊ Value range: see Table Default: 0

**99 – PS1 input function selection SL / FO / SLV / EC**

| | |
|---|---|
| **x00** | Bit 0 for selection of a fixed frequency (0–7); if this function is not selected, the bit is evaluated as Zero (see parameter 41–46) |
| **x01** | Selection of ramp set 2 (acceleration and deceleration time 2) |
| **x02** | Selection of customer parameter set 1 (see note 1, Page 2-97) |
| **x03** | Selection of customer parameter set 2 (see note 1, Page 2-97) |
| **x04** | Inverter disabling (coast to stop) |

| | |
|---|---|
| **x05** | DC braking. The inverter reverts to a mode in which it injects into the motor a DC voltage which results in deceleration of the motor (DC braking). In this case, the corresponding direct current is monitored so that, at maximum, the current specified by parameter **63 – DC brake current** is able to flow. The DC brake functions only as long as the output stages are enabled. This function may be selected only if parameter **2C – Application** has been programmed to value “0” or “2” |
| **x06** | Incrementing of the frequency factor (parameter 33 or E3) with the active switching edge; see note 3, Page 2-99 |
| **x07** | Incrementing of the frequency factor (parameter 33 or E3) in the active switching state every 64 ms; see note 3, Page 2-99 |
| **x08** | Deactivation of the position control |
| **x09** | Zero pulse search master setpoint (only active in the STOP state); see note 2, Page 2-98 |
| **x10** | No function |
| **x11** | Incrementing of the frequency factor (parameter 33 or E3) in an active switching state (motor potentiometer). The rate of change is defined by the parameter 7B. When a stop command is pending, the frequency factor is set to the low limit that is set in the parameter 38 |
| **x12** | Incrementing of the frequency factor (parameter 33 or E3) in the active switching state (motor potentiometer). The rate of the change is defined by the parameter 7B; see note 3, Page 2-99 |
| **x13** | Incrementing the parameter **D3 – Zero angle** with the active control state. The rate of change is determined by the parameter 7B. The zero angle is not stored in a non-volatile manner |
| **x14** | Deactivation of the master encoder for the synchronous system |
| **x15** | Suppression of positive counting pulses of the master encoder for the synchronous system. Only negative counting pulses of the master are active |
| **x16** | Suppression of negative counting pulses of the master encoder for the synchronous system. Only positive counting pulses of the master are active |
| **x17** | Inversion of the counting pulses of the master encoder |
| **x18** | Reserved N/A |
| **x19** | Acknowledge error state (see note 5, Page 2-99) |
| **x20** | Reserved N/A |
| **0xx** | NO contact trips the selected function (see note 4, Page 2-99) |
| **1xx** | NC contact trips the selected function (see note 4, Page 2-99) |

**NOTE:**

The binary input PS1 must not be triggered during execution of a test mode of operation (see parameter 2A).

◊ Value range: see Table Default: 4

## 9A – PS2 input function selection SL / FO / SLV / EC

| | |
|---|---|
| **x00** | Bit 1 for selection of a fixed frequency (0–7); if this function is not selected, the bit is evaluated as Zero (see parameter 41–46) |
| **x01** | Selection of ramp set 2 (acceleration and deceleration time 2) |
| **x02** | Selection of customer parameter set 1 (see note 1, Page 2-97) |

| | |
|---|---|
| **x03** | Selection of customer parameter set 2 (see note 1, Page 2-97) |
| **x04** | Inverter disabling (coast to stop) |
| **x05** | DC braking. The inverter reverts to a mode in which it injects into the motor a DC voltage which results in deceleration of the motor (DC braking). In this case, the corresponding direct current is monitored so that, at maximum, the current specified by parameter **63 – DC brake current** is able to flow. The DC brake functions only as long as the output stages are enabled. This function may be selected only if parameter **2C – Application** has been programmed to value “0” or “2” |
| **x06** | Decrementing of the frequency factor (parameter 33 or E3) with the active switching edge; see note 3, Page 2-99 |
| **x07** | Decrementing of the frequency factor (parameter 33 or E3) in the active switching state every 64 ms; see note 3, Page 2-99 |
| **x08** | Deactivation of the position control |
| **x09** | Zero pulse search master setpoint (only active in the STOP state); see note 2, Page 2-98 |
| **x10** | No function |
| **x11** | Decrementing of the frequency factor (parameter 33 or E3) in an active switching state (motor potentiometer). The rate of change is defined by the parameter 7C. When a stop command is pending, the frequency factor is set to the low limit that is set in the parameter 38 |
| **x12** | Decrementing of the frequency factor (parameter 33 or E3) in the active switching state (motor potentiometer). The rate of the change is defined by the parameter 7C; see note 3, Page 2-99 |
| **x13** | Decrementing of the zero angle (parameter 33) in an active switching state (shifting of the relative position between the master sensor and slave of the electrical shaft). The rate of change is defined by the parameter 7C. The zero angle is not stored in a power failsafe manner. The function can be used when the output stage is enabled and coupling is running |
| **x14** | Deactivation of the master encoder for the synchronous system |
| **x15** | Suppression of positive counting pulses of the master encoder for the synchronous system. Only negative counting pulses of the master are active |
| **x16** | Suppression of negative counting pulses of the master encoder for the synchronous system. Only positive counting pulses of the master are active |
| **x17** | Inversion of the counting pulses of the master encoder |
| **x18** | Reserved N/A |
| **x19** | Acknowledge error state (see note 5, Page 2-99) |
| **x20** | Reserved N/A |
| **0xx** | NO contact trips the selected function (see note 4, Page 2-99) |
| **1xx** | NC contact trips the selected function (see note 4, Page 2-99) |

**NOTE:**

The binary input PS2 must not be triggered during execution of a test mode of operation (see parameter 2A).

◊ Value range: see Table Default: 1

## 9B – PS3 input function selection SL / FO / SLV / EC

| | |
|---|---|
| **x00** | Bit 2 for selection of a fixed frequency (0–7); when this function is not selected, the bit is evaluated as Zero (see parameter 41–46) |
| **x01** | Selection of ramp set 2 (acceleration and deceleration time 2) |
| **x02** | Selection of customer parameter set 1 (see note 1, Page 2-97) |
| **x03** | Selection of customer parameter set 2 (see note 1, Page 2-97) |
| **x04** | Inverter disabling (coast to stop) |
| **x05** | DC braking. The inverter reverts to a mode in which it injects into the motor a DC voltage which results in deceleration of the motor (DC braking). In this case, the corresponding direct current is monitored so that, at maximum, the current specified by parameter **63 – DC brake current** is able to flow. The DC brake functions only as long as the output stages are enabled. This function may be selected only if parameter **2C – Application** has been programmed to value "0" or "2" |
| **x06** | Activation of LOCAL mode (see note 6, Page 2-99) |
| **x07** | No function |
| **x08** | Deactivation of the position controller |
| **x09** | Zero pulse search master setpoint (only active in the STOP state); see note 2, Page 2-98 |
| **x10** | No function |
| **x11** | No function |
| **x12** | No function |
| **x13** | No function |
| **x14** | Deactivation of the master encoder for the synchronous system |
| **x15** | Suppression of positive counting pulses of the master encoder for the synchronous system. Only negative counting pulses of the master are active |
| **x16** | Suppression of negative counting pulses of the master encoder for the synchronous system. Only positive counting pulses of the master are active |
| **x17** | Inversion of the counting pulses of the master encoder |
| **x18** | Reserved N/A |
| **x19** | Acknowledge error state (see note 5, Page 2-99) |
| **x20** | Reserved N/A |
| **0xx** | NO contact trips the selected function (see note 4, Page 2-99) |
| **1xx** | NC contact trips the selected function (see note 4, Page 2-99) |

**NOTE:**

The binary input PS3 must not be triggered during execution of a test mode of operation (see parameter 2A).

◊ Value range: see Table

Default Europe: 6
Default USA: 106

## NOTES ON PARAMETERS 98–9B:

**Note 1 – Changing the customer parameter sets:**

The UD 7000 features three equivalent parameter sets. Entered parameters and the results of measurements in the test mode are always only ever stored in the active parameter set (parameter **E9 – Customer parameter set**). Set 1 is active by default.

The active parameter set can be changed over either with the parameter **E9 – Customer parameter set** or with the aid of **binary inputs**. To this end, one of the binary inputs R/J, PS1–PS3 must be programmed to the corresponding function (see parameters 98–9B). Parameter sets can only be changed over in the stop state.

As one parameter set will be adequate for the majority of applications, it is possible to use the second or third one to back up the optimized settings. For further information, refer to the description of the parameters **E9 – Customer parameter set** and **EA – Application-dependent defaults** in Section 8.14 of this parameter description.

The parameter sets may contain diverse applications (parameter 2C). If, in the event of a parameter set change-over, the unit detects that the new set contains a different application, the inverter is restarted directly after the set change-over in order to adapt the inverter environment.

**ATTENTION!**

If the change in the parameter set also results in a change in the motor data, the application number or other important motor quantities (stator and rotor resistance or controller parameters etc.), this may lead to a situation in which the inverter loses control of the motor. This is why a safety function is integrated (parameter 8B) which deactivates the inverter output stages in any case after a stop command once a certain time has elapsed.

**Programming example: Switch-over of the set of parameters via 2 control inputs**

**HINT!**

It is recommended to adjust the actual set of parameters to the demands first and, if required, to switch from set of parameters 1 to set of parameters 2 and so on with the parameter E9 (do not use control inputs R/J, PS 1, PS 2, PS 3).

Only when all parameters in all needed set of parameters are set, the switch-over of the set of parameters with the control inputs R/J, PS 1, PS 2, PS 3 can be done according to the programming example of the following list.

2 of the 4 control inputs are needed for the call-up of the set of parameters (example R/J and PS 1):

| Terminal R/J | Parameter 98 | Klemme PS1 | Parameter 99 | Choice of set of parameters |
|---|---|---|---|---|
| **active-high** | 2 | **inactive** | 3 | 1 |
| **inactive** | 2 | **active-high** | 3 | 2 |
| **active-high** | 2 | **active-high** | 3 | 3 |

With smaller parameter differences between the single set of parameters, set 1 for example can be copied with parameter E9 (code 12) to set 2.

A changement on the binary inputs regarding the switch-over of sets of parameters is only passed on after 800 ms. This makes it possible to switch over from set 3 (both inputs active) to “no changement” (both inputs inactive) even with a slow control hardware without set 1 or set 2 being recognized.

**Programming example: Switch-over of 2 sets of parameters via 1 control input**

In this example, the binary input R/J is described. However this can be applied to any binary input. The actual set of parameters **has to be** set of parameter 1.

| Terminal R/J | Parameter 98 | Set of parameters 1 | Set of parameters 2 |
|---|---|---|---|
| inactive | 3 | active | |
| active-high | 102 | | active |

Course of the parameterisation, departing from the actual set of parameters 1:

- open input R/J (separate +24 V from input R/J).
- set parameter 98 to 3 (for set of parameter 1).
- close input R/J (wire the input with +24 V).
- set parameter 98 to102 (for set of parameters 2).

**Display of the active parameter set**

In the “stop state”, the active parameter set is shown in the standard display 1:

| | | |
|---|---|---|
| **REM** | **Stop** | **Set: 2** |
| **Set 23.45 Hz** | | **0%** |

When the parameters are displayed, the active parameter set is recognizable by the character between the parameter number and the value.

| PARAMETER SET | CHARACTER |
|---|---|
| 1 | : |
| 2 | = |
| 3 | # |

**EXAMPLE:**

| ... in customer parameter set 1 | ... in set 2 | ... in set 3 |
|---|---|---|
| **Maximum frequency** | **Maximum frequency** | **Maximum frequency** |
| **PROG 23: 100.0 Hz** | **PROG 23= 100.0 Hz** | **PROG 23# 100.0 Hz** |

The active parameter set is also correspondingly recognizable in standard display 2 (example with parameter set 2 active):

| | |
|---|---|
| **VIEW D5=** | **88.5 %** |
| **VIEW 9=** | **45.6 Hz** |

**Note 2 – Zero pulse search:**

This function is required for the “Electronic gearbox” application if the master setpoint has been specified using an encoder channel (see parameter **2A – Test mode**).

**Note 3 – Saving of parameter 33:**

The respectively reached value in parameter 33 is retained both in the STOP state and also on deactivation of the line.

**Note 4 – Contact type:**

The inputs are operated by means of switching contacts in conjunction with a certain reference potential. Whether the contact must be open or closed in order to trip the desired function is defined individually for the inputs R/J, PS1, PS2 and PS3 (the inputs FWD and REV can be activated only by closing of the contact). The reference potential is selected jointly for the inputs FWD, REV, R/J, PS1, PS2 and PS3 by means of parameter 9F, i.e. all contacts must be connected to the same reference potential.

**Note 5 – Acknowledge error state:**

An error state can be acknowledged through this input (see Chapter 8.17, “Error States”).

**Note 6 – Activation of LOCAL mode:**

**ATTENTION!**

If you switch over from LOCAL mode to REMOTE mode (see also parameter **9B – PS3 input function selection**), a Start command applied to the terminals is processed immediately if the motor is started. This may lead to death, injury or damage to equipment and installations.

**General note:**

**HINT!**

When several inputs are programmed to the same function, only the first of the applicable inputs is evaluated in the order R/J, PS1, PS2 and PS3. An input must be connected to the active level for at least 64 ms in order to ensure reliable activation of the selected function.

## 9C – Status of binary inputs (read-only) SL / FO / SLV / EC

The current level of the logical input signal is displayed. If SIO mode is not programmed (parameter **29 – Control mode**), these signals are generated from the levels of the device terminals, paying attention to the parameter **9F – High/Low active binary input selection**.

If SIO mode is programmed, the virtual terminals that are operable using the serial interface are used for this purpose (parameter **AD – Inverter control commands in SIO mode**).

The display is hexadecimal. Conversion to binary notation is illustrated with reference to the following example:

**0063**

| Display $_{Hex}$ | 0 | | | | 0 | | | | 6 | | | | 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary $_{Bin}$** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| **Bit No.** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Function** | Bits 15-8 are reserved for representing internal program information | | | | | | | | FWD | REV | R/J | Not used | Acknowledge error | PS3 | PS2 | PS1 |

Each bit has the same significance as the physical terminal of the same name in SIO mode. One exception is bit 3 “Acknowledge error” since there is no corresponding terminal on the inverter. This bit allows error messages pending on the unit to be acknowledged, as with keys PROG, SHIFT resp. ENTER on the display and operator-control unit (ABE).

◊ Value range: 0–$FFFF_H$

**9D – Status of binary outputs (read-only)** **SL / FO / SLV / EC**

The current level of the physical output signals is displayed. When the output ST4 is programmed to “Frequency output” (parameter 95), the corresponding bit is set to a fixed value.

The display is hexadecimal. Conversion to binary notation is illustrated with reference to the following example:

**00F9**

| **Display** $_{Hex}$ | 0 | | | | 0 | | | | F | | | | 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** $_{Bin}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| **Bit No.** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Function** | Bits 15-8 are reserved for representing internal program information | | | | | | | | Binary inputs High-active (parameter 9F) | Fan | Not used | REL | ST4 | ST3 | ST2 | ST1 |

◊ Value range: 0–$FFFF_H$

**9F – High/Low active binary input selection** **SL / FO / SLV / EC**

| | | |
|---|---|---|
| **0** | Active low | Switches must be connected to COM, internal pull-up resistor |
| **1** | Active high | Switches must be connected to +24 V, internal pull-down resistor |

Change-over takes place jointly for the inputs FWD, REV, R/F, PS1–PS3. Active high is selected if the switches are connected between the inputs and +24 Volt; Active low is selected if switches are connected to COM. Pull-up and pull-down resistors produce a defined potential at the terminals when the switch is open.

In the case of inputs R/J, PS1–PS3, it is possible to additionally select whether the desired function is tripped when the switch is opened or closed.

◊ Value range: see Table Default: 1

## 8.10 Group A – Analog Outputs/SIO

**A1 – Analog output MET1 selection** **SL / FO / SLV / EC – OE**

The following table applies to parameter A1 and A2.

| | MEANING | REMARK |
|---|---|---|
| **x0** | Actual value 1 from standard display 2 referred to parameter A6 | Maximum value of parameter A6 ***) |
| **x1** | Output frequency $f/f_{max}$ | Maximum value $f_{max}$ (parameter 23) |
| **x2** | Output voltage $V/V_n$ | Maximum value 100% |
| **x3** | Output current $I/I_n$ | Maximum value 200% |
| **x4** | Output torque $T/T_n$ | Maximum value 200% |
| **x5** | Output power $P/P_n$ | Maximum value 200% |
| **x6** | Line voltage $V_{line}$ | Maximum value 820 V |
| **x7** | DC link voltage $V_{DC\ link}$ | Maximum value 820 V |
| **x8** | Field-generating current $I_d/I_n$ | Maximum value 500% |
| **x9** | Torque-generating current $I_q/I_n$ | Maximum value 500% |
| **0x** | Output 0–10 V *) | MET 1 |
| **1x** | Output ±10 V | MET 1 |
| **0x** | Output 0–10 V **) | MET 2 |
| **1x** | Output 0–20 mA **) | MET 2 |
| **20** | Inactive | 0 V is output at the analog output |
| **21** | Reserved N/A | See Application description |

**NOTES:**

*) Negative values are output as an amount.

**) Negative values are output as Zero.

***) Each read-only parameter may be transferred to the standard display 2. The required read-only parameter must be selected for this purpose. Pressing keyboard short-cut SHIFT + ENTER (press key SHIFT first, hold it then press key ENTER) transfers the parameter to the upper position of the standard display 2. This shifts the parameter which was previously in the upper position to the lower position. The settings of standard display 2 are stored automatically in power-failsafe manner. An example is given for the parameter A6.

◊ Value range: see Table Default: 1

**A2 – Analog output MET2 selection** **SL / FO / SLV / EC – OE**

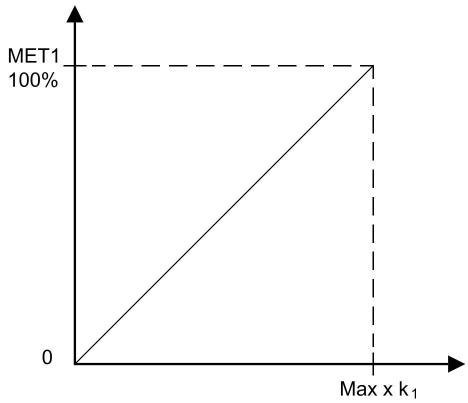
See parameter A1.

◊ Value range: see table under parameter A1 Default: 4

**A3 – MET1 factor** **SL / FO / SLV / EC – OE**

Scaling of the display output 1.
This parameter defines the amount of the maximum value of the display quantity for which 10 V is output at the “analog output 1”.

For example, if the inverter output current is displayed and this parameter is set to 50%, 10 V is output when the rated current is reached.




◊ Value range: 10.0–100.0% Default: 100.0%

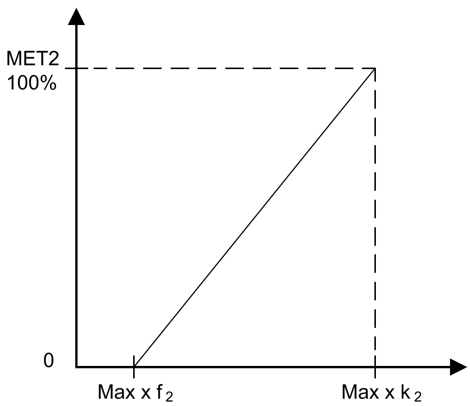
**A4 – MET2 factor** **SL / FO / SLV / EC – OE**

The same description as under parameter A3 applies analogously here.

◊ Value range: 10.0–100.0% Default: 100.0%

**A5 – MET2 offset** **SL / FO / SLV / EC – OE**

Calibration of the offset of display output 2.
The parameters define the amount of the maximum value of the display quantity for which 0 V and 10 V (or 0 mA and 20 mA) are output at the “analog output 2”.




◊ Value range: 0.0–100.0% Default: 0.0%

**A6 – Reference value for the analog output** **OE**

Setting of the displayed maximum value of analogue outputs MET1/MET2 if parameter A1 or A2 is set to value x0 “Actual value 1 from standard display 2”.

$$\text{Reference value} = \frac{\text{required maximum value}}{\text{resolution of the parameter to display}} \quad \text{e.g. } 1500 = \frac{150\%}{0.1\%}$$

**EXAMPLE:**

The actual value of the rotor frequency $f_{act.}$ (parameter 09) should be output signed at analogue input MET1. The required displayed maximum value should be 50 Hz:

Select parameter 09 (read-only parameter). First press key SHIFT, keep it pressed and then press key ENTER in order to display the actual frequency on the “standard display 2”. Enter value 10 in parameter A1. Enter value “500” in parameter A6 for the required displayed maximum value of 50 Hz since $f_{act.}$ is displayed with a resolution of 0.1 Hz (see formula). You can define whether the value to be output is also to be smoothed with parameter **A7 – Filtering time constant of displayed values in parameter group 0**.

◊ Value range: 0–32766 Default: 500

**A7 – Filtering time constant of displayed values in parameter group 0 SL / FO / SLV / EC – OE**

This parameter can be used to adapt the smoothing time constant of the display values in parameter group 0 (MET1/MET2 outputs). The longer a time is selected for this, the more stable will be the display of the value shown.

The parameter A7 is also important for a special function of the control outputs. See the description of parameter **8D – Reference value for load-dependent switching of control outputs**.

The value is represented exponentially in the form $2^x$ ms.

◊ Value range: 0–15 Default: 6 (corresponds to $2^6$ = 64 ms

**A8 – Baud rate SIO selection SL / FO / SLV / EC – OE**

**HINT!**

This parameter should be entered before commissioning the serial interface (SIO) to ensure communication between the inverter and control.

| | |
|---|---|
| **x0** | 110 baud |
| **x1** | 1200 baud |
| **x2** | 2400 baud |
| **x3** | 4800 baud |
| **x4** | 9600 baud |
| **x5** | 14400 baud |
| **x6** | 19200 baud |
| **x7** | 38400 baud |
| **x8** | 57600 baud |
| **x9** | 115200 baud |
| **1x** | Same as x0, x1, x2, but only read operation allowed |

**NOTE:** a change in this parameter value does not take effect until after the next power-on.

See also description: “UD 7000 – serial interface”.

◊ Value range: see Table Default: 4

**A9 – Slave address of the inverter for SIO operation SL / FO / SLV / EC**

For control through the serial interface, one of the addresses (0–31) must be assigned to each of the maximum number of 32 inverters.

Refer also to the description: “UD 7000 – serial interface”.

◊ Value range: 0–31 Default: 0

## AA – SIO protocol SL / FO / SLV / EC

**HINT!**

This parameter should be entered before commissioning the SIO to ensure communication between the inverter and control. The change in the parameter value does not take effect until after the next power-on.

| | |
|---|---|
| **0** | 7E1 (7 data bits, even parity, 1 stop bit) |
| **1** | 8N1 (8 data bits, no parity, 1 stop bit) |

See also description: “UD 7000 – serial interface”.

◊ Value range: see Table Default: 1

## AB – SIO operation time-out SL / FO / SLV / EC

Monitoring function (Watchdog function) for SIO communication. Each telegram received sets the watchdog counter to zero. If the counter reaches the value programmed at this point, error message “SIO timeout” is triggered.

The value 0 has the meaning: “No time-out monitoring”.

See also description: “UD 7000 – serial interface”.

◊ Value range: 0–60 s Default: 0 s

## AC – SIO operation error messages (read-only) SL / FO / SLV / EC

See also description: “UD 7000 – serial interface”.

The display is in hexadecimal notation. Conversion to the binary notation is illustrated with reference to the following example:

**80**

| **Display $_{Hex}$** | **8** | | | | **0** | | | |
|---|---|---|---|---|---|---|---|---|
| **Binary $_{Bin}$** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Bit No.** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Function** | Value range exceeded | Invalid write attempt (read only) | Unknown parameter | Invalid checksum | Reserved | Inverter is busy | Time-out | Not used |

**EXAMPLE:**

An 80 (hexadecimal value) is shown on the display. Determine the binary value using a pocket calculator which can convert hexadecimal values to binary values or with a table (see conversion table on Page 2-123 of this description). A “0” or a “1” must now be inserted for each error message (bits 7–0) in the order shown in the table above (starting from the left). Digit “0” corresponds to “no error occurred” and digit “1” corresponds to “error occurred”. The binary number in this example “1000 0000” (the “1” at the 1st position from the left (bit 7) stands for error message “Value range exceeded” (see table above). This means that this error has occurred in SIO mode.

◊ Value range: 0–$FF_H$

**AD – Inverter control commands in SIO mode** **SL / FO / SLV / EC – SC**

This parameter provides virtual terminals with which the inverter can be controlled in SIO mode. In the SIO mode, each bit has the same function as a physical terminal.

See also description: “UD 7000 – serial interface”.

The display is shown in hexadecimal notation. Conversion to binary notation is shown by way of the following example and explained analogously for parameter 97 (Page 2-92).

**12**

| Display $_{Hex}$ | 1 | | | | 2 | | | |
|---|---|---|---|---|---|---|---|---|
| Binary $_{Bin}$ | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Function | FWD | REV | JOG | Not used | Not used | PS3 | PS2 | PS1 |

◊ Value range: 0–$FF_H$ Default: 0

## 8.11 Group B – Speed Controller

**HINT!**

Group barred in the case of sensorless and V/f-controlled mode.

**B1 – Speed controller gain** **FO / SLV / EC – OE**

See description under parameter B2.

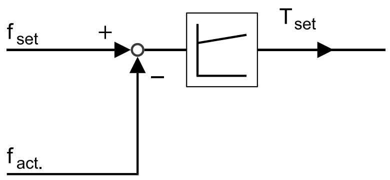
◊ Value range: 0–10000 Default: 100

◊ Value range *SLV*②: 0–10000 Default: 20

**B2 – Reset time of speed controller** **FO / SLV / EC – OE**

A PI controller is implemented as the speed controller. The speed controller computes the torque needed to reach the speed setpoint. The calculations are done with the frequency instead of the speed.

Parameter B1 is the P component (P gain). Increasing this parameter increases the gain. Parameter B2 is the I component (integral-action time resp. reciprocal of the I gain). Increasing it prolongs the integral-action time, i.e. the controller operates more slowly.




$f_{set}$ – Rotation frequency setpoint.
$f_{act.}$ – Rated rotation frequency.
$T_{set}$ – Torque setpoint.
$T_{act.}$ – Rated motor torque.

**HINT!**

The parameter **72 – Ramp function selection** should be programmed to "Ramp function off" for highly dynamic applications. For ***SLV***② applications, it is advisable to use short ramps without an S shape.

◊ Value range: 1–30000 ms Default: 500 ms

**B3 – Speed controller gain boosting factor FO / SLV / EC – OE**

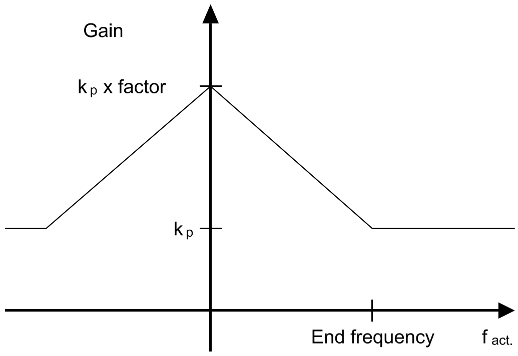
The functions of these two parameters are explained under parameter B4 by means of a graphic.

◊ Value range: 1.0–5.0 Default: 1.1

**B4 – Speed controller gain boosting end frequency FO / SLV / EC – OE**

To be able to balance out disturbances more dynamically in the lower speed range, the controller gain can be boosted in this range. Below the frequency value defined by the parameter B4, the controller gain is boosted, rising in linear fashion up to speed Zero. Attention must be paid to the fact that the motor is subjected to a higher thermal load as the result of boosting of the controller gain. It is therefore advisable to observe the temperature development after boosting the gain.

The speed controller p-gain is boosted in the lower speed range from a frequency of 0 Hz up to this frequency.




**NOTES:** in ***SLV***② applications in the field attenuation range, the parameter B4 can be programmed to the same value as the knee frequency in order to operate with lower gains in the field attenuation range.

In V/Hz-controlled operation, this parameter is not visible.

◊ Value range: 0.0–100.0 Hz Default: 0.0 Hz

## B5 – Holding control FO / EC

Holding control is activated and deactivated.
Holding control serves the purpose of drift-free holding of positions, particularly at low speeds or at Zero speed in speed-controlled mode, regardless of the applicable load torque.

| | |
|---|---|
| **0** | Off |
| **1** | On |

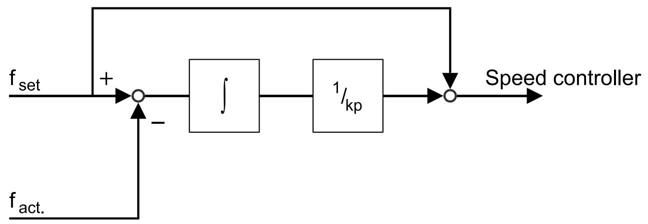
**NOTE:** this parameter is not visible during ***SLV***② and V/Hz-controlled operation.

◊ Value range: see Table Default: 0

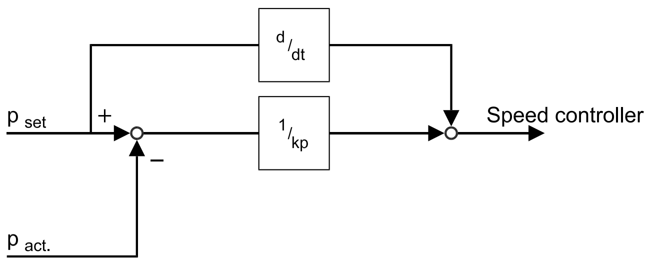
## B7 – Specific holding controller following error FO / EC – OE

This parameter is active in the following modes of operation:

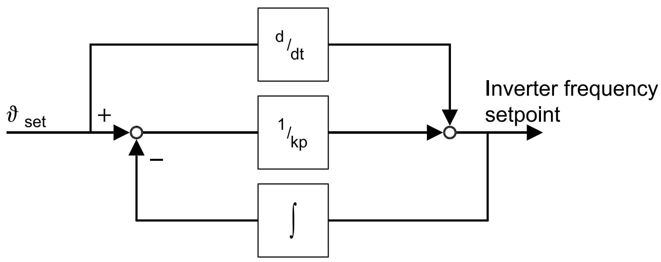
- Speed control with activated holding control for the holding controller.
- Electronic gearbox for the angle controller.
- Brushless servo inverter.




**Holding control**




**Angle control**




**Brushless servo inverter running**

$k_p$ – Specific following error in revolutions/Hz.

Pilot control serves to reduce the following error in the event of abrupt setpoint changes. If the holding control is to be used mainly to apply holding torques, $k_p$ can remain at Zero. A value around 100% should be selected for an undelayed reaction to abrupt setpoint changes.

**NOTE:** this parameter is not visible in the ***SLV***② and the V/Hz-controlled modes.

◊ Value range: 0.001–32.000% Default: 0.100%

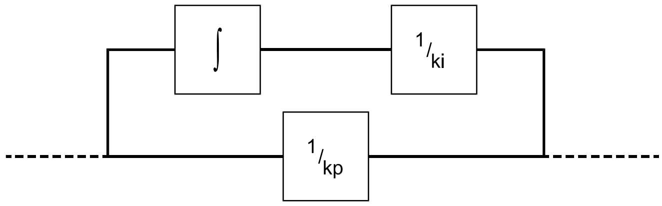
## B8 – Specific position control reset time FO / EC

This parameter adds an integral component to the position control whenever required. This is generally only needed for exact adjustment of target positions.

It is specified in the form $2^x$, i.e.:

$$1 \rightarrow \frac{t_N}{t_A} = 2;\ 2 \rightarrow \frac{t_N}{t_A} = 4;\ 3 \rightarrow \frac{t_N}{t_A} = 8;\ \ldots,\ 15 \rightarrow \frac{t_N}{t_A} = 32768$$

The parameter value Zero switches off the integral component.




**ATTENTION!**

A position controller with an integral component tends to oscillate. This parameter should therefore preferably be set to Zero or 15 ($2^{15}$ = 32768) to either deactivate the function or to operate with a very long reset time. Other values should only be selected if urgently called for by the application.

**NOTE:** this parameter is not visible in the ***SLV***② and in the V/Hz-controlled modes.

◊ Value range: 0–15 Default: 0

## BA – Resolver pole pair number FO / EC

**Only when the resolver option is fitted.**

Pole pair number of the resolver used.

The correctness of the entry can be checked in the parameter **BB – Motor shaft angle**.

**NOTE:** this parameter is not visible in the ***SLV***② mode.

◊ Value range: 1–20 Default: 1

## BB – Motor shaft angle (read-only) FO / EC

Display of the motor shaft angle from 0–360°. The measured angle, the correctness of the entries in the parameter **BA – Resolver pole pair number** and parameter **BD – Angle sensor direction of rotation** can be checked with reference to this display. In the case of a positive direction of rotation of the motor, the angle per revolution is counted once upwards from 0–360°.

**NOTE:** this parameter is not visible in the ***SLV***② and in the V/Hz-controlled modes.

## BC – Angle sensor installation offset FO / EC

It is imperative to determine the correct value of this parameter for EC motors if installation is not aligned.

It is sufficient to determine the offset once after installation. There are two possibilities of doing this:

1. Manual measurement and entry of the value in the parameter.

2. Determination by the inverter by setting the parameter **2A – Test mode** to the "Determine installation offset" function. In this case, the value is entered automatically and permanently after completion of the measurement. The parameter **2A – Test mode** can then be set back to "normal operation" when using an absolute value sensor (e.g. a resolver with the suitable pole pair number). When using an encoder, it is generally necessary to determine the value after every power-on.

**NOTE:** this parameter is not visible in the ***SLV***② and in the V/Hz-controlled modes.

◊ Value range: $8000–7FFF_H$ Default: $0000_H$

**BD – Angle sensor direction of rotation FO / EC**

It is imperative to determine the correct direction of rotation if installation is not aligned.

It is sufficient to determine the direction of rotation once after installation.

There are two possibilities of doing this:

1. Manual determination and entry of the value in the parameter.
2. Determination by the inverter by setting the parameter **2A – Test mode** to the "Determine installation offset" function. In this case, the direction of rotation is automatically entered permanently after termination of the measurement and together with the installation offset. The parameter **2A – Test mode** can then be set back to "normal operation".

| | |
|---|---|
| **0** | Angle sensor rotating in the same direction as the motor |
| **1** | Angle sensor rotating in the opposite direction to the motor |

The entry can be checked in the parameter **BB – Motor shaft angle**.

**NOTE:** this parameter is not visible in the ***SLV***② and in the V/Hz-controlled modes.

◊ Value range: see Table Default: 0

**BE – Number of encoder lines FO / EC**

**Only when the encoder option is fitted.**

Number of lines of the encoder used for speed or position feedback.

For the "Electronic gearbox" application, the number of lines of the master encoder must be programmed in the parameter **36 – Pulse number of LIM input**.

**NOTE:** this parameter is not visible in the ***SLV***② and in the V/Hz-controlled modes.

◊ Value range: 1–16384 Default: 1024

**BF – Resolver measured angle (read-only) FO / EC**

This parameter indicates the measured angle of the resolver evaluation electronics. It is displayed in hexadecimal notation in $0–FFFF_H$ increments within one resolver pole division.

**Examples:**

Resolver pole pair number: 1, display $8000_H \Rightarrow$ motor shaft angle: 180°.
Resolver pole pair number: 2, display $C000_H \Rightarrow$ motor shaft angle: 135°.

**NOTE:** this parameter is not visible in the ***SLV***② and in the V/Hz-controlled modes.

## 8.12 Group C – Stepper Control

The Berges inverter UD 7000 features a simple step-by-step control allowing simple function sequences to be implemented by the inverter itself as a function of programmable boundary conditions (e.g. as a function of the status of the binary inputs).

The step-by-step control is a special application and is thus not described in greater detail in this Manual.

**C2 – Enable step-by-step control application**

This parameter activates/deactivates step-by-step control.

| | |
|---|---|
| **0** | No enable (normal mode) |
| **1** | Enable step-by-step control |

◊ Value range: see Table — Default: 0

**NOTE:** if step-by-step control is enabled, other parameters are shown in group C. These parameters are not documented in this Manual. An application description for step-by-step control is available on request.

## 8.13 Group D – Options

**D1 – Option number (read-only)** **SL / FO / SLV / EC**

This parameter contains the number of the option board detected by the inverter. The option is detected automatically when the unit starts.

| | |
|---|---|
| **3** | Option Resolver evaluation |
| **7** | Option 2-channel encoder evaluation with Sub-D connectors |
| **11** | Option 2-channel encoder evaluation with screw terminals |
| **25** | No option |

**NOTE:** the options “Optical waveguide” and “I/O extension” do not appear in this parameter.

**D2 – Zero pulse search frequency** **FO / EC**

This parameter defines the frequency that is used when programming the “Zero pulse search” test mode (parameter 2A) for this function.

**NOTE:** the parameter is displayed only if an application with rotational speed feedback is selected and an encoder option card is detected.

◊ Value range: 0.1–100.0 Hz — Default: 0.5 Hz

**D3 – Zero angle** **FO / EC**

This parameter defines the angle that is assigned to the position of the front edge of an encoder's Zero pulse. Therefore, when using a position control, e.g. the “Electronic gearbox” application, the Zero point of the reference system can be defined.

**NOTE:** the parameter is displayed only if an application with rotational speed feedback is selected and an encoder option card is detected.

◊ Value range: –180.0–180.0° — Default: 0.0°

**D4 – Total stray factor σ (read-only)** **SLV**

The total leakage factor σ is used by the inverter in the *SLV*② model. It is computed from the parameter **F7 – Main reactance $X_h$** and the parameter **F5 – Leakage reactance Xσ**. If the total leakage factor s for the motor used is known and the value for the magnetising reactance $X_h$ is adapted (see Section 6.8, “Commissioning an SLV Application”), it is possible to select the correct total leakage factor σ by correcting parameter **F5 – Leakage reactance Xσ**.

◊ Resolution: 0.01% Default: –

**D5 – Actual value of the field-generating current component $i_d$ (read-only)** **SL / FO / SLV / EC**

In the field-orientated coordinate system, $i_d$ is the field-generating current component. The ratio $i_d/I_{d,nom}$ thus describes the degree of magnetisation of the motor.

◊ Resolution: 0.01% Default: –

**D6 – Actual value of the torque-generating current component $i_q$ (read-only)** **SL / FO / SLV / EC**

In the field-orientated coordinate system, $i_q$ is the torque-generating current component. The ratio $i_q/I_{q,nom}$ describes the load utilisation of the motor. With field attenuation, the ratio $i_q/I_{q,nom}$ = 100% at nominal motor load.

◊ Resolution: 0.01% Default: –

**D7 – Setpoint of the torque-generating current component $i_{q,set}$ (read-only)** **SL / FO / SLV / EC**

Percentage setpoint of the torque-generating current component (referred to the nominal working point of the machine).

◊ Resolution: 0.01% Default: –

**D8–DF – (application-dependent)**

Parameters D8–DF are application-dependent parameters. Only if an application (parameter 2C) uses one of these parameters do you receive a parameter name, factory default settings and inputs limits. These parameters are described only in the corresponding application descriptions.

## 8.14 Group E – Service Data II

**E1 – Realised acceleration time (read-only)** **SL**

**E2 – Realised deceleration time (read-only)** **SL**

Display of the times measuring during the last acceleration or deceleration operations. After power-on, the values of ramp set 1 are displayed.

**NOTE:** these parameters are not displayed when operating with speed control.

**E3 – Frequency factor (read-only)** **SL / FO / SLV / EC**

This parameter defines a factor in percentage by which the frequency setpoint is multiplied.

This read-only parameter is identical with parameter 33 and creates the possibility of adopting the frequency factor in the standard display 2.

**E4 – Software version (read-only)** **SL / FO / SLV / EC**

Version number of the device software. The number consists of a version number and a subnumber (e.g. 19.00). The complete version number is also contained in the start display, which is shown on the display every time the inverter is activated.

◊ Value range: 0.00–327.99

**E5 – Lifetime (read-only)** **SL / FO / SLV / EC**

Display of the unit's running time in hours.

**E6 – On time (read-only)** **SL / FO / SLV / EC**

Display of the time since the last power-on in hours.

**E7 – Enabling time (read-only)** **SL / FO / SLV / EC**

Amount of the lifetime during which the power output stage was enabled (start) in hours.

**E8 – Inverter status (read-only)** **SL / FO / SLV / EC**

Binary affiliation of the inverter status:

The display is in hexadecimal notation. The display is explained by way of the following example.

**1007**

| Display $_{Hex}$ | 1 | | | | 0 | | | | 0 | | | | 7 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary $_{Bin}$** | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| **Bit No.** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Function** | Field build-up time running | Test mode active | SIO mode | REMOTE mode | LOCAL mode | Inverter operating on the DC bus | Trap motor | Load limit | Slow-down | Start-up | Nominal direction of rotation, left (reverse) | Jog mode | DC brake | Output stage enabled | ST (1) | BB (2) |

(1) ST – Start command issued (FWD or REV).
(2) BB – Inverter ready (no error).

**EXAMPLE:**

A 1007 (hexadecimal value) is shown on the display. Determine the binary value with the aid of a pocket calculator which can convert hexadecimal numerical values to binary values or with a table (see conversion table on Page 2-123 of this description). Now enter a “0” or a “1” for each display option (bit 15 to bit 0) in the order shown in the table above (starting from the left). Digit “0” corresponds to “function not activated” and digit “1” corresponds to “function activated”. The binary number in this example “0001 0000 0000 0111” (the “1” at 4th position from the left stands for function “REMOTE mode”, at 14th position stands for “Output stage enabled”, at 15th position stands for “ST” and at 16th position stands for “BB” (see the table above). The means that the inverter is in REMOTE mode, the output stages are activated, a Start command has been issued and the inverter is running trouble-free.

◊ Value range: 0–$FFFF_H$

## E9 – Customer parameter set SL / FO / SLV / EC

This parameter contains the number of the current parameter set (1, 2 or 3). Parameters are always stored in the displayed parameter set in input mode. The parameter set is changed after input of the changed number. Change-over by means of parameter input is possible in stop condition only.

This parameter also permits copying of customer parameter sets into each other (1, 2 or 3).

| | |
|---|---|
| **1** | Customer parameter set 1 |
| **2** | Customer parameter set 2 |
| **3** | Customer parameter set 3 |
| **12** | Copy the customer parameter set 1 ⇒ 2 |
| **13** | Copy the customer parameter set 1 ⇒ 3 |
| **21** | Copy the customer parameter set 2 ⇒ 1 |
| **23** | Copy the customer parameter set 2 ⇒ 3 |
| **31** | Copy the customer parameter set 3 ⇒ 1 |
| **32** | Copy the customer parameter set 3 ⇒ 2 |

◊ Value range: see Table Default: 1

**EXAMPLE:**

The inverter is running with the current parameter set 1. You would like to change some parameters in order to optimise the system. To do this it is necessary to select function 12 or 13. The parameters of customer parameter set 1 are then copied to parameter set 2 or 3. The required changes can now be made by selection of parameter set 2 or 3. If these changes should not improve the interaction of inverter/motor, then operation is guaranteed again by simply selecting parameter set 1.

**NOTE:** the parameter set can also be changed by means of binary inputs. For this purpose it is necessary to program one of the binary inputs R/J, PS1–PS3 to the corresponding function in each case (see also parameter 98–9B). The following points must be observed:

- Evaluation of the binary inputs takes place statically.
- Change-over by means of binary inputs is also possible only in stop condition.
- A parameter input (set change) does not have any effect if such a binary input is active.
- The last active parameter set is loaded automatically when the system is switched on again after line power off.

The parameter sets may contain diverse applications (parameter 2C). If, in the event of a parameter set change-over, the unit detects that the new set contains a different application, the inverter is restarted directly after the set change-over in order to adapt the inverter environment.

**ATTENTION!**

If the change in the parameter set also results in a change in the motor data, the application number or other important motor quantities (stator and rotor resistance or controller parameters etc.), this may lead to a situation in which the inverter loses control of the motor. This is why a safety function is integrated (parameter 8B) which deactivates the inverter output stages in any case after a stop command once a certain time has elapsed.

## EA – Application-dependent defaults SL / FO / SLV / EC

The customer parameter sets are loaded with default values. Settings for Europe and the USA are possible as default values. The settings for Europe and the USA are required to permit adaptation to the respective network conditions and usual motor series.

The parameters are reset the next time the unit is switched on. After loading of the default values, this parameter is set automatically to zero. In addition, the step control parameters C4–CB can be reset.

**ATTENTION!**

The UD 7000 features a wide variety of special applications offering solutions to special problems of drive engineering. Our Sales Division will be more than willing to inform you of applications available for the UD 7000. Never activate an application for which you do not have an application description. All functions described in this Manual apply only to the applications listed in this Manual.

| PRESETTINGS FOR EUROPE (400 V/50 HZ) | |
|---|---|
| **0** | No function |
| **1** | Customer parameter sets 1, 2 and 3 are loaded with Europe default values at the next start |
| **3** | Customer parameter set 1 is loaded with Europe default values at the next start |
| **4** | Customer parameter set 2 is loaded with Europe default values at the next start |
| **5** | Customer parameter set 3 is loaded with Europe default values at the next start |
| **6** | Step control C4–CB is cleared at the next start |
| **50** | Customer parameter set 1 is loaded with Europe presettings for application 50 (sensorless speed control *SLV*②) |
| **51** | Customer parameter set 1 is loaded with Europe presettings for application 51 (sensorless torque control *SLV*②) |

| PRESETTINGS FOR USA (460 V/60 HZ) | |
|---|---|
| **0** | No function |
| **-1** | Customer parameter sets 1, 2 and 3 are loaded with USA default values at the next start |
| **-3** | Customer parameter set 1 is loaded with USA default values at the next start |
| **-4** | Customer parameter set 2 is loaded with USA default values at the next start |
| **-5** | Customer parameter set 3 is loaded with USA default values at the next start |
| **6** | Step control C4–CB is cleared at the next start |
| **-50** | Customer parameter set 1 is loaded with USA presettings for application 50 (sensorless speed control *SLV*②) |
| **-51** | Customer parameter set 1 is loaded with USA presettings for application 51 (sensorless torque control *SLV*②) |

◊ Value range: see Table Default: 0

**EB – Inverter status 2 (read-only)** **SL / FO / SLV / EC**

Binary affiliation of the inverter status.

The display is shown in hexadecimal notation. Conversion to binary notation is shown by way of the following example and explained analogously with parameter E8.

**1007**

| **Display** $_{Hex}$ | 1 | | | | 0 | | | | 0 | | | | 7 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** $_{Bin}$ | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| **Bit No.** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Function** | Internal status signals | | | | | | Encoder Zero pulse search running | Xσ measurement running | Installation offset determination running | R1 measurement running | Braking resistor control | Load limit (briefly) | U-DC control active | Drive running | FE (1) | AO (2) |

(1) FE – Fatal error.
(2) AO – Autostart condition not met.

◊ Value range: $0000_H$–$FFFF_H$ Default: –

**EC – Standard display** **SL / FO / SLV / EC**

Display of the number of the current standard display (1 or 2).

The standard display is normally selected in the REMOTE mode with the ▲ and ▼ keys.

Using this parameter, the standard display can also be switched over in the LOCAL mode.

◊ Value range: 1–2 Default: 1

## 8.15 Group F – Service Data III

**F1 – Rated inverter power (read-only)** **SL / FO / SLV / EC**

Display of the inverter's rated power in kW for service purposes.

**F2 – Power failure filter** **SL / FO / SLV / EC – OE**

If a line undervoltage occurs, fault 1 “Min. net voltage” is tripped after the time determined by this parameter has elapsed. The further behaviour of the inverter is determined by parameter **74 – Power failure response**.

◊ Value range: 0.000–20.000 s Default: 0.040 s

## F3 – Stator resistance R1 SL / FO / SLV / EC

Stator resistance in Ω.
The stator resistance is measured by the inverter after the parameter **2A – Test mode** has been programmed to "Measure stator resistance". During measurement, a direct current is impressed. The previous value of the parameter remains unchanged if measurement is unsuccessful.

When this parameter is entered and modified, the following parameters are recalculated:

Parameter F5 – Leakage reactance Xσ
Parameter F7 – Main reactance $X_h$
Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

**HINT!** Only a correct value that matches the motor used guarantees good leakage behaviour of the inverter. For example, functioning of the BOOST, speed estimation or control dynamics depends on this value.

◊ Value range: 0.00–50.00 Ω

Default Europe: see Table 8.6
Default USA: see Table 8.7
(see also parameter EA)

## F4 – Rotor resistance R2 SL / FO / SLV / EC

Rotor resistance in Ω.
The rotor resistance is measured by the inverter after the parameter **2A – Test mode** has been programmed to "Measure stator resistance and leakage inductance". The previous value of the parameter remains unchanged if measurement is unsuccessful.

When this parameter is entered and modified, the following parameters are recalculated:

Parameter F7 – Main reactance $X_h$
Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

**HINT!** Only a correct value that matches the motor used guarantees good leakage behaviour of the inverter. For example, functioning of the BOOST, speed estimation or control dynamics depends on this value.

◊ Value range: 0.00–50.00 Ω

Default Europe: see Table 8.6
Default USA: see Table 8.7
(see also parameter EA)

## F5 – Leakage reactance Xσ SL / FO / SLV / EC

Leakage reactance at rated motor frequency (parameter 12) in Ω.
The leakage reactance is measured by the inverter when the parameter **2A – Test mode** is programmed to "Measure stator resistance and leakage inductance". The previous value of the parameter remains unchanged if measurement is unsuccessful.

When this parameter is entered and modified, the following parameters are recalculated:

Parameter F7 – Main reactance $X_h$
Parameter F8 – Current controller gain
Parameter F9 – Specific current controller reset time

**HINT!** Only a correct value that matches the motor used guarantees good leakage behaviour of the inverter. For example, functioning of the BOOST, speed estimation or control dynamics depends on this value.

| EUROPE 400 V MOTOR | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_{n\ inverter}$ [kW] | | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 | 7.5 | 11.0 | 15.0 | 18.5 | 22.0 | 30.0 | 37.0 | 45.0 | 55.0 |
| R1 [Ω] | Parameter F3 | 6.10 | 4.00 | 2.40 | 1.58 | 1.10 | 0.68 | 0.41 | 0.29 | 0.21 | 0.16 | 0.11 | 0.09 | 0.07 | 0.05 |
| R2 [Ω] | Parameter F4 | 3.80 | 2.50 | 2.00 | 1.10 | 0.69 | 0.50 | 0.26 | 0.19 | 0.14 | 0.11 | 0.08 | 0.06 | 0.05 | 0.04 |
| $X_{Sigma}$ [Ω] | Parameter F5 | 4.25 | 3.24 | 2.59 | 2.44 | 1.64 | 1.16 | 0.91 | 0.75 | 0.53 | 0.45 | 0.35 | 0.29 | 0.25 | 0.32 |

Table 8.6

| USA 460 V MOTOR | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_{n\ inverter}$ [kW] | | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 | 7.5 | 11.0 | 15.0 | 18.5 | 22.0 | 30.0 | 37.0 | 45.0 | 55.0 |
| R1 [Ω] | Parameter F3 | 3.83 | 2.36 | 1.95 | 1.53 | 0.67 | 0.37 | 0.26 | 0.21 | 0.21 | 0.13 | 0.09 | 0.08 | 0.06 | 0.05 |
| R2 [Ω] | Parameter F4 | 2.90 | 1.73 | 1.42 | 1.53 | 0.57 | 0.34 | 0.26 | 0.15 | 0.15 | 0.12 | 0.07 | 0.06 | 0.05 | 0.04 |
| $X_{Sigma}$ [Ω] | Parameter F5 | 5.79 | 4.94 | 3.88 | 2.82 | 2.01 | 1.85 | 1.39 | 0.86 | 0.85 | 0.81 | 0.79 | 0.62 | 0.50 | 0.32 |

Table 8.7

**NOTE:**

The default values depend on the power of the inverter.

◊ Value range: 0.00–50.00 Ω — Default Europe: see Table 8.6; Default USA: see Table 8.7 (see also parameter EA)

## F6 – Rotor time constant setting — SL / FO / SLV – OE

This parameter serves to adjust the rotor time constant within the scope of field-oriented control of an induction motor. The value determined by the inverter on the basis of the motor's rated data corresponds to 100% (default).

If the manufacturer data or the measured motor data deviates excessively from the real motor parameters, this may lead to a situation in which the drive does not issue the full torque. In this case, it may be necessary to adapt this parameter.

**NOTE:** this parameter is irrelevant when using a brushless servo motor.

◊ Value range: 0.0–250.0% — Default: 100.0%

## F7 – Main reactance $X_h$ — SLV

Main reactance $X_h$ (unit: Ω) of the connected asynchronous motor at nominal motor frequency.

The ***SLV***② applications use a motor model in which the main reactance $X_h$ from the single-phase equivalent circuit of the asynchronous motor is included. The main reactance $X_h$ is computed from the ***SLV***② model from the values for the stator resistance R1 (parameter F3), the motor data (parameter group 1) and the measured results from Test mode. A change of R1, R2, Xσ and the motor parameters (by parameter entry) results in re-computation of this parameter. If a Test mode is run, this parameter is recomputed only if a measurement of the leakage inductance is also conducted.

This parameter influences the magnetisation current consumption of the machine. Correct setting of this parameter can be checked with the drive operating by means of parameter D5. This should be virtually 100% over the entire rotational speed range.

**NOTE:** this parameter is only display in ***SLV***② applications.

◊ Value range: 0.00–327.67 Ω — Default: 30.00 Ω

## F8 – Current controller gain — FO / SLV / EC – OE

## F9 – Specific current controller reset time — FO / SLV / EC – OE

The parameter **F8 – Current controller gain** and the parameter **F9 – Specific current controller reset time** have the following meanings:

$$\text{Gain } k_p = \frac{V_{x,\,Set}}{\Delta i}$$

$$\text{Specific reset time } k_i = \frac{t_N}{t_A}\left(\text{sampling time } t_A = \frac{1}{f_{PWM}}\right)$$

One PI controller each for the d and q components is implemented as the current controller. The current controller calculates the voltage needed to reach the respective current set-point.

$$V_{Set} = \Delta i \times k_p + \frac{I(n-1)}{k_i}$$

$V_{set}$ – Output voltage in the d or q axis.
$I_{(n)}$ – Integral component at the time n.
$\Delta i$ – System deviation in the d or q axis.
$k_p$ – Gain (P factor).
$k_i$ – Specific reset time.

**NOTES:**

Parameters F8 and F9 are dependent on a wide variety of boundary conditions: on the entered nominal motor current, the PWM frequency, the motor parameters determined during the test run or entered by hand (F3–F7) and, not least, the selected application.

Consequently, these parameters should be optimized manually only if all motor data, the PWM frequency and the parameters F3 to F7 have been entered correctly and the test run (parameter 2A) has been performed successfully.

**NOTE:** these parameters are not displayed in the case of V/f applications.

◊ Value range parameter F8: 0.00–250.00 Ω — Default: 1.00 Ω

◊ Value range parameter F9: 10–30000 — Default: 50

## FA – Dead time compensation — SL / FO / SLV / EC – OE

This parameter switches compensation of voltage errors resulting from switching dead times on/off.

As the voltage emitted by the inverter drops clearly when dead time compensation is off, it is advisable not to modify the default setting.

| | |
|---|---|
| **0** | Off |
| **1** | Inverter, ***SLV***②: On; EC/FO: Off |
| **2** | On |

◊ Value range: see Table — Default: 1

## FB – PWM frequency slaving — SL / FO / SLV / EC

To improve the running characteristics of the machine at low speeds, the PWM frequency can be slaved automatically to the frequency setpoint. In this case, increased noise may occur at low speeds.

| | |
|---|---|
| **0** | PWM frequency is not auto-adjust to the output frequency. The value in parameter **79 – PWM frequency** is used as the PWM frequency. |
| **1** | PWM frequency is auto-adjust to the output frequency. This amounts to 1000 times the frequency setpoint, but at least 2 kHz, and no more than the value selected in parameter **79 – PWM frequency**. |

◊ Value range: see Table — Default: 0

## FC – Ramp acceleration control (torque) — SL

This parameter switches torque-dependent acceleration control of the frequency ramp on/off. Acceleration control corresponds to dynamic torque limiting (see also parameter **5F – Gain ($V_{Rm}$), acceleration control (ramp), torque**.

| | |
|---|---|
| **0** | Off |
| **1** | On |

**NOTE:** this parameter is not relevant during operation with speed control and *SLV*②.

◊ Value range: see Table — Default: 1

## FD – Torque limiting — SL

This parameter allows torque limitation to be activated or deactivated.

In V/f-controlled mode, there is not the option of direct torque limitation (reduction in current), as in FO, *SLV*② or EC operating mode (application), so that the system establishes a rotational speed corresponding to the load. In application 0, the rotational speed is reduced when the torque limit is reached (parameter setting) assuming that the load torque will also drop as the rotational speed drops.

| | |
|---|---|
| **0** | Off |
| **1** | On |

**NOTE:** this parameter is not relevant during operation with speed control and *SLV*②.

◊ Value range: see Table — Default: 1

## FE – Excitation (read-only) — SL / FO / SLV / EC

Display of the current setpoint for the excitation of the motor in percent of its nominal excitation. The value is always 100%. It is not reduced until entry into the field-attenuation range.

Reference value: nominal excitation of the motor.

**NOTE:** the “Min.excitation” warning is issued if the field setpoint is controlled down to the minimum value defined in parameter **6C – Minimum excitation**.

## 8.16 Group 0 – Service Data I

**01 – Output frequency (read-only)** **SL / FO / SLV / EC**

Display of the inverter's output frequency = motor's stator frequency.

◊ Resolution: 0.1 Hz

**02 – Output voltage (read-only)** **SL / FO / SLV / EC**

Display of the inverter's output voltage.

Reference variable:
Inverter – Rated voltage of the motor.
EC/FO – Line voltage.

◊ Resolution: 1%

**03 – Output current (read-only)** **SL / FO / SLV / EC**

Display of the inverter's output current (rms value).

◊ Resolution: 0.1 A

**04 – Output torque (read-only)** **SL / FO / SLV / EC**

Display of the inverter's output torque.

Reference variable: rated torque of the motor.

◊ Resolution: 0.1%

**05 – Output power (read-only)** **SL / FO / SLV / EC**

Display of the inverter's output power.

Reference variable: rated power of the motor.

◊ Resolution: 0.1%

**06 – Line voltage (read-only)** **SL / FO / SLV / EC**

Display of the line voltage (Rms value of the external line conductor tension).

◊ Resolution: 1 V

**07 – DC link voltage (read-only)** **SL / FO / SLV / EC**

Display of the DC link voltage value.

◊ Resolution: 1 V

**09 – Actual frequency (read-only)** **SL / FO / SLV / EC**

Display of the actual rotor rotation frequency that has been measured or determined by the motor model.

◊ Resolution: 0.1 Hz

**0A – Heat sink temperature (read-only)** **SL / FO / SLV / EC**

Display of the inverter's heat sink temperature.

◊ Resolution: 1 °C

**0B – Error 1 (read-only)** **SL / FO / SLV / EC**

**0C – Error 2 (read-only)** **SL / FO / SLV / EC**

**0D – Error 3 (read-only)** **SL / FO / SLV / EC**

**0E – Error 4 (read-only)** **SL / FO / SLV / EC**

**0F – Error 5 (read-only)** **SL / FO / SLV / EC**

Display of the error numbers pertaining to the last occurring errors (Error 1: youngest error in the Error memory; Error 5: oldest error).

**HINT!**

Error 0 (Emergency-Stop), 1 (AC Line voltage to low), 10 (DC Bus voltage to low), 11 (Option), 12 (Autostop), 13 (SIO timeout) and 15 ($I^2t$ monitoring) are not stored in the history.

## 8.17 Error States

**HINT!**

If the PROG, SHIFT or ENTER key is pressed, the message is reset on the ABE (display and operator-control unit). Acknowledgement of the error message does not cancel the cause of the error. Errors may be also still be pending after reset.

### 8.17.1 Normal Handling of Error States

In certain circumstances, the inverter may assume an error state. The occurrence of such a state can be reported through relay or transistor outputs (parameters 92–96, setting x01). The output is activated if an error occurs. When the cause of the error disappears, the error signalling output becomes inactive with deactivation of drive enabling; the drive is ready for operation.

### 8.17.2 Handling of Error States with the “Acknowledge Error State” Function

When a binary input R/J, PS1–PS3 is programmed with the “Acknowledge error state” function, an error state always continues to exist until the cause of the error has been remedied, drive enabling has been cancelled and the binary input “Acknowledge error state” is activated. Thus, in a system with several inverters, it is possible to cancel all drive enabling signals in the event of a malfunction occurring and to nevertheless locate the defective inverter through the relay or transistor output.

In the basic state, the binary input must be deactivated as otherwise the inverter cannot be started. In the event of an error, drive enabling must first be cancelled and only then the input activated. The binary input should not be cancelled until the error state is no longer indicated by the inverter.

| FAULT NO. | MESSAGE | DESCRIPTION |
|---|---|---|
| 0 | Local stop | Keypad Stop button has been pushed in the remote mode |
| 1 | Min. net voltage | AC Line voltage to low |
| 2 | Overtemperature | Heat sink temperature to high |
| 3 | Overcurrent | Over current in the output stage |
| 4 | Error PWM | PWM Fault |
| 5 | MOL contact open | MOL contact open/Motor temperature to high |
| 6 | Overvoltage DC-L | DC Bus voltage to high |
| 7 | DC-Link failure | DC Bus voltage out of limit during power up |

| FAULT NO. | MESSAGE | DESCRIPTION |
|---|---|---|
| **8** | Speed observer | Speed above limit or control error too high (see parameter 8E) |
| **9** | Dyn.brake-overld | DB duty cycle above limit |
| **10** | UndervoltageDC-L | DC Bus voltage to low |
| **11** | Option | The option board is not plug in for the selected application |
| **12** | Auto-Stop | The auto stop control has been detect |
| **13** | SIO-Timeout | Series communication is disconnect |
| **14** | Position sensor | Motor feedback is disconnect |
| **15** | $I^2t$-Watch | The electronic motor protection has been exceeded |
| **WARNING MESSAGES:** | | |
| **16** | Overtemperature | Warning: Heat sink temperature to high |
| **17** | MOL contact | Warning: Motor temperature exceeded |
| **18** | Dyn.brake 80% | Warning: DB resistor overload |
| **19** | Motor synchron. | Warning: Speed synchronization in an running motor doesn't work |
| **21** | $I^2t$ | Warning: The electronic motor protection has been exceeded |
| **22** | R1-Measuring | Warning: R1 measuring out of limit |
| **23** | Overcurrent | Warning: Overcurrent limit would been reached |
| **25** | Cable cap. | The cable capacitor is to high |
| **26** | Xs-Measuring | Warning: Xσ-Measuring is out of limit |
| **27** | Set disconn | Warning: In case of setting the parameter 31 to 2 or 5 you get this message if the set-point is below 2 V/4 mA |
| **28** | Sensor off. | Warning: The measuring of the mounting offset is fail |
| **29** | Zero pulse | Warning: No zero pulse is found |
| **30** | CAN-Controller | No can controller found |
| **31** | Min. excitation | Warning: Minimum limit of excitation is reached |
| **THE FOLLOWING INTERNAL FAULTS ARE DISPLAYED ONLY AFTER POWER UP:** | | |
| **32** | Watchdog reset | Watchdog-Fault |
| **33** | Ill.trap number | Unknown trap-number |
| **34** | Ill.Ext.Bus Acc. | Unknown external Bus-access |
| **35** | Ill.Instr.Access | Unknown instruction access |
| **36** | Ill.Word Op.Acc. | Unknown word access |
| **37** | Protection Fault | Protection fault |
| **38** | Undefined Opcode | Undefined op-code |
| **39** | Stack Underflow | Stack-underflow |
| **40** | Stack Overflow | Stack-overflow |
| **41** | Nonmaskable Int. | Nonmaskable interrupt |

# 9 Annex

## 9.1 Abbreviations Used

The following abbreviations are used in this parameter description:

**OE** Parameter can be edited on-line.

**SC** Parameter can be written in the SIO control mode through the serial interface (see description “UD 7000 – serial interface”).

**SL** Parameter is of significance in the version consisting of the standard inverter (Hz/V-controlled amplifier).

**FO** Parameter is significant in the version consisting of a field-oriented controller with feedback.

**SLV** Sensorless vector control ***SLV***②.

**EC** Parameter is significant in the version consisting of a brushless servo amplifier.

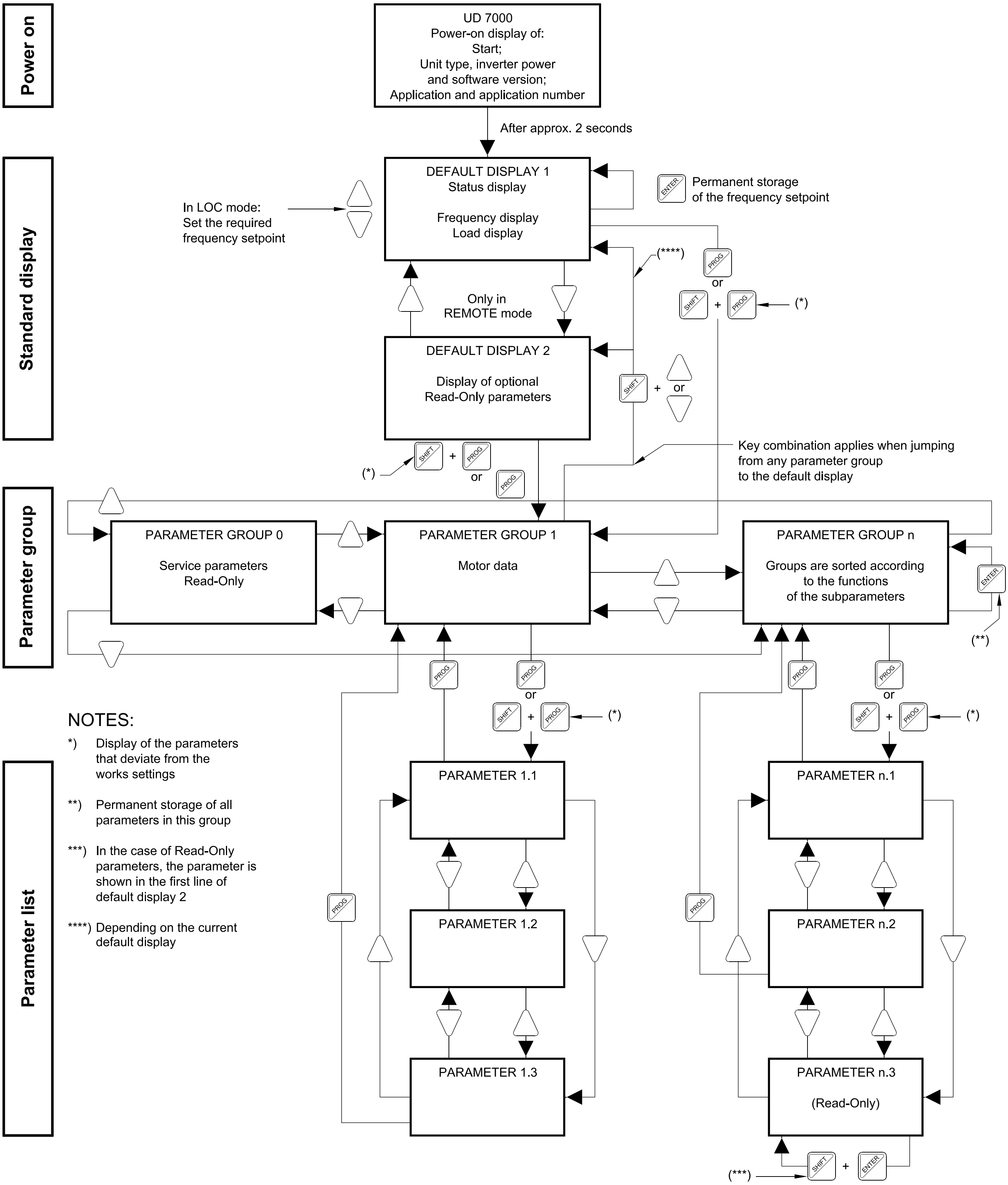
**SIO** Serial RS 485 interface.

## 9.2 Hexadecimal to Binary Conversion

The following table shows the sixteen hexadecimal values and the corresponding binary values.

| Hex | Binary | | | |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 1 | 0 |
| 3 | 0 | 0 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 |
| 5 | 0 | 1 | 0 | 1 |
| 6 | 0 | 1 | 1 | 0 |
| 7 | 0 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 |
| 9 | 1 | 0 | 0 | 1 |
| A | 1 | 0 | 1 | 0 |
| B | 1 | 0 | 1 | 1 |
| C | 1 | 1 | 0 | 0 |
| D | 1 | 1 | 0 | 1 |
| E | 1 | 1 | 1 | 0 |
| F | 1 | 1 | 1 | 1 |

## 9.3 Parameter Structure




NOTES:

*) Display of the parameters that deviate from the works settings

**) Permanent storage of all parameters in this group

***) In the case of Read-Only parameters, the parameter is shown in the first line of default display 2

****) Depending on the current default display

**Figure 9.1**

## 9.4 Parameter Overview

| GROUP 1 – Motor data | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| 11 | Nominal voltage | Rated voltage | [0.1 V] | 2-40 | 400.0 | |
| 12 | Nom. frequency | Rated frequency | [0.1 Hz] | 2-40 | 50.0 | |
| 13 | Power factor | Power factor | [0.01] | 2-40 | | |
| 14 | Nominal speed | Rated speed | [$min^{-1}$] | 2-41 | | |
| 15 | Nominal power | Rated power | [0.01 kW] | 2-41 | | |
| 16 | Nominal current | Rated current | [0.1 A] | 2-41 | | |

| GROUP 2 – Basic data | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| 21 | V/Hz knee | Knee frequency | [0.1 Hz] | 2-42 | 50.0 | |
| 22 | Boost | Boost | [0.1%] | 2-42 | 100.0 | |
| 23 | Max. frequency | Maximum frequency | [0.1 Hz] | 2-43 | 50.0 | |
| 24 | Min. frequency | Minimum frequency | [0.1 Hz] | 2-43 | 0.0 | |
| 25 | Acceleration #1 | Acceleration time 1 | [0.1 s] | 2-43 | 3.0 | |
| 26 | Deceleration #1 | Deceleration time 1 | [0.1 s] | 2-43 | 3.0 | |
| 27 | Acceleration #2 | Acceleration time 2 | [0.1 s] | 2-43 | 5.0 | |
| 28 | Deceleration #2 | Deceleration time 2 | [0.1 s] | 2-43 | 5.0 | |
| 29 | Control mode | Control mode | [S-P] | 2-43 | 13 | |
| 2A | Test mode | Test mode | [S-P] | 2-45 | 101 | |
| 2B | Tuning mode | Adjustment mode | [S-P] | 2-50 | 0 | |
| 2C | Application | Application | [S-P] | 2-50 | 0 | |
| 2D | SW-Reset | Software reset | [S-P] | 2-56 | 0 | |

| GROUP 3 – Setpoint selection (display: Setpoint-select) | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| 31 | Reference-selec | Setpoint selection (frequency setpoint) | [S-P] | 2-57 | 0 | |
| 32 | Selection LIM | Function of the LIM input | [S-P] | 2-61 | 1 | |
| 33 | Ratio frequency | Frequency factor | [0.01%] | 2-62 | 100.00 | |
| 34 | Fact.LIM analog | Scaling factor $A_{LIM}$ for analogue LIM input | [0.1%] | 2-63 | 10.0 | |
| 35 | Calibr.LIM digi | Calibration digital LIM input with factor $D_{LIM}$ | [0.1 Hz/kHz] | 2-63 | 2.0 | |
| 36 | Pulse numberLIM | Pulse number of LIM input | [1] | 2-63 | 6 | |
| 37 | Dir.master-ref. | Direction of rotation, master setpoint | [S-P] | 2-65 | 0 | |
| 38 | min Ratio freq. | Low frequency factor limit | [0.01%] | 2-65 | 0.00 | |
| 39 | max Ratio freq. | High frequency factor limit | [0.01%] | 2-66 | 105.00 | |
| 3A | F-EXT1 (SIO) | External frequency setpoint 1 | [0.01 Hz] (1) | 2-66 | 0.00 | |
| 3B | F-EXT2 (SIO) | External frequency setpoint 2 | [0.01 Hz] (1) | 2-66 | 80.00 | |
| 3C | Time. VIN/CIN | Filtering time constant VIN/CIN input | [$2^x$ ms] | 2-66 | 4 | |
| 3D | Time. LIM | Filtering time constant LIM input | [$2^x$ ms] | 2-66 | 4 | |
| 3E | Pulse no. ST4 | Pulse number ST4-output | [1] | 2-66 | 10 | |
| 3F | Speed Reference | *Frequency setpoint on the basis of ramp* | *[0.1 Hz]* | 2-67 | r-o | |

**NOTES:**

Various parameters are only available as a function of the current mode.

r-o Read-only parameters are printed in italics and the reference in the tables is abbreviated to “r-o”.

[S-P] Selection parameter (for adaptation of the inverter functions).

◊ Value range and default values.

(1) In the “high frequency” application profile: unit [0.1 Hz].

| GROUP 4 – Frequencies | | | | | | |
|---|---|---|---|---|---|---|
| **NO.** | **DISPLAY** | **DESCRIPTION** | **RESOLUTION** | **PAGE** | **DEFAULT** | **CUSTOMER** |
| 41 | Preset speed #1 | Fixed frequency 1 | [0.1 Hz] | 2-67 | 5.0 | |
| 42 | Preset speed #2 | Fixed frequency 2 | [0.1 Hz] | 2-67 | 20.0 | |
| 43 | Preset speed #3 | Fixed frequency 3 | [0.1 Hz] | 2-67 | 40.0 | |
| 44 | Preset speed #4 | Fixed frequency 4 | [0.1 Hz] | 2-67 | 60.0 | |
| 45 | Preset speed #5 | Fixed frequency 5 | [0.1 Hz] | 2-67 | 0.0 | |
| 46 | Preset speed #6 | Fixed frequency 6 | [0.1 Hz] | 2-67 | 0.0 | |
| 47 | Skip band | Hysteresis band for blocking frequencies | [0.1 Hz] | 2-69 | 1.0 | |
| 48 | Skip freq. #1 | Blocking frequency 1 | [0.1 Hz] | 2-69 | 0.0 | |
| 49 | Skip freq. #2 | Blocking frequency 2 | [0.1 Hz] | 2-69 | 0.0 | |
| 4A | Skip freq. #3 | Blocking frequency 3 | [0.1 Hz] | 2-69 | 0.0 | |
| 4B | Skip freq. #4 | Blocking frequency 4 | [0.1 Hz] | 2-69 | 0.0 | |

| GROUP 5 – Torque | | | | | | |
|---|---|---|---|---|---|---|
| **NO.** | **DISPLAY** | **DESCRIPTION** | **RESOLUTION** | **PAGE** | **DEFAULT** | **CUSTOMER** |
| 51 | Select.TLim.MFo | Torque limit selection, right rotation, motor operation | [S-P] | 2-69 | 0 | |
| 52 | Select.TLim.MRe | Torque limit selection, left rotation, motor operation | [S-P] | 2-69 | 0 | |
| 53 | Select.TLim.GFo | Torque limit selection, right rotation, generator operation | [S-P] | 2-69 | 0 | |
| 54 | Select.TLim.GRe | Torque limit selection, left rotation, generator operation | [S-P] | 2-69 | 0 | |
| 55 | Torque-lim(LIM) | Torque factor LIM input | [0.1%] | 2-70 | 100.0 | |
| 56 | T-Offset-Acc. | Additional acceleration torque | [0.1%] | 2-70 | 0.0 | |
| 57 | T-Offset-Dec. | Additional deceleration torque | [0.1%] | 2-70 | 0.0 | |
| 58 | TLimit-Mot-FWD | Torque limit, right rotation, motor operation | [0.1%] | 2-70 | 100.0 | |
| 59 | TLimit-Mot-REV | Torque limit, left rotation, motor operation | [0.1%] | 2-70 | 100.0 | |
| 5A | TLimit-Gen-FWD | Torque limit, right rotation, generator operation | [0.1%] | 2-70 | 100.0 | |
| 5B | TLimit-Gen-REV | Torque limit, left rotation, generator operation | [0.1%] | 2-70 | 100.0 | |
| 5C | SIO-Torq.limit | External torque limit | [0.1%] | 2-70 | 100.0 | |
| 5D | Start torque | Starting torque | [0.1%] | 2-71 | 130.0 | |
| 5E | Ref.torque(VIN) | Torque setpoint factor | [0.1%] | 2-71 | 100.0 | |
| 5F | Gain TCtrl-ramp | Gain ($V_{Rm}$), acceleration control (ramp), torque | [0.1%] | 2-71 | 200.0 | |

| GROUP 6 – V/Hz characteristic (display: V/f-char) | | | | | | |
|---|---|---|---|---|---|---|
| **NO.** | **DISPLAY** | **DESCRIPTION** | **RESOLUTION** | **PAGE** | **DEFAULT** | **CUSTOMER** |
| 61 | Autoboost | Autoboost | [S-P] | 2-72 | 1 | |
| 62 | V-Hz selector | V/Hz characteristic selection | [S-P] | 2-73 | 3 | |
| 63 | Curr. DC-brake | DC brake current | [0.1 A] | 2-74 | | |
| 64 | DC-brake time | DC brake time | [0.1 s] | 2-74 | 1.0 | |
| 65 | Freq. DC On | DC brake switch-on frequency | [0.1 Hz] | 2-74 | 0.5 | |
| 66 | Setuptime field | Field build-up time | [0.1 s] | 2-74 | 0.5 | |
| 67 | V/f-Char. V0 | V/Hz characteristic, voltage V0 | [0.1 V] | 2-75 | 0.0 | |
| 68 | V/f-Char. V1 | V/Hz characteristic, voltage V1 | [0.1 V] | 2-75 | 100.0 | |
| 69 | V/f-Char. V2 | V/Hz characteristic, voltage V2 | [0.1 V] | 2-75 | 150.0 | |
| 6A | V/f-Char. V3 | V/Hz characteristic, voltage V3 | [0.1 V] | 2-75 | 200.0 | |
| 6B | Max. Voltage | Cut-in point of voltage limitation control | [0.1%] | 2-76 | 98.0 | |
| 6C | Min.excitation | Minimum excitation | [0.1%] | 2-76 | 33.0 | |
| 6D | Setup fld.activ | Field build-up time activation | [S-P] | 2-76 | 1 | |
| 6E | Filt.Time.FWeak | Filter field weakening | [1 ms] | 2-76 | 100 | |
| 6F | Increments | Increment | [1] | 2-76 | 1 | |

| GROUP 7 – Inverter functions (display: Inverter funct.) | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| 71 | Start/Stop opt. | Start and Stop options | [S-P] | 2-77 | 0 | |
| 72 | Ramp selector | Ramp function selection | [S-P] | 2-78 | 0 | |
| 73 | Ramp. smooth | Drag time | [0.1 s] | 2-79 | 0.1 | |
| 74 | Sel. power fail | Power failure response | [S-P] | 2-79 | 2 | |
| 75 | Gain UDC-Ctrl. | DC link voltage control gain $V_{DC\ link}$ | [0.1%] | 2-80 | 500.0 | |
| 76 | Slip compensat. | Slip compensation | [S-P] | 2-80 | 0 | |
| 77 | Gain slip-comp. | Slip compensation setting | [0.1%] | 2-81 | 100.0 | |
| 78 | Language | Language | [S-P] | 2-81 | 0 | |
| 79 | PWM frequency | PWM frequency | [0.01 kHz] | 2-81 | 4.50 | |
| 7A | Power Chopp-R | Braking resistor power | [0.01 kW] | 2-81 | 0.08 | |
| 7B | Sped motpot.Inc | Increment motor potentiometer speed | [0.1 s] | 2-82 | 10.0 | |
| 7C | Sped motpot.Dec | Decrement motor potentiometer speed | [0.1 s] | 2-82 | 10.0 | |
| 7D | heating time R | Permissible heating time of braking resistor | [1 s] | 2-83 | 2 | |
| 7E | brake resistor | Connected braking resistor | [1 Ω] | 2-83 | 20/75 | |
| 7F | PWM mode | Control method | [S-P] | 2-83 | 1 | |

| GROUP 8 – Protective functions (display: Security funct.) | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| 81 | Selector MOL | MOL input function selection | [S-P] | 2-83 | 2 | |
| 82 | MOL-Input | *MOL input display* | *[1%]* | 2-84 | r-o | |
| 83 | Restart Select. | Restart after fault definition | [Binary] | 2-84 | 0000 | |
| 84 | Number Restart | Number of restarts | [1] | 2-85 | 0 | |
| 85 | Delay Restart | Restart delay | [0.1 s] | 2-85 | 10.0 | |
| 87 | Access code | Password | [1] | 2-85 | 0 | |
| 88 | Therm.timeconst | Thermal motor time constant | [1 min] | 2-85 | 15 | |
| 89 | $I^2$t-Limit(Warn) | $I^2$t warning threshold | [0.1%] | 2-86 | 115.0 | |
| 8A | $I^2$t-Limit | $I^2$t error threshold | [0.1%] | 2-86 | 120.0 | |
| 8B | Max.Ramp.Delay | Maximum permissible ramp extension in the event of stop | [1%] | 2-86 | 200 | |
| 8C | T.Stop observer | *Current monitoring time $t_{out}$ for stop ramp* | *[0.1 s]* | 2-87 | | |
| 8D | Refer. ST-Outp. | Reference value for load-dependent switching of control outputs | [0.1%] | 2-88 | 0.0 | |
| 8E | Watch Speed | Selection speed control | [1] | 2-88 | 0 | |

| GROUP 9 – Binary inputs/outputs (display: Binary In/Outpt) | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| 91 | Inputs FWD/REV | Function of inputs FWD and REV | [S-P] | 2-89 | 1 | |
| 92 | Aux. output #1 | Output ST1 function selection | [S-P] | 2-89 | 3 | |
| 93 | Aux. output #2 | Output ST2 function selection | [S-P] | 2-89 | 102 | |
| 94 | Aux. output #3 | Output ST3 function selection | [S-P] | 2-89 | 10 | |
| 95 | Aux. output #4 | Output ST4 function selection | [S-P] | 2-89 | 115 | |
| 96 | Auxiliary relay | Relay output function selection | [S-P] | 2-89 | 101 | |
| 97 | Outp.SIO-Contrl | Control of binary outputs through SIO | [Binary] | 2-92 | 0 | |
| 98 | Input Run/Jog | Run/Jog input function selection | [S-P] | 2-92 | 0 | |
| 99 | Input PS1 | PS1 input function selection | [S-P] | 2-93 | 4 | |
| 9A | Input PS2 | PS2 input function selection | [S-P] | 2-94 | 1 | |
| 9B | Input PS3 | PS3 input function selection | [S-P] | 2-96 | 6 | |
| 9C | Status Inputs | *Status of binary inputs* | *[Binary]* | 2-99 | r-o | |
| 9D | Status Outputs | *Status of binary outputs* | *[Binary]* | 2-100 | r-o | |
| 9F | Inpt.H/L-active | High/Low active binary input selection | [S-P] | 2-100 | 1 | |

| GROUP A – Analog outputs/SIO (display: Analog Out/SIO) | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| A1 | Meter output #1 | Analog output MET1 selection | [S-P] | 2-101 | 1 | |
| A2 | Meter output #2 | Analog output MET2 selection | [S-P] | 2-101 | 4 | |
| A3 | Factor Analog1 | MET1 factor | [0.1%] | 2-101 | 100.0 | |
| A4 | Factor Analog2 | MET2 factor | [0.1%] | 2-102 | 100.0 | |
| A5 | Offset Analog2 | MET2 offset | [0.1%] | 2-102 | 0.0 | |
| A6 | Reference MET | Reference value for the analog output | [1] | 2-102 | 500 | |
| A7 | FilterTime Gr.0 | Filtering time constant of displayed values in parameter group 0 | [$2^x$ ms] | 2-103 | 6 | |
| A8 | SIO-Baudrate | Baud rate SIO selection | [S-P] | 2-103 | 4 | |
| A9 | SIO-Address | Slave address of the inverter for SIO operation | [0–31] | 2-103 | 0 | |
| AA | SIO-Protocol | SIO protocol | [S-P] | 2-104 | 1 | |
| AB | SIO-Timeout | SIO operation time-out | [1 s] | 2-104 | 0 | |
| AC | SIO-Errors | *SIO operation error messages* | *[Binary]* | 2-104 | r-o | |
| AD | SIO-Commands | Inverter control commands in SIO mode | [Binary] | 2-105 | 0 | |

| GROUP B – Speed controller (display: Speed control) | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| B1 | P-gain | Speed controller gain | [1] | 2-105 | 100 | |
| B2 | I-gain | Reset time of speed controller | [1 ms] | 2-105 | 500 | |
| B3 | Gain boost | Speed controller gain boosting factor | [0.1] | 2-106 | 1.1 | |
| B4 | Maxfreq.gain-b. | Speed controller gain boosting end frequency | [0.1 Hz] | 2-106 | 0.0 | |
| B5 | Holding control | Holding control | [S-P] | 2-107 | 0 | |
| B7 | Rel.drag.dist. | Specific holding controller following error | [0.001%] | 2-107 | 0.100 | |
| B8 | TN pos.cntrl | Specific position control reset time | [$2^x$] | 2-108 | 0 | |
| BA | Pole pairs Rslv | Resolver pole pair number | [1] | 2-108 | 1 | |
| BB | Angle (mech.) | *Motor shaft angle* | *[0.1°]* | 2-108 | r-o | |
| BC | Off.angle senso | Angle sensor installation offset | [8000–$7FFF_H$] | 2-108 | 0000 | |
| BD | Dir.angle senso | Angle sensor direction of rotation | [S-P] | 2-109 | 0 | |
| BE | Lines Encoder | Number of encoder lines | [1] | 2-109 | 1024 | |
| BF | Angle (Sensor) | *Resolver measured angle* | *[0–$FFFF_H$]* | 2-109 | r-o | |

| GROUP C – Stepper control (display: Step-control) | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| C2 | Step-control | Enabling | [S-P] | 2-110 | 0 | |
| C3 | Input step | Step number for parameter input | [1] | 2-110 | 0 | |
| C4 | Condition Input | Input condition | | 2-110 | 0 | |
| C5 | Condition Outpt | Output condition | | 2-110 | 0 | |
| C6 | Parameter-no. 1 | Parameter number 1 | [1] | 2-110 | 0 | |
| C7 | Param. value 1 | Parameter value 1 | [1] | 2-110 | 0 | |
| C8 | Parameter-no. 2 | Parameter number 2 | [1] | 2-110 | 0 | |
| C9 | Param. value 2 | Parameter value 2 | [1] | 2-110 | 0 | |
| CA | Parameter-no. 3 | Parameter number 3 | [1] | 2-110 | 0 | |
| CB | Param. value 3 | Parameter value 3 | [1] | 2-110 | 0 | |
| CC | Delay time | Waiting time | [0.001 s] | 2-110 | 0 | |
| CD | Actual step | Current step | [1] | 2-110 | 0 | |
| CE | Mask pin | Mask for terminal signals | | 2-110 | 0 | |
| CF | Step-ctrl input | Input for terminal signals | | 2-110 | 0 | |

| GROUP D – Options | | | | | | |
|---|---|---|---|---|---|---|
| NR. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| D1 | Option | *Option number* | *[1]* | 2-110 | r-o | |
| D2 | F-zero pulse | Zero pulse search frequency | [0.1 Hz] | 2-110 | 0.5 | |
| D3 | Zero angle | Zero angle | [0.1°] | 2-110 | 0.0 | |
| D4 | sigma | *Total stray factor* $\sigma$ | *[0.01%]* | 2-111 | r-o | |
| D5 | id/Id,nom | *Actual value of the field-generating current component* $i_d$ | *[0.01%]* | 2-111 | r-o | |
| D6 | iq/Iq,nom | *Actual value of the torque-generating current component* $i_q$ | *[0.01%]* | 2-111 | r-o | |
| D7 | iq,set/Iq,nom | *Setpoint of the torque-generating current component* $i_{q,set}$ | *[0.01%]* | 2-111 | r-o | |

| GROUP E – Service data II | | | | | | |
|---|---|---|---|---|---|---|
| NR. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| E1 | Real.Acc.time | *Realised acceleration time* | *[0.1 s]* | 2-111 | r-o | |
| E2 | Real.Dec.time | *Realised deceleration time* | *[0.1 s]* | 2-111 | r-o | |
| E3 | Ratio frequency | *Frequency factor* | *[0.01%]* | 2-111 | r-o | |
| E4 | SoftwareVersion | *Software version* | *[0.01]* | 2-112 | r-o | |
| E5 | Total op. time | *Lifetime* | *[1 h]* | 2-112 | r-o | |
| E6 | Total run time | *On time* | *[1 h]* | 2-112 | r-o | |
| E7 | Enable time | *Enabling time* | *[1 h]* | 2-112 | r-o | |
| E8 | Status | *Inverter status* | *[Binary]* | 2-112 | r-o | |
| E9 | Custom para.set | Customer parameter set | [S-P] | 2-113 | 1 | |
| EA | Reset Parameter | Application-dependent defaults | [S-P] | 2-114 | 0 | |
| EB | Status 2 | *Inverter status 2* | *[Binary]* | 2-115 | r-o | |
| EC | Standarddisplay | Standard display | [S-P] | 2-115 | 1 | |

| GROUP F – Service data III (display: Service dataIII) | | | | | | |
|---|---|---|---|---|---|---|
| NR. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| F1 | Nom.Power Inv | *Rated inverter power* | *[0.01 kW]* | 2-115 | r-o | |
| F2 | Filt.power fail | Power failure filter | [0.001 s] | 2-115 | 0.040 | |
| F3 | R1 | Stator resistance R1 | [0.01 Ω] | 2-116 | | |
| F4 | R2 | Rotor resistance R2 | [0.01 Ω] | 2-116 | | |
| F5 | Xsigma | Leakage reactance Xσ | [0.01 Ω] | 2-116 | | |
| F6 | Tr-Adaptation | Rotor time constant setting | [0.1%] | 2-117 | 100.0 | |
| F7 | Main reactance | Main reactance $X_h$ | [0.01 Ω] | 2-117 | 30.00 | |
| F8 | Gain I-control | Current controller gain | [0.01 Ω] | 2-118 | 1.00 | |
| F9 | TN/TA I-control | Specific current controller reset time | [1] | 2-118 | 50 | |
| FA | Dead-time comp. | Dead time compensation | [1] | 2-118 | 1 | |
| FB | PWM freq.chnge. | PWM frequency slaving | [1] | 2-119 | 0 | |
| FC | Ramp control | Ramp acceleration control (torque) | [S-P] | 2-119 | 1 | |
| FD | Torq.limitation | Torque limiting | [S-P] | 2-119 | 1 | |
| FE | Excitation | *Excitation* | *[0.1%]* | 2-119 | r-o | |

| GROUP 0 – Service data I | | | | | | |
|---|---|---|---|---|---|---|
| NR. | DISPLAY | DESCRIPTION | RESOLUTION | PAGE | DEFAULT | CUSTOMER |
| 01 | Outpt frequency | *Output frequency* | *[0.1 Hz]* | 2-120 | r-o | |
| 02 | Output voltage | *Output voltage* | *[1%]* | 2-120 | r-o | |
| 03 | Output current | *Output current* | *[0.1 A]* | 2-120 | r-o | |
| 04 | Load torque | *Output torque* | *[0.1%]* | 2-120 | r-o | |
| 05 | Output power | *Output power* | *[0.1%]* | 2-120 | r-o | |
| 06 | Line voltage | *Line voltage* | *[1 V]* | 2-120 | r-o | |
| 07 | DC voltage | *DC link voltage* | *[1 V]* | 2-120 | r-o | |
| 09 | Actual freqncy. | *Actual frequency* | *[0.1 Hz]* | 2-120 | r-o | |
| 0A | Inverter temp. | *Heat sink temperature* | *[1 °C]* | 2-120 | r-o | |
| 0B | fault 1 | *Error 1* | | 2-121 | r-o | |
| 0C | fault 2 | *Error 2* | | 2-121 | r-o | |
| 0D | fault 3 | *Error 3* | | 2-121 | r-o | |
| 0E | fault 4 | *Error 4* | | 2-121 | r-o | |
| 0F | fault 5 | *Error 5* | | 2-121 | r-o | |

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